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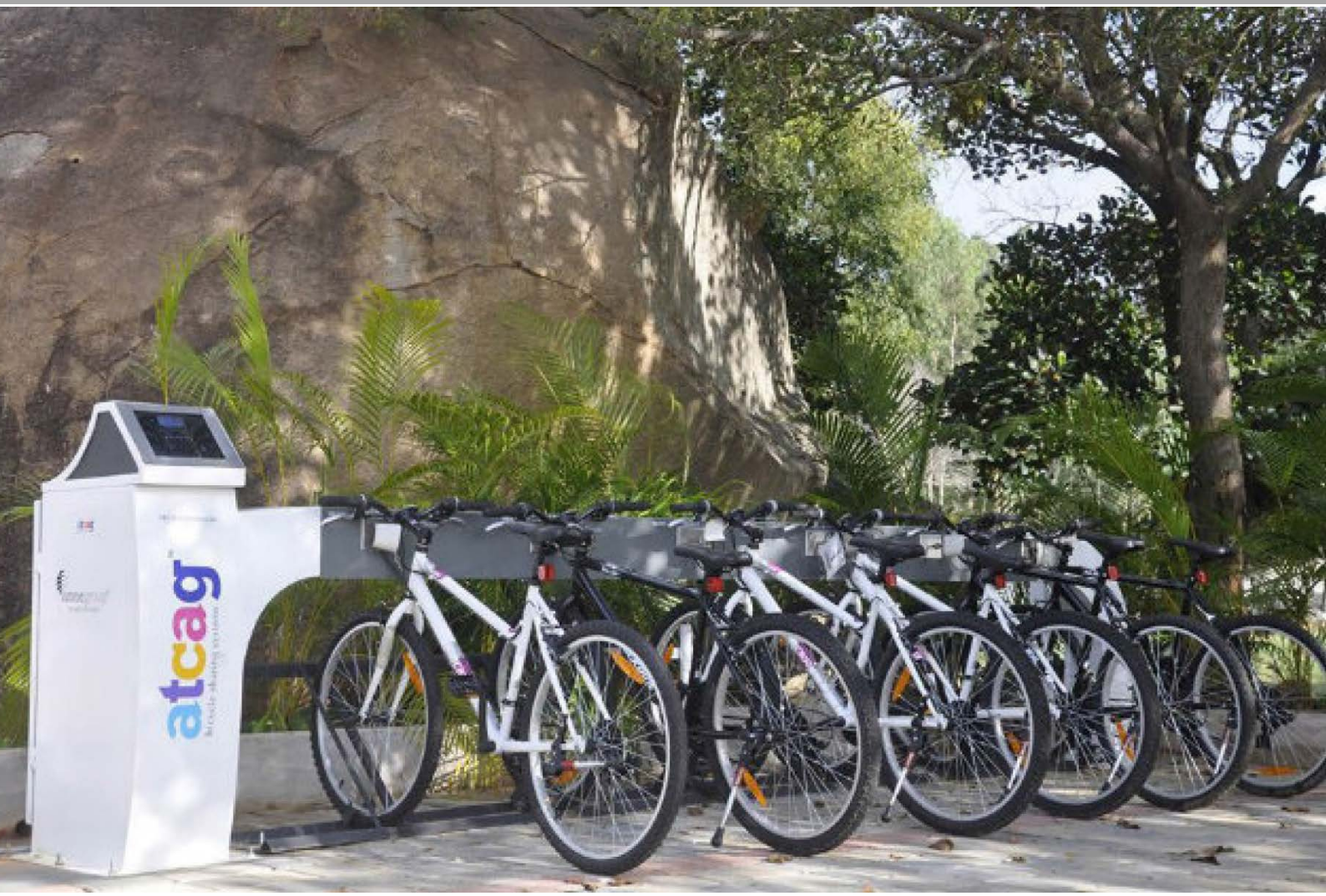
MINISTRY OF URBAN DEVELOPMENT
GOVERNMENT OF INDIA

PBS CITY SPECIFIC PLAN - VADODARA



CONSULTANCY SERVICES FOR DEVELOPING GUIDANCE DOCUMENTS FOR TRANSIT ORIENTED DEVELOPMENT (TOD), NON-MOTORISED TRANSPORT (NMT) AND PUBLIC BICYCLE SHARING (PBS)

May, 2016

PUBLIC BICYCLE SHARING

VADODARA CITY SPECIFIC PLAN

Cover Page:

Image of PBS docking station in Bangalore | source: IBI Group

Prepared for Ministry of Urban Development, Government of India

By IBI Group

FOREWORD

Prior to the launch of the National Urban Renewal Mission (2005) and the National Urban Transport Policy (2006), investments in public transportation systems to meet the mobility needs of the current and future population were limited in Indian cities. Planning for essential city systems — environmental, land, mobility, economic and social — has largely been attempted in piecemeal manner. The need to induce a paradigm shift, putting people first in planning our regions, cities and neighbourhoods, implies providing for increased mobility choices from dependence on private vehicles to the availability of good public transportation and safe non-motorised transport.

Non-Motorised Transport (NMT) is a foundational mobility concept that prioritizes planning for walking and cycling over automobiles. Public Bicycle Sharing (PBS) is emerging as one of the most sustainable, popular and attractive public transport modes throughout the world. This mode offers the conveniences of both public and personal modes. It enables public access to personal bicycles, offering maximum flexibility with minimum liability. This PBS City Specific Plan presents a compendium of strategies and recommendations for integrating accessibility with land use and infrastructure investment decisions in shaping NMT-friendly streetscapes and intelligent system designs. It follows the five-step planning process as prescribed in the PBS Guidance document for implementing public bicycle sharing projects.

The document includes a comprehensive study on assessing the existing conditions in the context of encouraging higher share of NMT usage for localized intra-city short trips, reviewing current institutional support, proposing development strategies and funding opportunities to facilitate implementation of innovative public bicycle sharing proposals. The plan also provides its stakeholders in Vadodara on the city specific planning process for PBS and equip them with essential tools and resources necessary to integrate PBS planning as an extension to city's existing public transit framework.

It is of utmost importance that the local agencies integrate the PBS recommendations presented in this document to mainstream non-motorised transport planning in Vadodara. This will ensure that strategic investments in Vadodara lead to mitigating environmental impacts of polluting transportation and reviving cycling as a sustainable and inclusive mode of urban commuting India's emerging tier II city.

PREFACE

The Government of India (GoI) has initiated the Sustainable Urban Transport Project (SUTP) with the Ministry of Urban Development (MoUD) as the nodal agency and supported by the Global Environment Facility (GEF), World Bank and UNDP. SUTP consists of capacity building programmes and city demonstration projects, which aim to induce a major change in urban transport planning as currently undertaken in Indian cities.The primary objective of GEF-SUTP is to apply National Urban Transport Policy (2006) principles to achieve a paradigm shift in India's urban transport system for more favourable sustained developments and alternatives.

Under the guidance of MoUD, the project envisaged development of Guidance Documents for three sustainable development concepts: Transit Oriented Development (TOD), Non-Motorised Transport (NMT) and Public Bike Sharing (PBS) as essential steps towards achieving a comprehensive urban transport and land development planning process in the country. To further validate the findings and recommendations of the Guidance Documents, City Specific Plans (CSPs) for two selected demonstration cities each for the above mentioned concepts have been prepared. CSPs have also provided road map to the cities interested in applying these concepts. Lessons learned from these CSPs have helped contextualise the final Guidance Document(s) to Indian conditions.

The two PBS CSPs provide guidance for cities with: a) high modal share for cycling and the penetration of cycling culture in the city's urban form and b) integration of PBS schemes with transit systems to improve the first and last mile connectivity. The ease with which cycling systems are integrated with NMT infrastructure planning will significantly influence the overall feasibility of using PBS schemes as primary modes of transportation for short trips.

The Vadodara Mahanagar Seva Sadan (VMSS) applied for selection as a demonstration city for preparation of a City-specific PBS Plan. Vadodara, as a compact city is dominated by mixed land use pattern with concentration of commercial activities making the average trip length of the city not more than 4.8km^2. Compact and conducive to supporting walking and cycling, Vadodara has nearly 40% dependence on walk and cycle representing a ready captive population to ensure success of PBS systems. Furthermore, the city already has an operational cycle share program in Kamati Baug. Its successful implementation and positive user response has encouraged Vadodara to expand its PBS system to other areas. This Plan has been prepared in partnership with the VMSS, who also serves as the nodal agency for this PBS planning process.

ACKNOWLEDGEMENT

The successful completion of this project required extensive involvement from the local nodal agency in Vadodara - the Vadodara Mahanagar Seva Sadan (VMSS) under guidance of

1. Shri H.S. Patel, IAS (Municipal Commissioner, VMSS), and
2. Dr. Narander Kumar Meena, IAS (Dy. Municipal Commissioner, VMSS)

The consultant team would like to thank the VMSS, specifically the staff that helped organize the meetings and guided the study process. In addition, IBI Group would also like to thank all stakeholders who attended the meetings and workshops, including

1. Shri Dhirenkumar. N Talpada (EE - Roads & Bridges, VMSS)
2. Shri Jignesh J. Shah (Dy. Executive Engineer, VMSS)
3. Shri Yashpal Jaganiya, IPS (ACP 'F', Commissioner of Police, Vadodara)
4. Ms. Neha Sarwate (Faculty, MS University, Vadodara)
5. Kamati Baug Welfare Association, Vadodara

The consultant team for the preparation of the Vadodara PBS CSP was led by the following members from IBI Group:

- Mr. Bankim Kalra
- Mr. Anuj Malhotra
- Mr. Deepak Darda
- Ms. Zohra Mutabanna
- Mr. Visweswara Rao
- Ms. Astha Malhotra
- Mr. Sourav Mondal

EXECUTIVE SUMMARY

Introduction

The Ministry of Urban Development (MoUD), Government of India, under the Sustainable Urban Transport Project (SUTP), has appointed IBI Group, to undertake the task of developing Guidance Documents and City Specific Plans for Transit Oriented Development (TOD), Non-Motorised Transportation (NMT), and Public Bicycle Sharing (PBS) for Indian cities. The Vadodara Mahanagar Seva Sadan (VMSS) served as the nodal agency for the project.

Public bicycle sharing (PBS) is a service in which bicycles are made available to multiple users (on a sharing basis) for short duration trips, offering an option of returning them at different destinations. Vadodara was selected as one of the demonstration cities for preparing a PBS scheme where the five-step planning process (Fig. XX) recommended in the Guidance Document was applied to test its validity.

This Executive Summary highlights the research, analysis and stakeholder involvement activities that have been performed in the development of the PBS scheme; the resulting projects, programmes and policies that comprise the Plan; and the implementation strategy that will guide project and programme activities.

The objectives of the Vadodara PBS scheme included:

- **Define the appropriate scale for introducing PBS as an alternative transport mode within the municipal limits of Vadodara to improve mobility choices and provide residents and visitors another option to travel in and around the city.**
- **Share benefits of PBS with local stakeholders, promote greater interest in cycling, and increase cycling ridership in the city.**
- **Integrating PBS schemes with existing transit and land use to solve first and last mile connectivity issues.**

Illustration on how to use a PBS system

NEED FOR PBS

Vadodara is a growing city with a population of 16.6 lakh, spread across 125 sq. km of VMSS area (Census of India, 2011). Bus and autorickshaw are the only public transit options available in Vadodara. At present, these are grossly insufficient and barely serve 6% of the commuting needs of the city. A BRTS network is proposed in the city that could potentially increase the public transport modal share.

The need for PBS in Vadodara is strengthened based on the following considerations:

- 19% of the daily trips are made on bicycle, which proves high bicycle acceptance in the city that could be extended to serve the first and last mile connectivity from the proposed BRTS system.
- The city has short trip lengths (<5 km) and a high modal share of bicycle riders in the city (19%) compared to the national average (11%) .
- Successful track record in operating a pilot cycle share program in the city's recreational tourist destination of Kamati Baug- a 113 acre (0.46 sq km) garden located in the heart of the city.

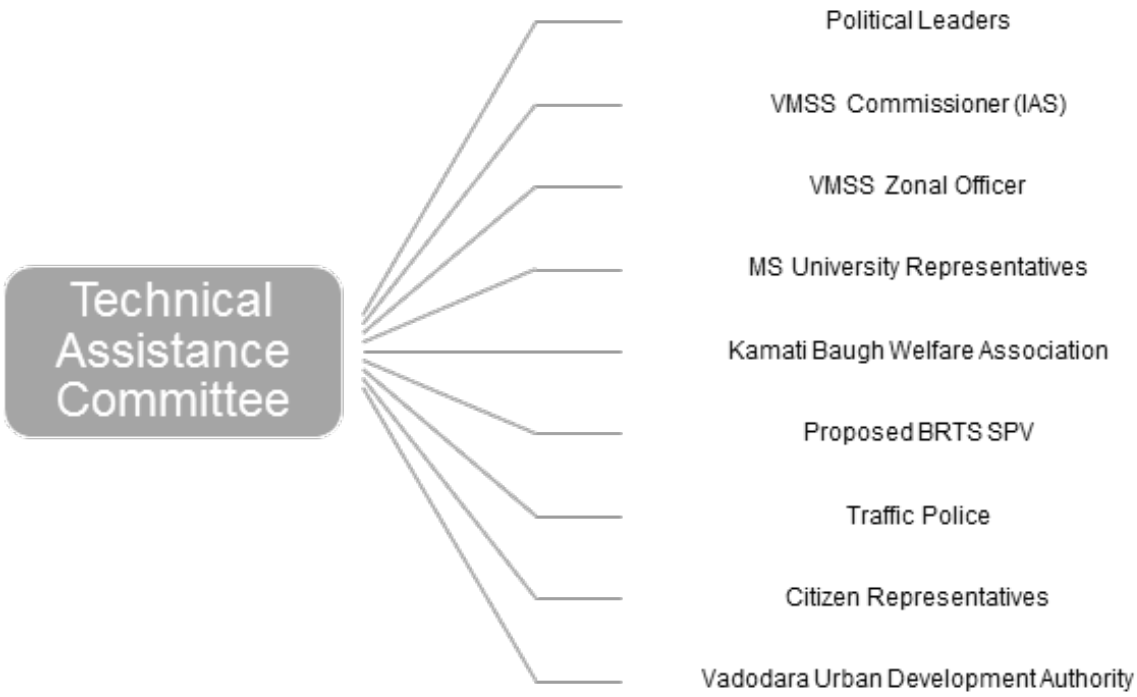
SUPPORT FOR PBS

VMSS is identified as the agency that will spearhead the PBS project in Vadodara. However, in order to be successfully implemented, the PBS program requires political and technical leadership. Key strategies recommended in this plan to gather the necessary support for PBS include:

Key Strategies:

- *Establish a Technical Assistance Committee (TAC):* TAC will consist of political leaders and stakeholders. The committee's responsbilities may include:
  - Acquiring land for PBS stations,
  - Facilitating public outreach,
  - Developing partnership with private entities for funding opportunities, and
  - Reaching out to vendors for discounted products.
- *Building Technical Expertise and Issue Awareness :* This plan recommends that VMSS hire a Project Management Consultancy (PMC). The PMC's primary role will be to handhold the municipality through the design, building, operations and transfer (DBOT) of the PBS project.
- *Create Awareness and Enable Public Participation*: VMSS will have to work with agencies that can help in branding and advertising the PBS system through print and other media. The involvement of MSU students in awareness and outreach efforts will help in changing the perception of cycling in the city.
- *Develop Partnerships for Long Term Success*: Strengthen partnership between the implementing agencies of the PBS system, PT systems, and VMSS employees working on NMT improvements in the city, especially encouraging exchange of technical knowledge.
- *Align PBS with Other Initiatives*: Integrates planning for BRTS and PBS including integrated fare management, and other commuter-friendly services will help expedite PBS scheme implementation.

SUPPORT FOR PBS



PBS Technical Assistance Committee (TAC) | Source: Centre for Green Mobility (CGM)

PBS NETWORK PLAN

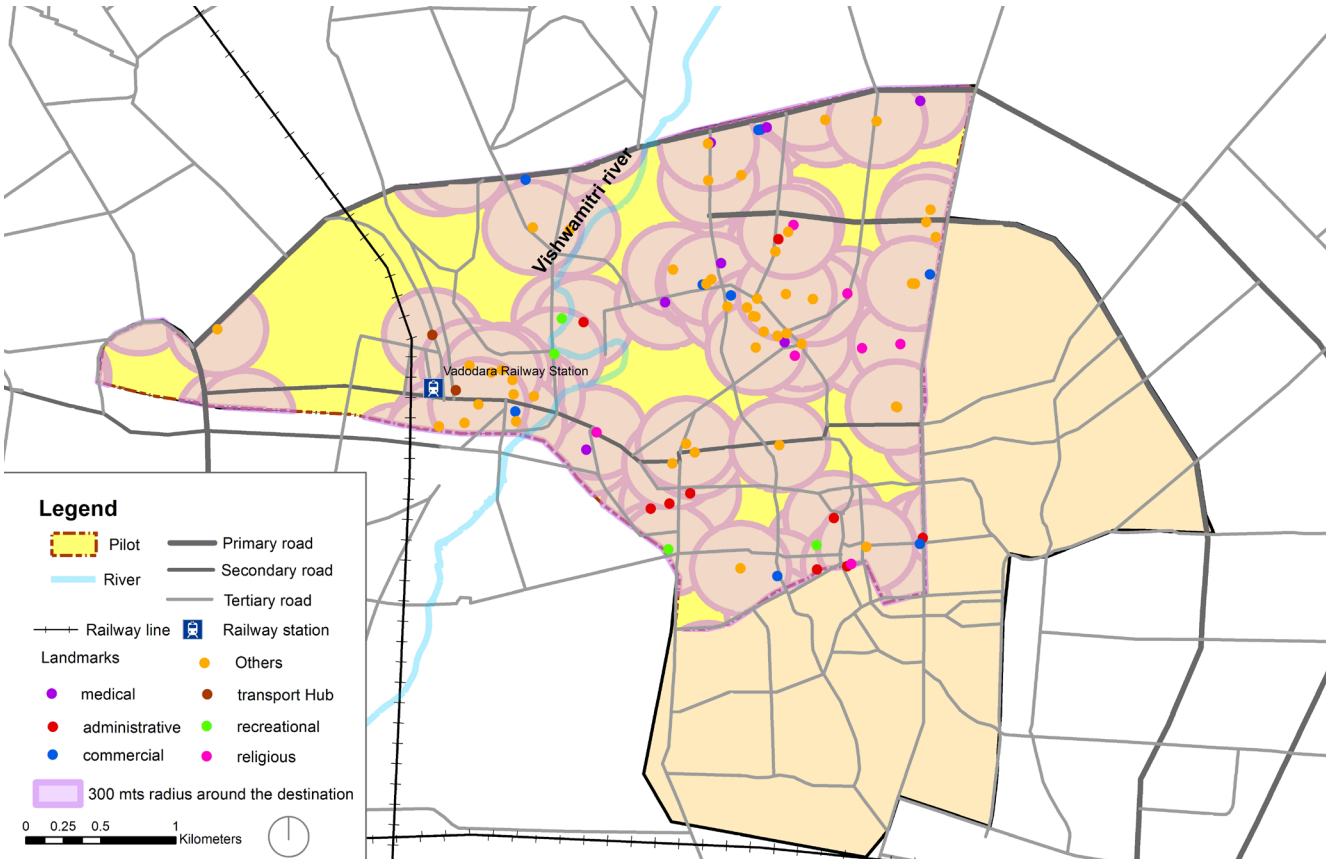
The PBS system phasing was derived from the analysis of density of activity nodes. Vadodara's proposed PBS system is divided into three phases.

- **Phase I** is the inner city region which historically has had the highest number of activity areas and population density.
- **Phase II** includes areas with high potential for growth, mainly the industrial areas in the city
- **Phase III** includes the rest of study area to ensure denser PBS network coverage.

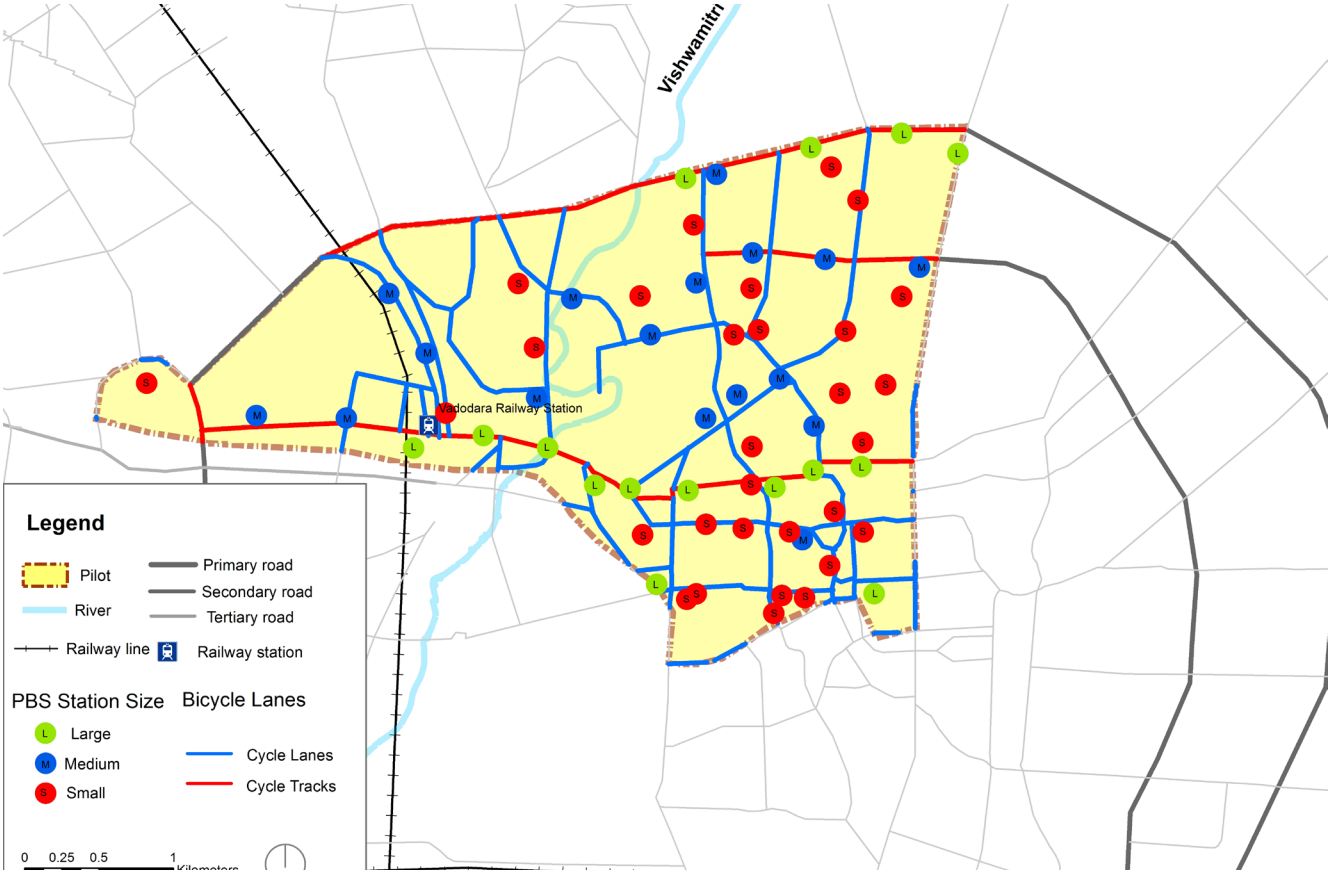
The following table shows the phase wise estimation of number of stations and bicycles for proposed PBS system in Vadodara.

Phase	Area (Sq. km)	No of Bicycles	Small Stations	Medium Stations	Large Stations	Total Stations
Pilot	10.0	1,000	30	17	15	62
Phase I	17.8	1,800	60	80	40	180
Phase II	45.1	4,500	151	200	100	451
Phase III	62.1	6,200	251	250	120	621
Total (1+2+3)	**125.0**	**12,500**	**462**	**530**	**260**	**1252**

PBS NETWORK PLAN



PBS coverage map for pilot area with phase I | Source: CGM



Proposed PBS stations and Bicycle Lanes in Pilot Phase | Source: CGM

INVEST

The total investment required for implementing and operating the proposed PBS system is classified as CAPEX (capital costs) and OPEX (operation and maintenance costs). The total cost for implementation of the pilot PBS System inclusive of capital cost for PBS components and the supporting infrastructure is **INR 32.69 Crores.** The annual operating cost for the pilot phase is estimated at **INR 4.17 Crores.**

The project is proposed to be funded through a combination of public funding, fare collection and cross-subsidies.

In order to diversify its funding and revenue sources, VMSS could potentially evaluate one or more of the following alternatives to augment the system's financial gap:

- Municipal Budget
- Transit-linked Funding
- Grants
- Funding through Corporate Social Responsibility (CSR) Activities

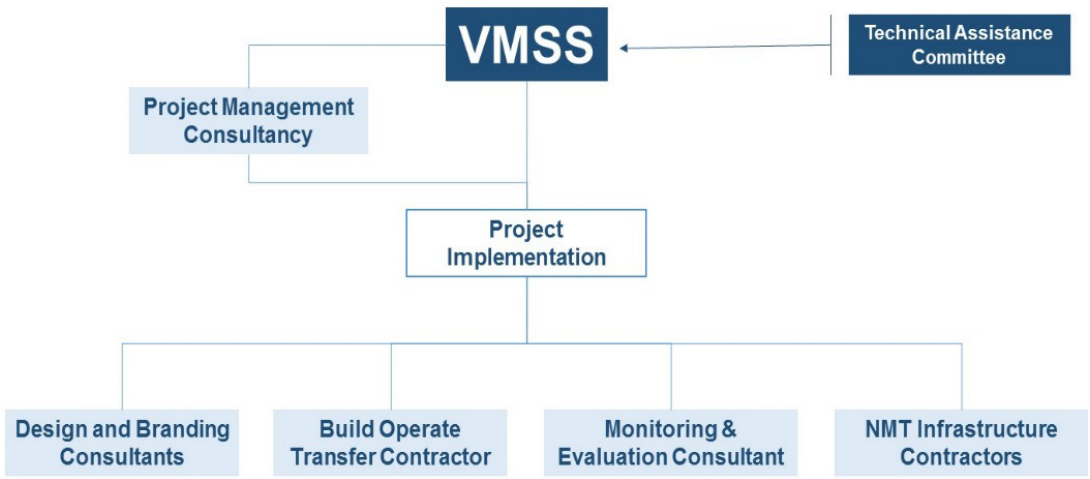
Direct Revenue: Direct revenue collections from user fees and subscription fees will help in repayment of loans and pay operational costs.

Estimated Annual Revenue = INR 6,00,000 (from subscription) + INR 3,60,000 (from user fees) = INR 9,60,000 (INR 9.6 crores)

Cross subsidies will form the largest portion of the continual earning. Primary forms of cross subsidies proposed include parking charges and advertisement fees.

IMPLEMENT

Defining the roles and responsibilities of various governmental agencies is a crucial step in implementing the recommendations of the PBS Plan. The plan proposes the following institutional structure for implementing PBS in Vadodara.



Proposed institutional structure for PBS implementation

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ABBREVIATIONS

AAQ	:	Ambient Air Quality
ATM	:	Automated Teller Machine
BRTS	:	Bus Rapid Transit System
CAPEX		Capital Expenditure
CDP	:	City Development Plan
CETP	:	Common Effluent Treatment Plant
CGM	:	Centre for Green Mobility
CIRT	:	Central Institute of Road Transport
CMP	:	Comprehensive Mobility Plan
CPCB	:	Central Pollution Control Board
CRISIL	:	Credit Rating Information Services of India Limited
CSP	:	City Specific Plan
DOT	:	Department of Telecommunication
DPR	:	Detailed Project Report
GIDC	:	Gujarat Industrial Development Corporation
GIS	:	Geographic Information System
GPCB	:	Gujarat Pollution Control Board
GPS	:	Global Positioning System
HR	:	Human Resource
ID	:	Identity
INR	:	Indian Rupees
IPCL	:	Indian Petrochemical Corporation Limited
IPT	:	Intermediate Public Transport
IPTS	:	Intermediate Public Transport System
IT	:	Information Technology
ITS	:	Intelligent Transportation System
NFC	:	Near Field Communication
NGO	:	Non-Government Organization
NIUA	:	National Institute of Urban Affairs
NMT	:	Non-motorised Transport
NMV	:	Non-motorised Vehicle
NUTP	:	National Urban Transport Policy
NYCBS	:	New York City Bike Share
OPEX		Operational Expenditure

PBS	:	Public Bicycle Sharing
PIN	:	Personnel Identification Number
PMC	:	Project Management Consultant
PPP	:	Public-Private Partnership
PT	:	Public Transit
RFID	:	Radio Frequency Identification
RITES	:	Rail India Technical and Economic Service
SMS	:	Short Message Service
SPM	:	Suspended Particulate Matter
SPV	:	Special Purpose Vehicle
ST	:	State Transport
SUTP	:	Sustainable Urban Transport Project
TOD	:	Transit Oriented Development
ULB	:	Urban Local Body
UMC	:	Urban Management Centre
UMTA	:	Unified Metropolitan Transport Authority
VAS	:	Value Added Service
VMSS	:	Vadodara Mahanagar Seva Sadan
VPN	:	Virtual Private Network
VUDA	:	Vadodara Urban Development Authority

CHAPTER I: INTRODUCTION

1. INTRODUCTION

The Ministry of Urban Development (MoUD), Government of India, is the primary agency responsible for development of cities by guiding and developing policies for urban development. MoUD, through its policies and programmes, such as the National Urban Transport Policy (NUTP 2006), continues to strengthen the capacities of urban local bodies and state governments to create conditions that will make Indian cities more liveable and sustainable for its citizens. One such initiative to further the goals of the NUTP 2006 is the Sustainable Urban Transport Project (SUTP). The World Bank and UNDP support SUTP under the Global Environment Facility (GEF) programme.

Under this GEF-SUTP programme, MoUD has appointed IBI Group as the lead consultant for developing National-level Guidance Documents and City Specific Plans for (i) Transit Oriented Development (TOD), (ii) Non-motorised Transport (NMT), and (iii) Public Bicycle Sharing (PBS) Scheme. The guidance document(s) present a "how-to" manual for each of these three sustainable transportation concepts in detail, by considering the lessons learned from worldwide experience and contextualizing the concepts to better suit India's unique conditions.

To implement the findings and recommendations of the Guidance Documents, City Specific Plans for two cities were prepared for each of the above-mentioned concepts. Lessons learned from these City Specific Plans were integrated in refining the Guidance Document(s) and ensuring that they are based on ground realities with a focus on implementation.

PBS is a service in which bicycles are made available to multiple users (on a sharing basis) for short duration trips, offering an option of returning them at different destinations. Often, PBS systems are integrated with public transit stations to provide last mile connectivity or in mixed land use areas to facilitate short duration work and/ or personal trips.

This report contains the Public Bicycle Sharing (PBS) Scheme for the city of Vadodara (hereinafter referred as the 'Vadodara PBS Plan') as one of the two City Specific Plans prepared to test the applicability of the PBS Guidance Document in cities. Vadodara, with Vadodara Mahanagar Seva Sadan (VMSS) acting as the nodal agency, was selected as one of the two demonstration cities because of the following reasons:

- The city has short trip lengths (<5 km)[1] and a high modal share of bicycle riders in the city (19%) compared to the national average (11%)[2].
- Successful track record in operating a pilot cycle share program in the city's recreational tourist destination of Kamati Baug- a 113 acre (0.46 sq km) garden located in the heart of the city.

1.1. Plan Objectives

The Vadodara PBS plan is intended to provide VMSS with a strategic plan of action to expand its pilot Kamati Baug PBS to other areas of the city. The key objectives of the PBS Plan are:

- Define the appropriate scale for introducing PBS as an alternative transport mode within the municipal limits of Vadodara to improve mobility choices and provide residents and visitors another option to travel in and around the city.
- Share benefits of PBS with local stakeholders, promote greater interest in cycling, and increase cycling ridership in the city.
- Integrating PBS with existing transit and land use to solve first and last mile connectivity issues.

[1] *Study on Traffic and Transportation Polices and Strategies in Urban Areas in India" by Wilbur Smith Associates, Page 21, May 2008*

[2] *CMP Vadodara 2012*

1.2. Target Audience

This City Specific Plan provides detailed information on planning and implementing Public Bicycle Share system in Vadodara. The document will be beneficial especially for the multiple stakeholders such as local governments, urban planners, transport planners, police department, engineers, community leaders, and others who are interested in promoting public bicycling. The main aim of this document is to contribute to the implementation of a PBS system in Vadodara, which was initiated through an EOI released on 22nd March 2016.

1.3. Project Methodology

Following extensive interactions with VMSS officials and local stakeholders including MS Baroda University, field visits were conducted to record the on-ground conditions to gauge the city's preparedness in supporting a successful PBS system. The City Specific Plan (CSP) for Vadodara follows the steps suggested in the National-level PBS Guidance Document, prepared as part of this project. These steps included:

Exhibit 1.1: Overview of project methodology

Source: IBI Group

The section below presents a detailed description of the five-step methodology adopted in preparation of this plan and the report structure.

1.3.1. Assess

Chapter 2 of the Vadodara PBS Plan includes an assessment of city's preparedness in implementing a PBS system. Data used in the plan preparation relied on secondary sources and interviews with key stakeholders. The assessment includes undertaking a series of tasks to gauge the city's existing strengths and limitations to drive the project beyond the planning stage for implementing the system, in terms of:

Physical attributes, including factors such as modal share, transit capacity, cycling infrastructure and integration with other modes.

Non-physical factors, such as supportive policy framework, institutional capacity, local commitment, stakeholder ownership, and civic awareness.

Prior to embarking on a detailed study, it is essential to review the current initiatives that can support PBS, understand present technical capacities available locally, identification of possible revenue streams and broad understanding of city's travel patterns. In parallel, it is also important to bring on-board the various stakeholders and administrators who will be involved in the decision making process. Tasks in the 'Assess' step include:

1) Create a consolidated database of city-level transportation and land use data.
2) Conduct a review of current institutional support for bicycling.
3) Develop an understanding of the city's budgetary allocation for transportation.
4) Formulate preliminary goals for the city's PBS system.
5) Identify stakeholders to create an effective communications strategy.
6) Determine initial scale and scope of proposed coverage area.
7) Prepare a preliminary feasibility study including potential business models for initial coverage area.

1.3.2. Enable

The 'Enable' step highlights the visioning and goal setting process that the city should follow in creating a coherent message for the community. In addition, policy level gaps, financial availability and political support are enabling factors that should ideally be in place to create an implementable plan. Tasks under the 'Enable' step include:

1) Establish leadership support and project champions.
2) Conduct capacity building workshops and awareness generation campaigns.
3) Define PBS scheme delivery mechanism alternatives.
4) Align PBS scheme with planned NMT and transit infrastructure improvement projects.
5) Assist with fundraising efforts to undertake detailed planning and implementation.

1.3.3. Plan + Design

Building upon the findings of the Assess and Enable chapters, the 'Plan + Design' chapter presents planning considerations for establishing the PBS programme for Vadodara. This section includes a definition of the area to be covered by the initial system, the recommended size of the PBS network, proposed station locations, typical station placements, technology interventions and considerations for future expansion of the program.

Specific tasks under 'Plan + Design' steps include:

1) Conduct a detailed existing conditions inventory and demand analysis for initial PBS coverage area.
2) Determine PBS system design including station density, station location, station sizing.
3) Refine initial PBS coverage area and determine system-phasing strategy.
4) Conduct participatory planning workshops to finalise the PBS network plan.
5) Prepare detailed technical specifications for system hardware and software design.
6) Identify NMT infrastructure improvements to support PBS network plan.

1.3.4. Invest

Sustainable financing mechanisms are essential for long term viability of the PBS system and also to ensure that the system is economically sustainable. Possible business models (i.e. ownership, administration, and operation of the system) are explored along with potential funding strategies in Chapter 5. This builds on the experience of other Indian cities and tailored for Vadodara's market. This chapter also presents expected capital and operating costs for the system along with forecasts of user demand and revenue, potential sponsorship / advertising revenue, and other revenue sources. A "cash-flow" analysis is presented for the first five years of operations to determine whether the system will be able to sustain operating costs and pay-back initial capital costs. Tasks under the 'Invest' include:

1) Identify detailed capital and operating costs.
2) Determine revenue streams including pricing structure.
3) Create operational business model.

1.3.5. Implement

Implementation of the PBS system requires increased coordination and meticulous planning of the various tasks identified in the planning phase. The 'Implement' chapter (Chapter 6) identifies the various stakeholders in Vadodara that will have a crucial role to play in successful implementation of the plan. It also defines their roles and responsibilities to gear themselves up for the extensive process of implementation. It is advisable that governance and monitoring structure be created for the purpose of long-term management of PBS. Tasks under implement steps are as under:

1) Establish institutional framework including roles and responsibilities.
2) Devise operation & maintenance protocol.
3) Build awareness through communication and outreach strategy.
4) Undertake operational training and capacity building.
5) Develop monitoring system and improvement strategy.
6) Expand system.

Exhibit 1.2 illustrates the overall project methodology as a flow-chart.

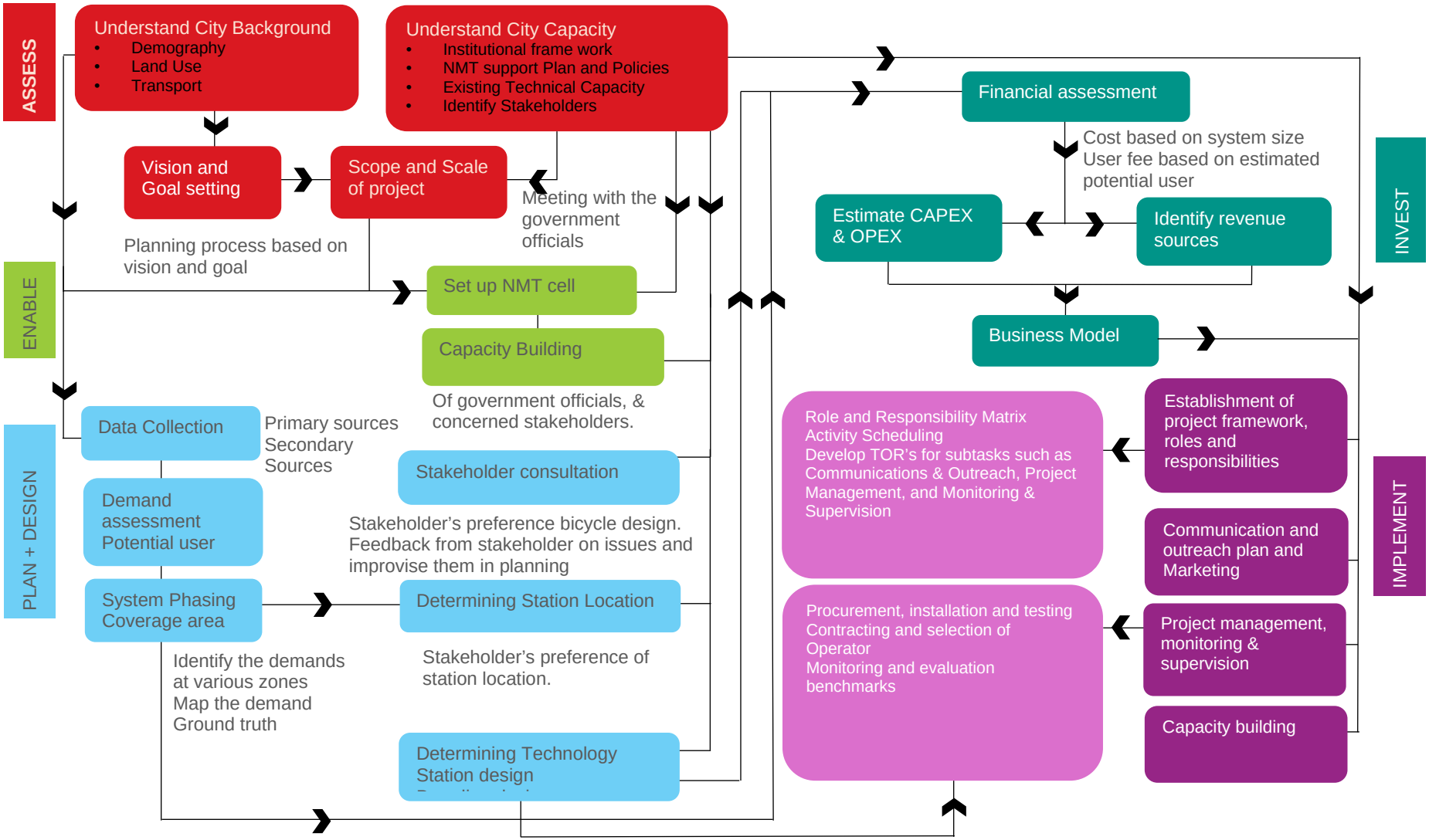


Exhibit 1.2: Flow chart for project overview

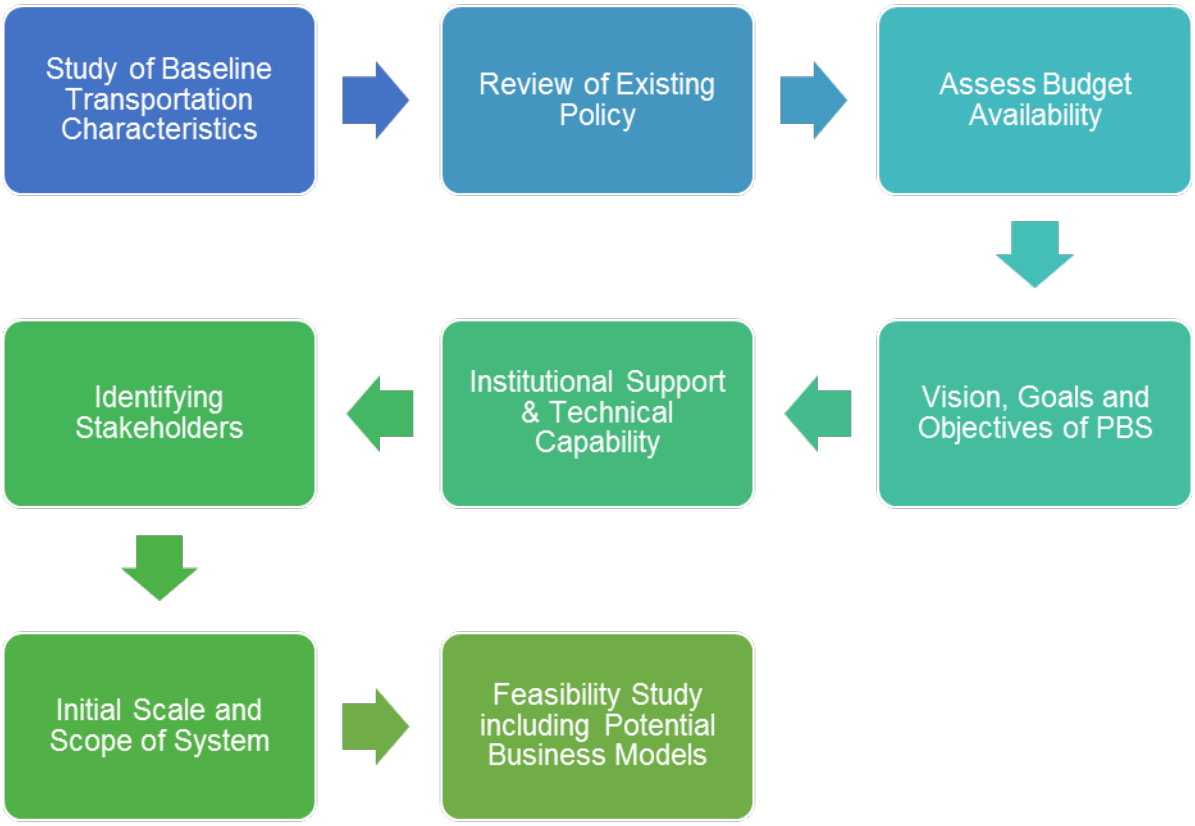
Source: IBI Group

CHAPTER 2: ASSESS

2. ASSESS

The 'Assess' chapter provides an overview of the steps needed to examine the city's preparedness for a public bicycle sharing system. In this chapter, the current situation in the city of Vadodara, with respect to the transportation and land use scenario, is studied in detail based on available literature and data. Various information sources are referred to in this chapter to assess and establish the baseline transport scenario of Vadodara. Understanding the baseline conditions and transport needs of the city will help evaluate the options available to steer Vadodara towards a sustainable mobility.

The following chart describes how the viability and feasibility of a PBS system in Vadodara was studied.



Source: IBI Group

2.1. Vadodara City Profile

Vadodara, formerly known as Baroda, shot to prosperity in the 19th century when Maharaja Sayajirao III established the transportation rail link between Mumbai and Vadodara in 1870 and opened up the region to other parts of the country. Industry, trade and commerce were given due importance during the period and also focus was laid to enhancing educational and improved health facilities. Since then, Vadodara has been growing as an administrative, commercial and educational centre. The establishment of Indian Petrochemicals Corporation Limited (IPCL) and Gujarat Refinery transformed the socio-economic landscape and attracted many rural inhabitants to the city. Today it is the third most populated city in Gujarat after Ahmedabad and Surat with a total population of 16.6 lakh (Census 2011) (Refer Exhibit 3). The city serves as an administrative headquarter of its district and spreads over an area of 125 sq km. The city is popular for its palace, park, museum and temples. It is also known for its "Gateway to the Golden Corridor".

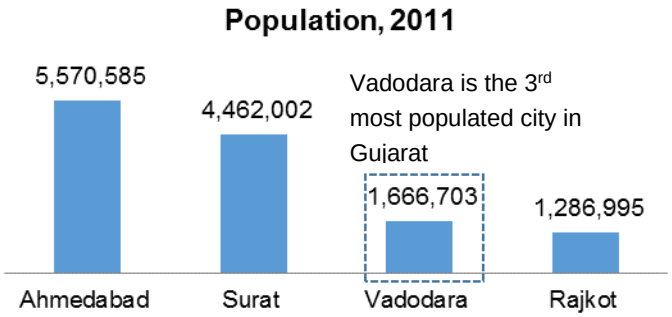


Exhibit 2.1: Population of Vadodara compared to other cities in Gujarat
Source: Census 2011

2.1.1. Geographic Characteristics

Map 2.1: City of Vadodara
Source: Google maps

Vadodara is located in south eastern part of Gujarat on the banks of the Vishwamitri River. The city has fairly flat topography. It experiences three main seasons, summer, monsoon and winter. Summers are hot with average temperature of 36 ˚C which goes up 40-44 ˚C during the month of March to May. Average annual precipitation is 131mm, with more or less 8-day rainfall each month from June to November. The winters are generally mild with temperature varying from 12˚C to 16˚C lasting from November to February. The overall weather is dry in Vadodara and rainfall is infrequent. **These climatic conditions make Vadodara conducive to cycling for 8 to 9 months of the year. The flat topography makes cycling in the city less strenuous and is not a barrier to the use of the system.**

2.1.2. Demography and Socio- economic Characteristics

As per the 2011 census data, the city accommodated 16.6 lakh people within 12 wards spread across 125 sq km of VMSS area. During the early 20th Century industrial boom, Vadodara became one of the attractive destinations for the migrating population. Key industries driving this growth were chemicals & petrochemicals, pharmaceuticals and bio-technology. In the years from 1981 to 1991, the share of manufacturing workers declined by 3.4% due to the limited industrial development and primary sector declined by 0.54% during the same period. Remarkable increase was noticed in construction, trade and commerce and other tertiary activity in 2001. The sector engaged nearly one fourth of city's total workforce. Owing to urbanization, the growth of the city has seen a steady rise post 2001 (Refer Exhibit 2.2). Due to the presence of a significant migrant workforce, 46% of the city's population falls within the age group of 15 – 44 years.

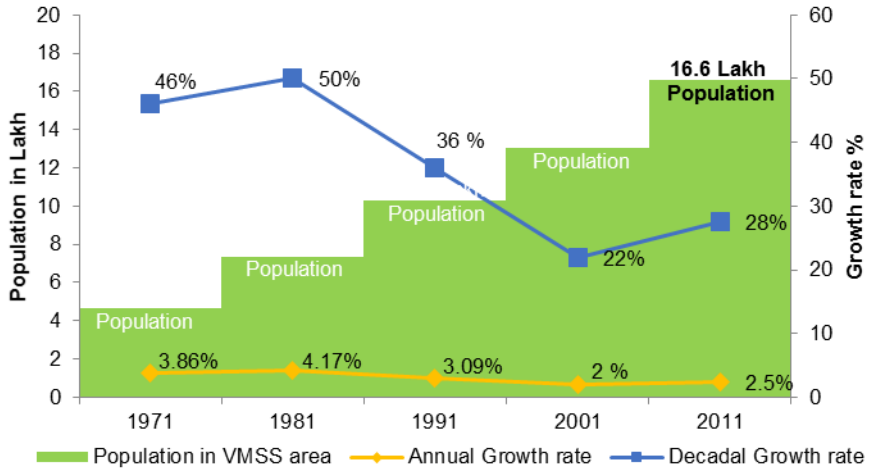
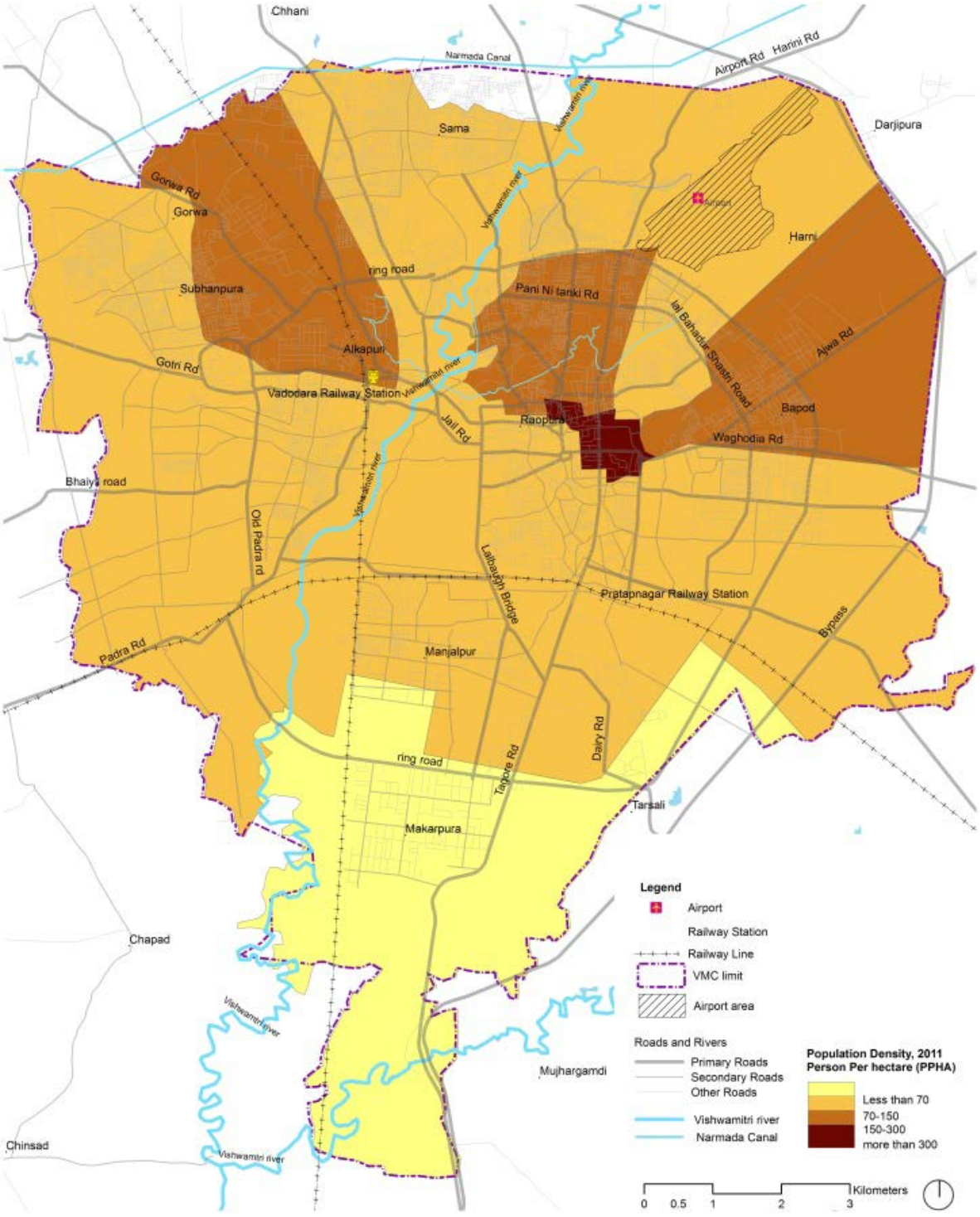


Exhibit 2.2: Population growth of Vadodara

Source: Census

The population in Vadodara is concentrated in the northern and central parts of the city. The central part of the city encompasses the Old City, neighbourgoods of Mandvi, Nyay Mandir, and Raopura. Packed bazaars, clustered and barricaded pols, and numerous places of worship dominate the overall character of this area. The central city also houses heritage structures such as the Nyay Mandir (courthouse) and landmark buildings like the General Post Office. The north-western parts of Vadodara is home to reputed educational institutions such as M S University, Railway Station, transit hubs and large residential areas. The eastern bank of Vishwamitri River has the Laxmi Villas Palace and population density there is less than 100 person per hectare. The tapering southern Vadodara- in around Makarpura has the Gujarat Industrial Development Corporation (GIDC) and other Industrial stretch, attracting the working population from surrounding areas. (Refer Map 2.2).

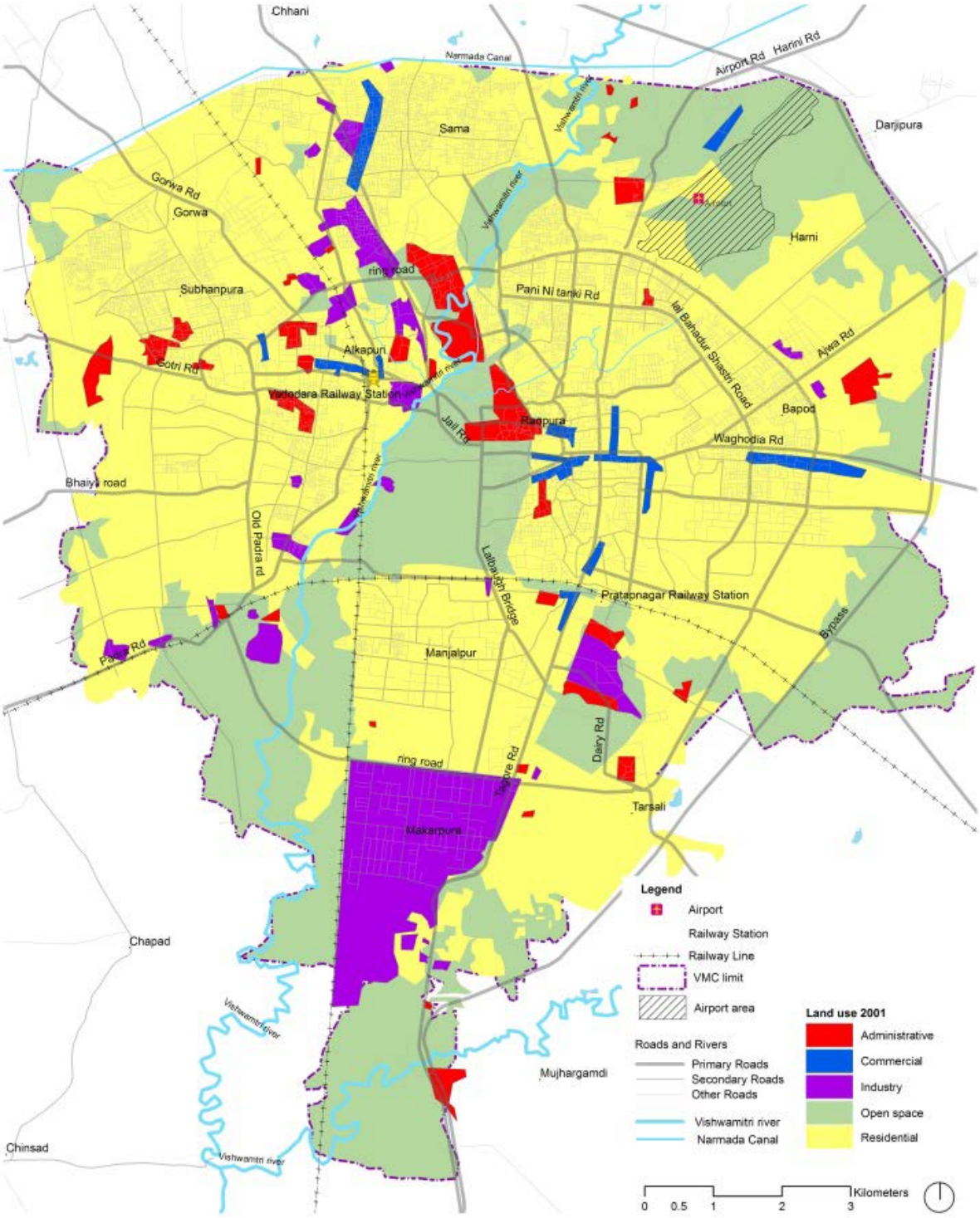


Map 2.2: Ward wise population density of Vadodara, 2011

Source: CDP Vadodara

2.1.3. Land Use

Vadodara has a mix of land use categories distributed unevenly across the city. During the last 15-20 years, new residential areas like Gorwa, Gotri, Harni, Sama, Bapod, Tarsali, Manjalpur and Channi have come to support the population of the expanding city and industrial areas. Along the fringes, agricultural lands are slowly being converted into residential, industrial and commercial developments. Between 1991 and 2001, the residential land use increased from 40 sq km to 70 sq km. The expansion in area of residential population is a result of the development of industrial belts in the outskirts of the city and massive commercialization at city centre (Refer Map 2.3).



Map 2.3: Land use map of Vadodara 2011

Source: CDP Vadodara 2012

Concentration of commercial activities is observed along major arterial roads within the city, in areas like Raopura Road, Sayaji Gunj Road, Alkapuri Road, Race Course Circle, Nizampura, Subhanpura, Palace Road, and due to this, these arteries are experience heavy traffic congestion. In 1991, the commercial land-use was 1.51 sq km, which increased to 4.95 sq km- an increase by 3 times in over a decade. The institutional buildings accommodating the government offices are located in the Vadodara Kasba area, and attract a large number of trips to the area.

This characteristic nature of Vadodara with its mix of land uses provide opportunities for the bicycle to act as a viable mode for utility-based short trips.

Exhibit 2.3: land use distribution of VUDA (2011)

Sl. No.	Land use		1993		2011	
			Sq km	%	Sq km	%
1	Residential		41.0	37.8%	131.2	54.6%
2	Commercial		1.5	1.3%	7.7	3.2%
3	Industrial		19.5	18.0%	24.6	10.2%
4	Recreational/ Open Space		2.8	2.5%	15.6	6.5%
5	Road and Railways		6.3	5.8%	6.5	2.7%
6	Restricted Areas		32.8	30.3%	45.8	19.1%
7	River,Tank etc.		4.3	4.0%	8.2	3.4%
Total Urban Area	**108.5**	**100%**	**240.0**			**100%**

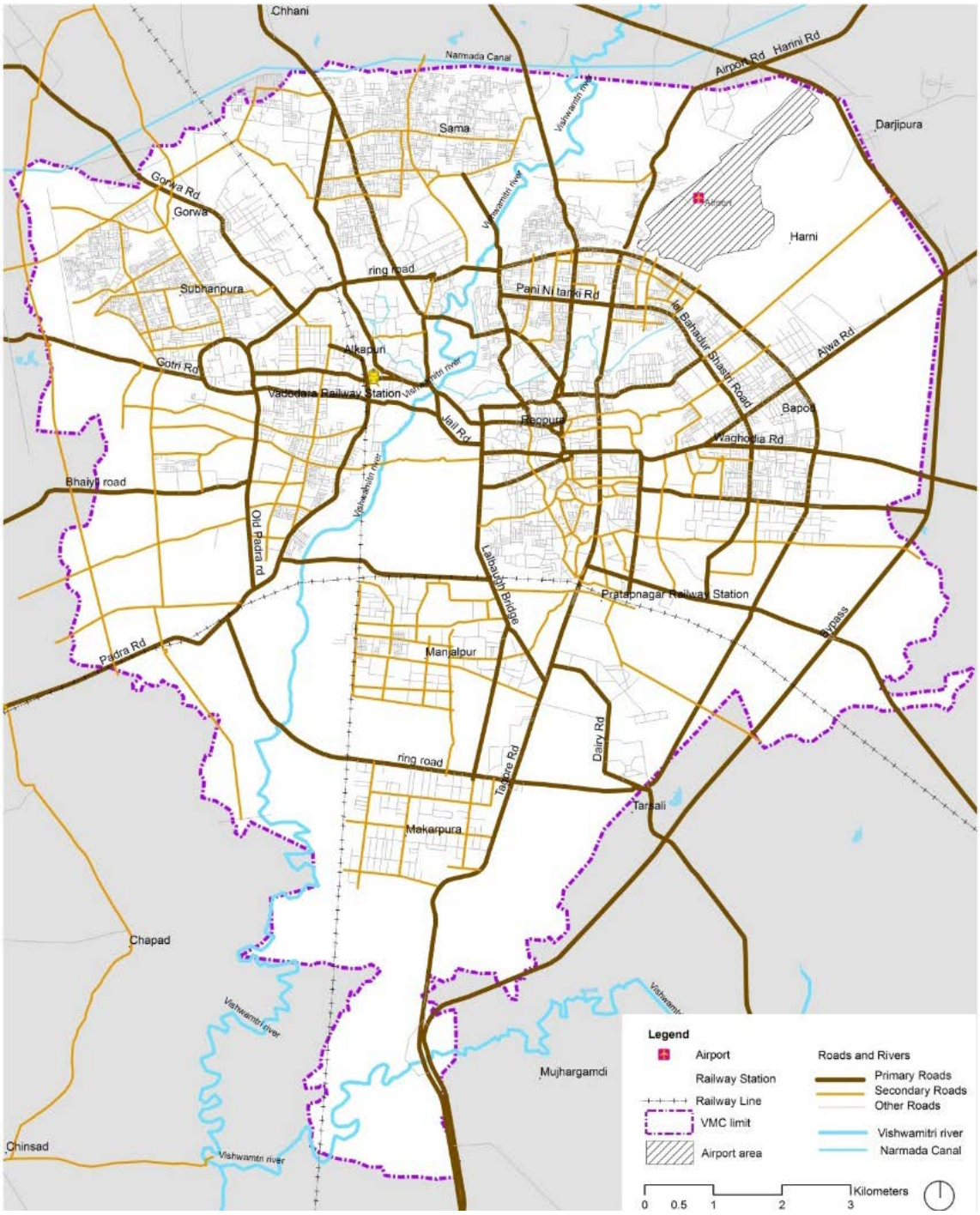
Source: CMP Vadodara, 2012

2.1.4. Existing Transport Scenario

a) Road Network

Vadodara's ring radial road network pattern encompasses the entire city; it covers 2.7% of the city's land use. Road density is 7km road per sq km and for every one km of primary road there are 3 local or other roads joining, giving a very well distributed dense road network.

The local roads are well connected, however are not favourable to promoting a cycling-friendly environment which requires a shaded path and road safety features (Refer Map 2.4).

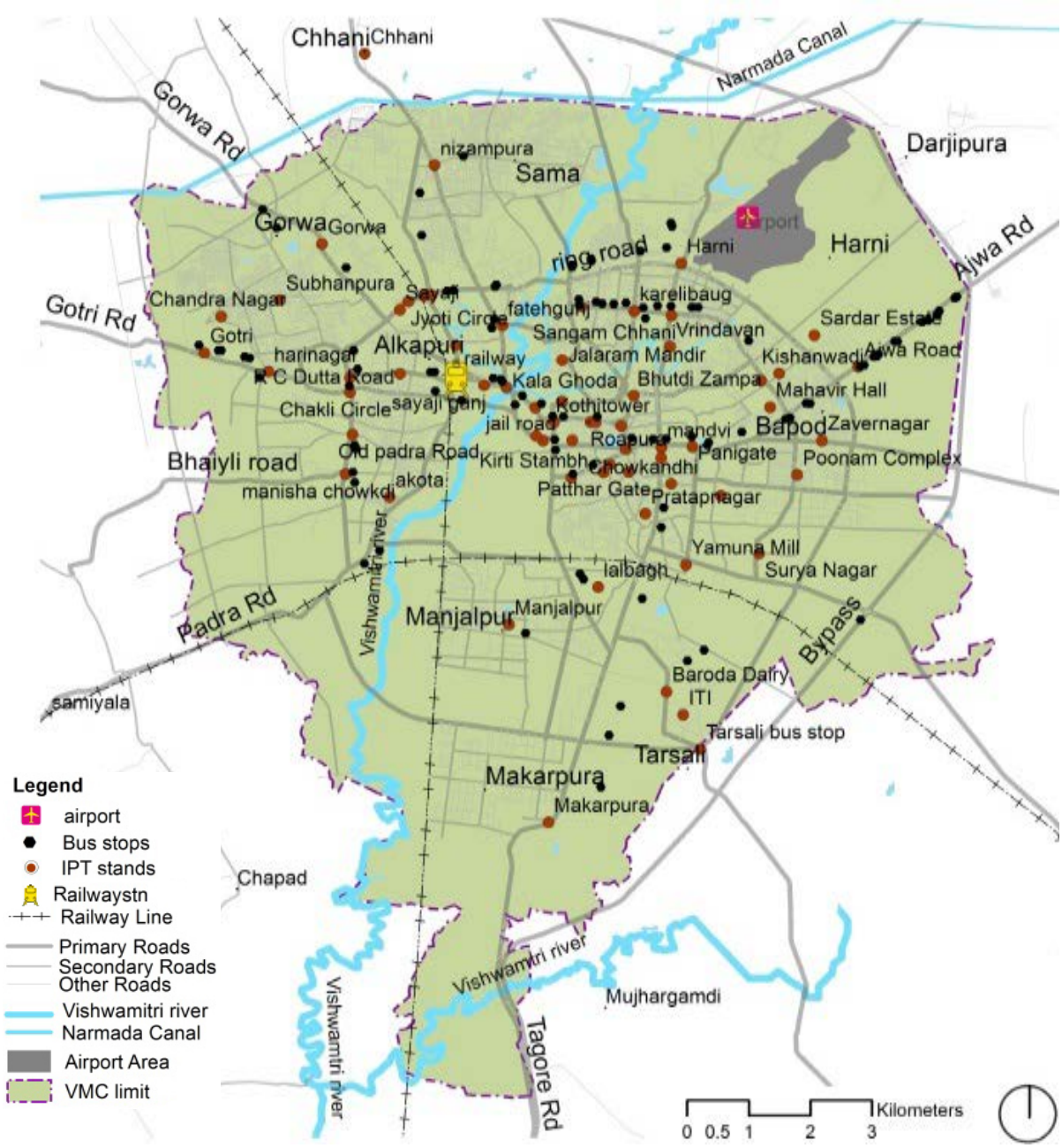


Map 2.4: Road network map of Vadodara

Source: CDP Vadodara 2012

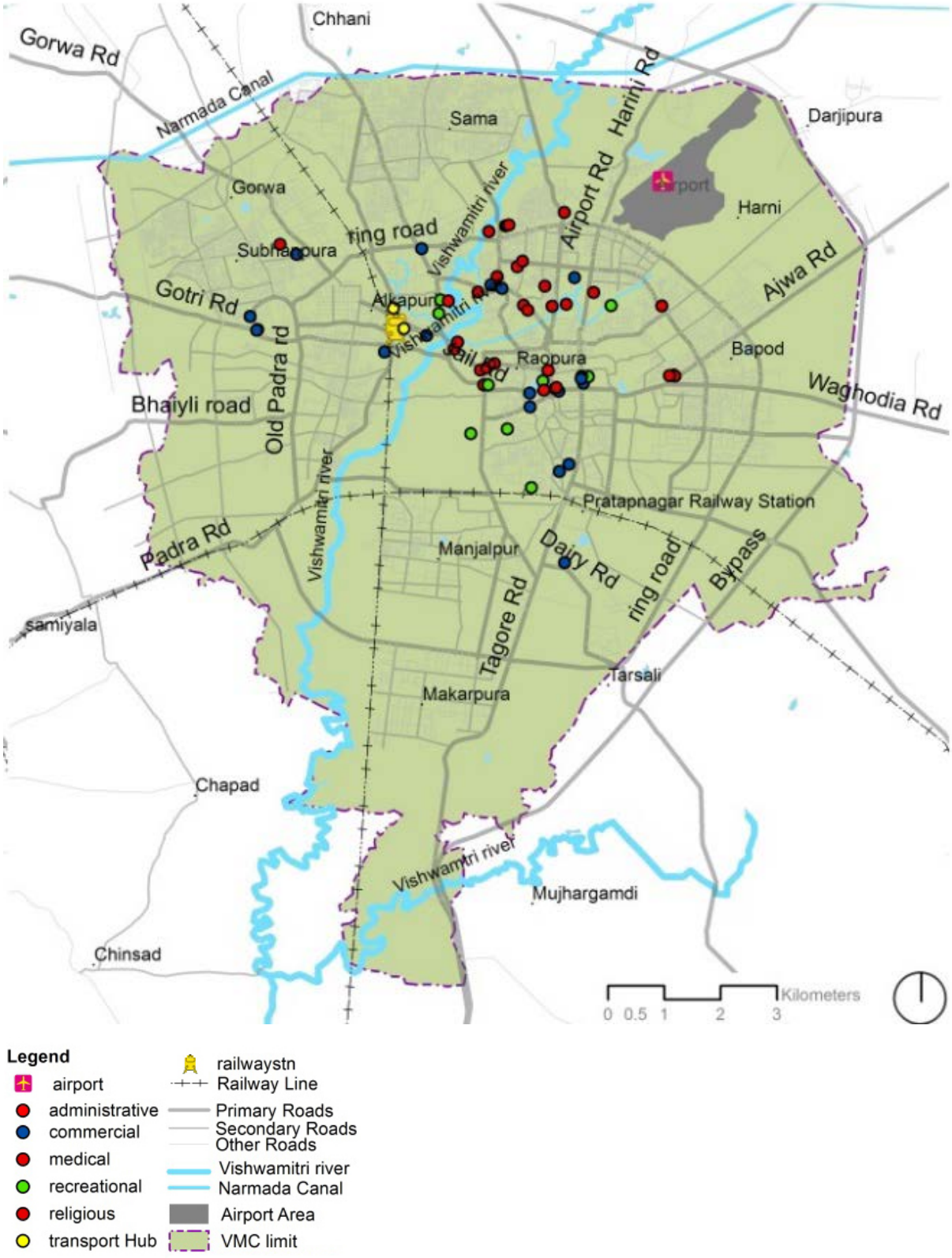
b) Traffic Generating Activity

The city centre primarily consists of a mix of uses with major administrative buildings, recreational places, medical centres, religious places and transit nodes such as bus stops and shared auto stands. Some of the active areas in the central parts of the city that include Mandvi, Nyay Mandir, Raopura and railway station area(s), are connected by major arterial roads including Alkapuri Road, Race Course, Nizampura Road, Subhanpura Road, Palace Road, R.C Dutt Road. Owing to narrow road widths, these activities create acute traffic congestion on the roads throughout the day. The presence of abundant educational institutions across the city and many notable green areas like Sayaji Garden (popularly known as Kamati Baug) and Laxmi Vilas Palace near the riverbank add to the diverse nature of land uses that the city offers to its residents. The following maps (Map 2.5 to Map 2.8) illustrates variations in the intensity of activities that is high in the central areas and spreads towards the periphery of the city to form the new residential areas.



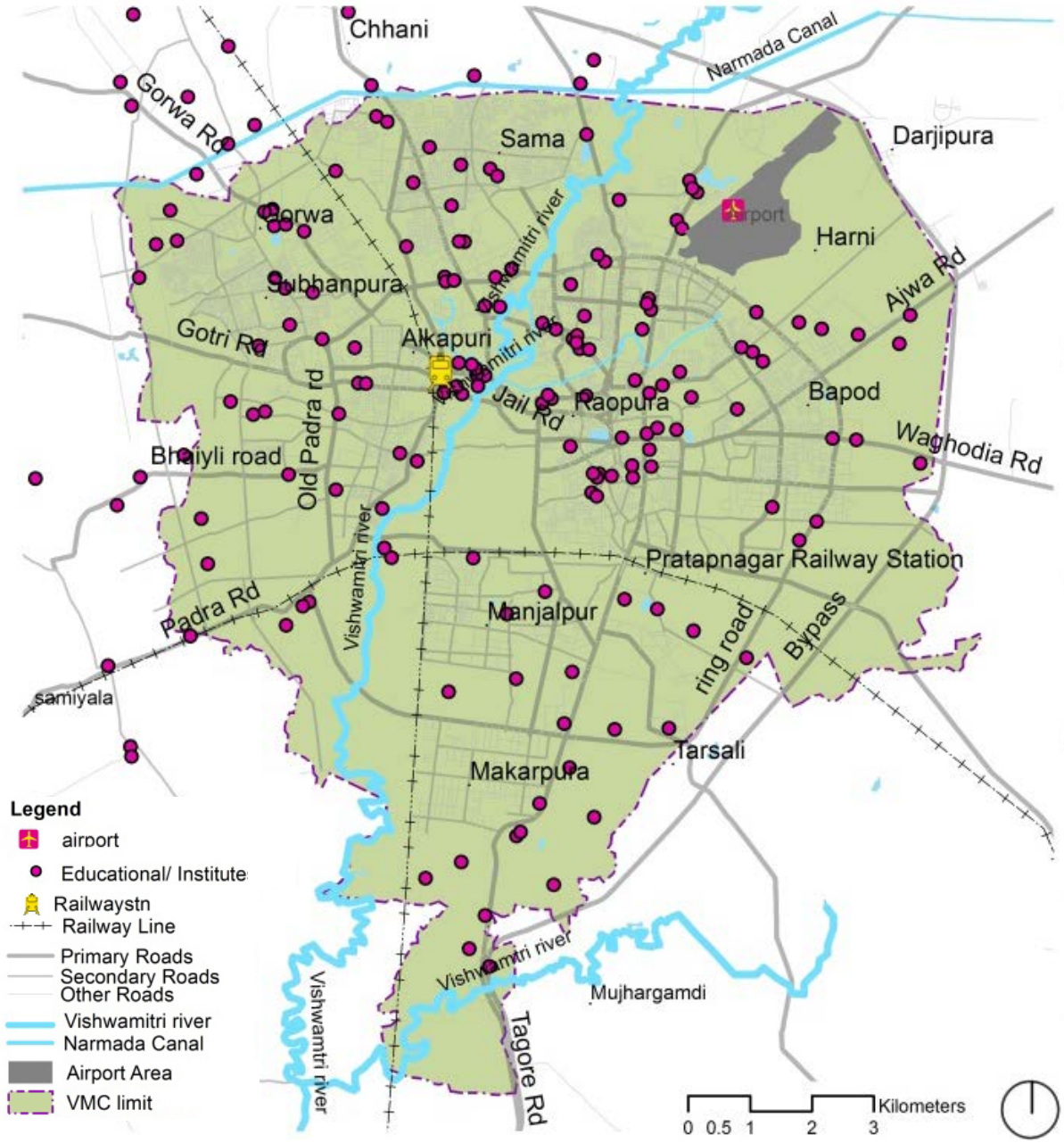
Map 2.5: Transit nodes of Vadodara – bus & IPT stands

Source: CGM, 2015



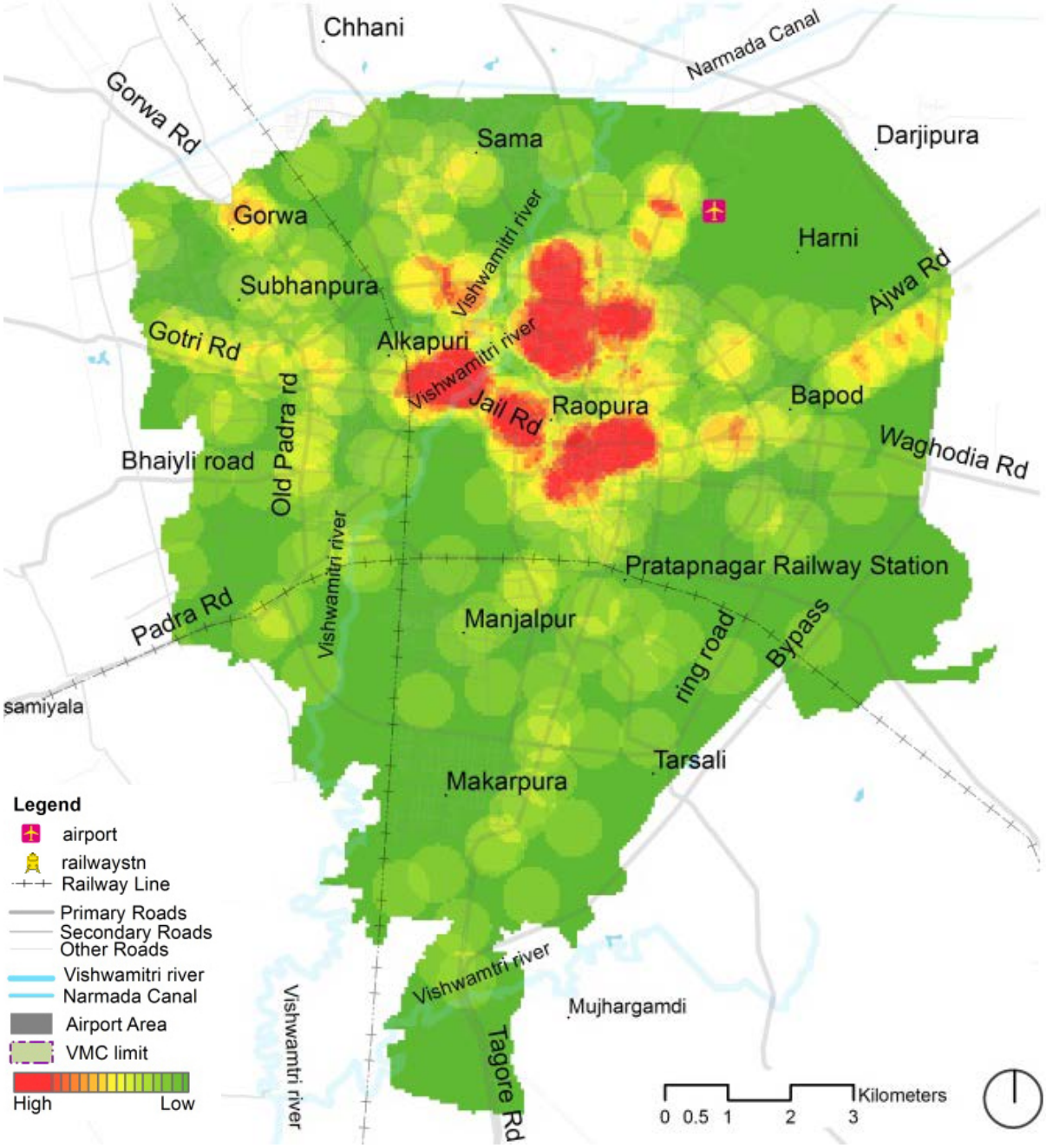
Map 2.6: Traffic generating nodes in Vadodara

Source: CGM, 2015



Map 2.7: Educational institutes in Vadodara

Source: CGM, 2015



Map 2.8: Heat map showing intensity of activities in Vadodara

Source: CGM, 2015

c) Travel Characteristics- Trip Rate, Modal Choice

The average trip length[3] of the city is not more than 4.8km. The average trip rate of the city is around 1.3 (2011), which includes walking trips[4]. Details regarding the various means of transit separately are discussed in the following section.

Exhibit 2.4 illustrates the modal share for Vadodara. It is discussed briefly below:

- NMT forms 40% of all trips. One-fifth of all trips in the city (19%) are already been made on bicycles.
- 68% trips are of less than 5km trip length and the share of IPT, bicycle, two wheeler and walk takes over 90% mode share.
- The mode share of public transport is very low (only 6% share). The bus service, VTCOS (Vallabhaipur Transportation Co. Op. Society Pvt Ltd), suffers low ridership due to low frequency and poor service[5].
- Auto rickshaws have a mode share of 14%. They fill the gap created by the inefficient bus service and their share is on the rise catering to the demand unmet by public transit.
- Two wheelers are the dominant private mode for transit in Vadodara. They represent 36% of all commuting trips while cars account for only 5% of the modal share.

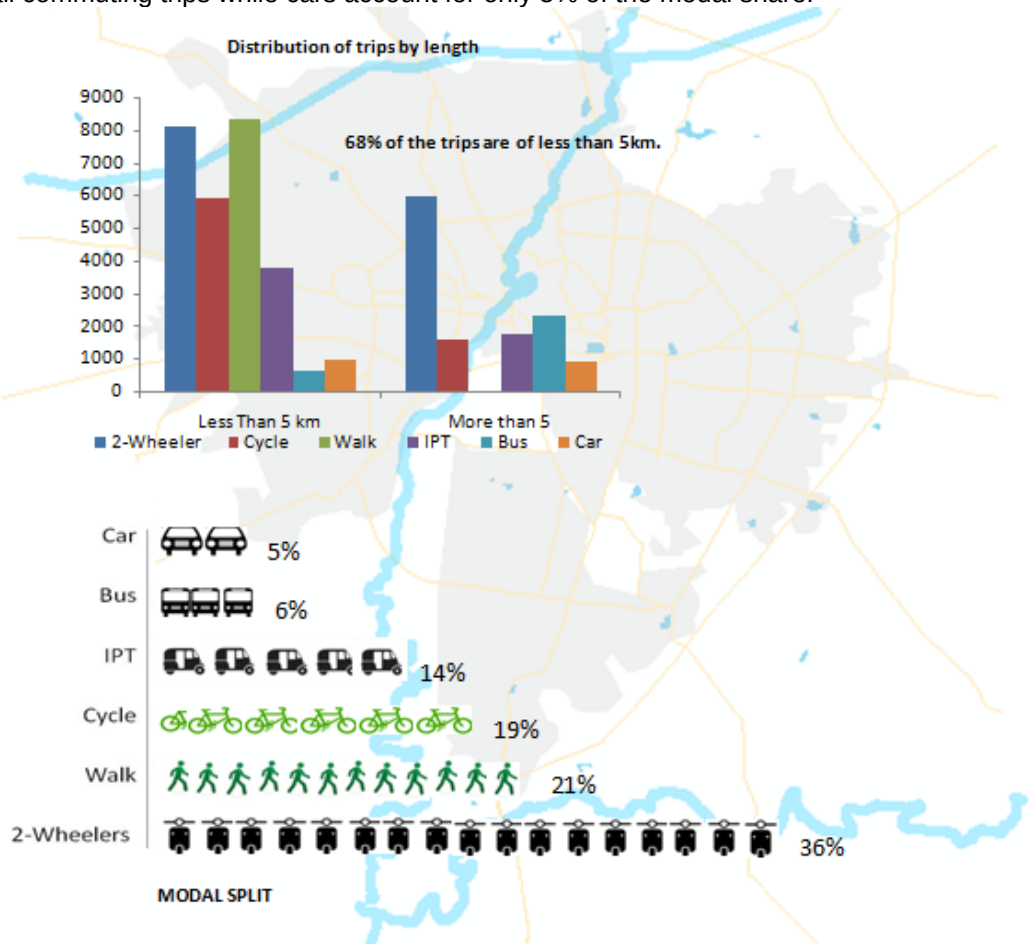


Exhibit 2.4: Modal split and trip distribution of Vadodara

Source: CMP Vadodara, 2012

[3] *CMP Vadodara 2012*

[4] *Total trips incl. walk 22.3 lakh, 2011, CMP Vadodara 2012*

[5] *Modal share figures are from CMP 2012 since then VTCOS are in the process of winding up services in Vadodara and will be replaced by another bus service (http://timesofindia.indiatimes.com/city/vadodara/Vitcos-to-wind-up-city-bus-service/articleshow/45975456.cms)*

d) Public Transport and IPT

Vadodara has operational intra-city bus and dominant auto rickshaw service plying within the city.

In 2012 modal split for intra-city public transport was about 6%. (Map 2.9). At this time, the **bus service in Vadodara,** was operated by VTCOS. In 2012, VTCOS had a fleet of about 90 buses. There were about 40 bus routes operated at 5 to 8 minute headway from city bus terminal opposite the railway station. VMSS also developed 124 bus stops through a private developer: Proactive (In & Out Advertisement Ltd.). Since last year, VTCOS has begun to wind up its services in the city. The municipal corporation is looking for new city bus service providers for Vadodara[6].

Map 2.9: City bus route and bus stops

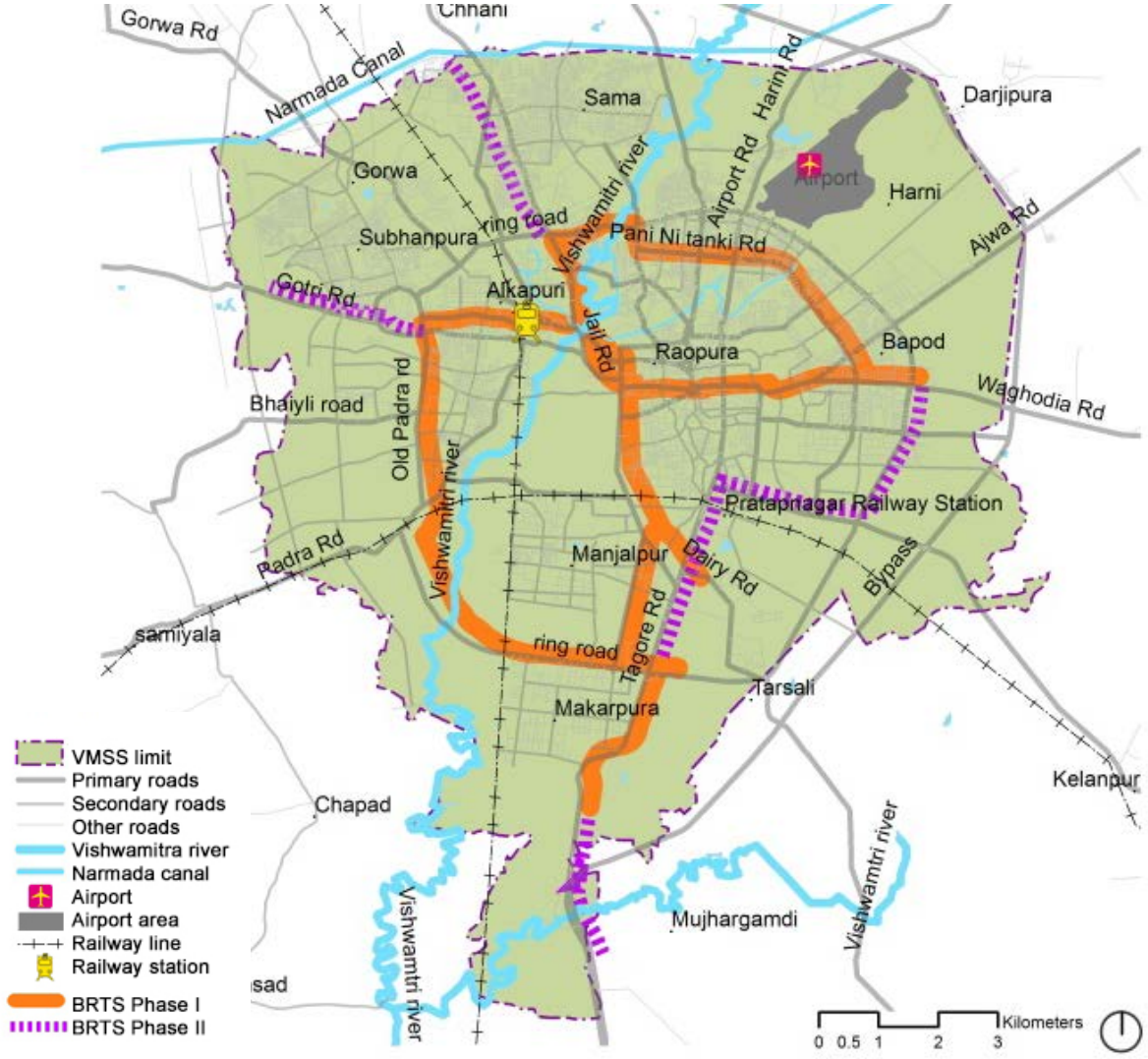
Source: Vadodara BRTS DPR, 2014 CEPT.

The city has also a proposed BRTS network currently in the planning stages. The proposed BRTS network covers 22 km in Phase 1, includes a north south connection from Fatehgunj to the industrial estate of Makarpura in the south and an east west connection from Akota to Waghodia Road. Phase two would be implemented on the Ring Road, and would include dense residential areas, airport and upcoming commercial areas. (Map 2.10). Feeder service has also been proposed to complement the last mile trips.

If implemented, the PBS system could integrate with the proposed BRTS system to provide first and last mile connectivity options and complement the feeder bus service. However the BRTS project has

[6] http://timesofindia.indiatimes.com/city/vadodara/Vitcos-to-wind-up-city-bus-service/articleshow/45975456.cms

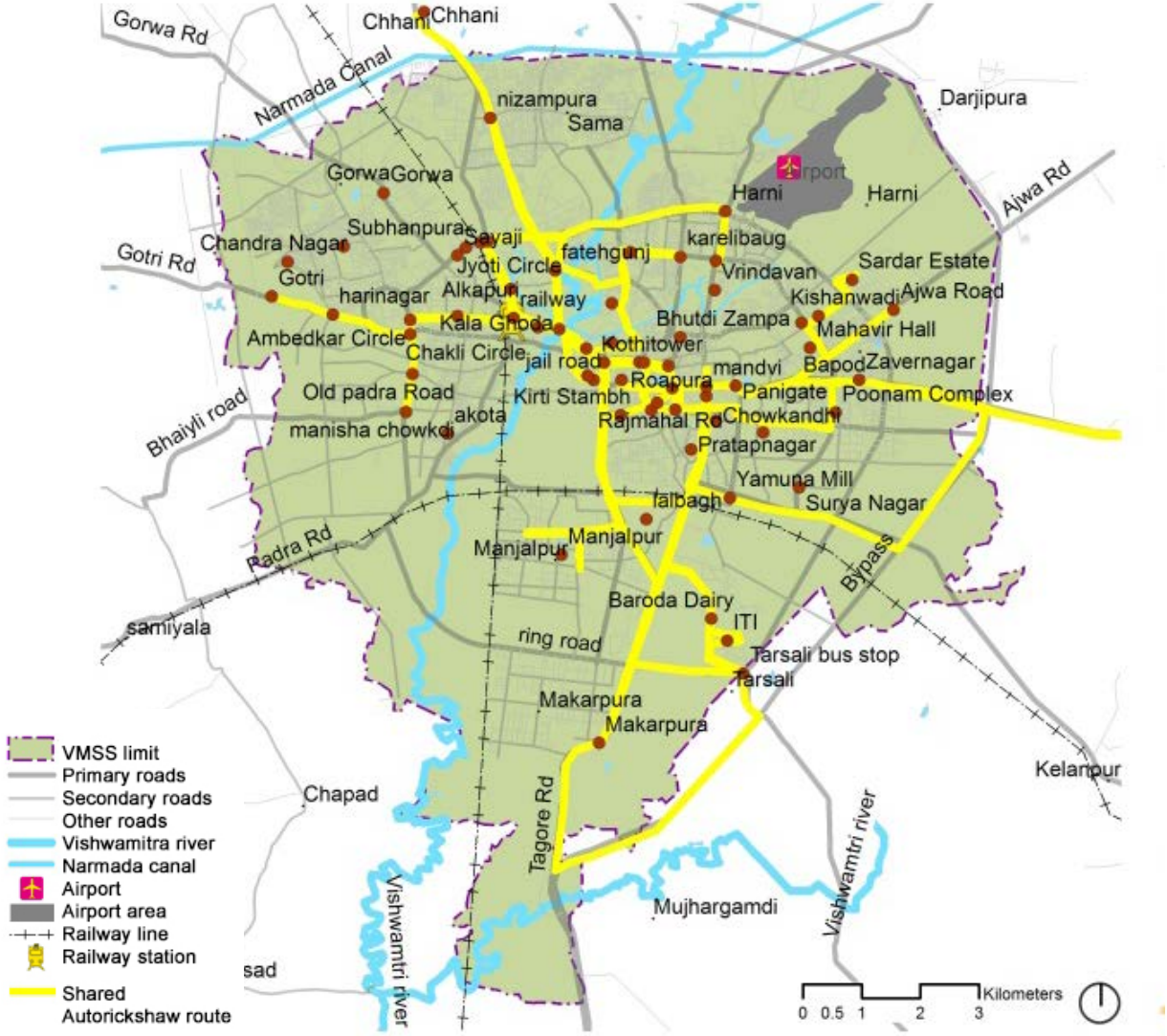
hit many hurdles in the past two years. The project is in the pipeline and the administration is yet to take a final decision on its implementation.



Map 2.10: Proposed BRTS network

Source: Vadodara BRTS DPR, 2014 CEPT

The IPT share of trips is 14%, dominated primarily by auto-rickshaws, including shared autos. The auto-rickshaws ply in the entire city and cater to main trips as well as last mile trips within the city. Map 2.11 shows the popular routes of shared auto.



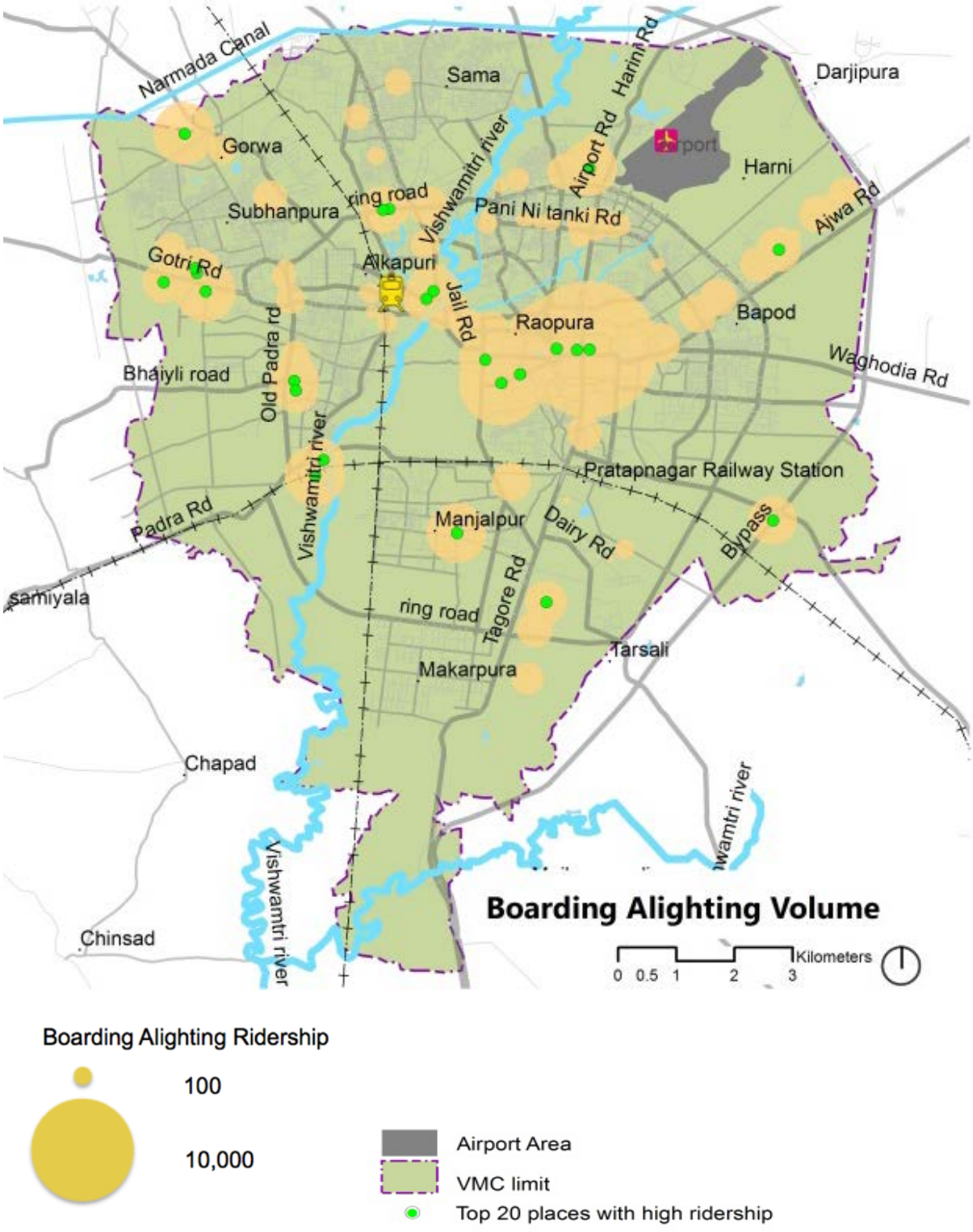
Map 2.11: Shared auto routes and auto stands in Vadodara

Source: CMP Vadodara 2012

Vadodara's city bus service is not adequate. The supply of city buses per lakh population works out to mere 5 buses. Central Institute of Road Transport (CIRT), in their study in 1995, had proposed a fleet of 1,040 buses by 2011 to serve a projected population of 20.6 lakh under the Vadodara Urban Development Authority (VUDA). A city the size of Vadodara must provide around 70 to 80 buses per lakh population. With the growth of population, the number of commuters has increased many folds. However, the public transport system has been unable to cope up with increased demand.

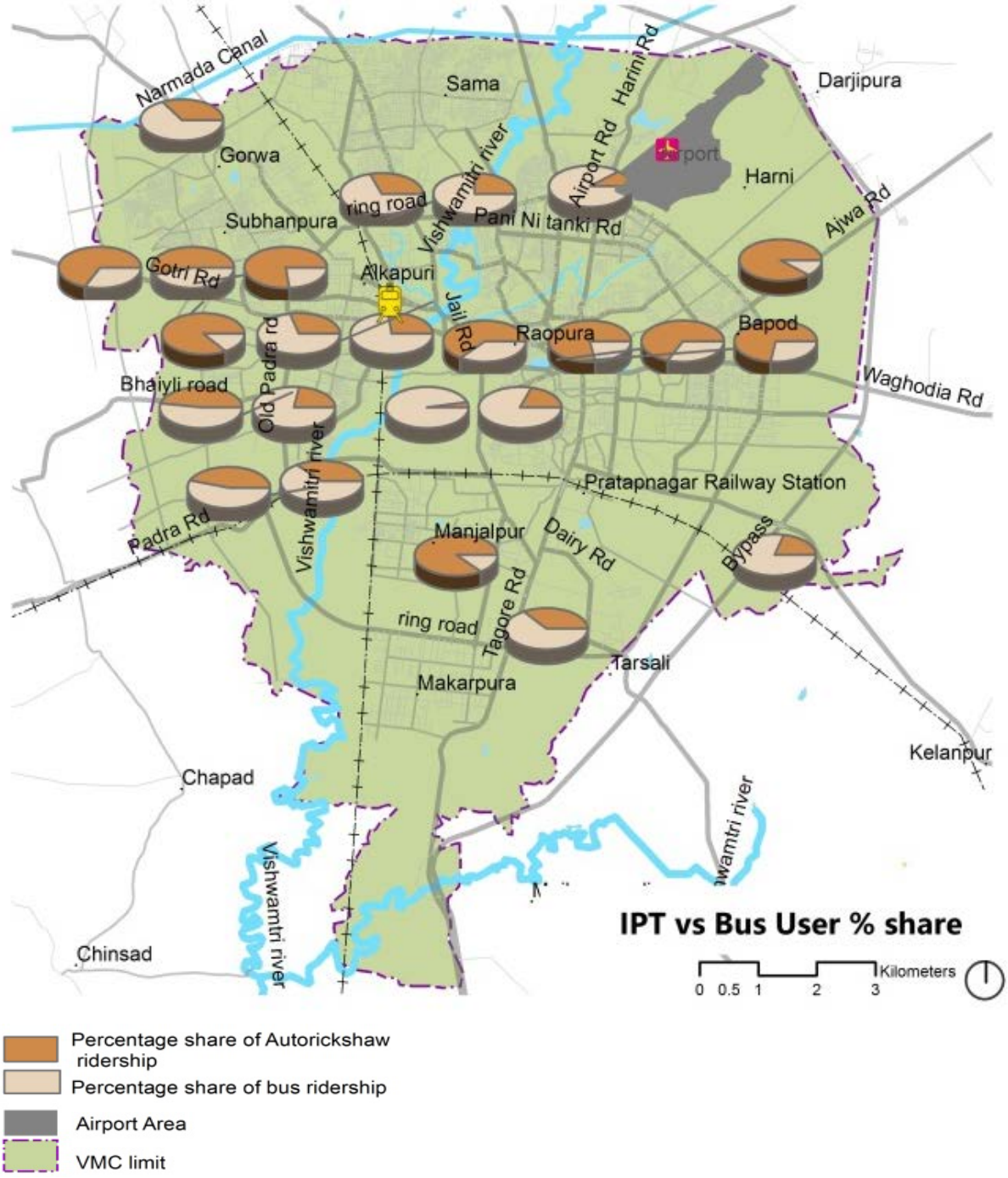
Exhibit 2.5: VTCOS bus service in Vadodara
Source: NIUA

Exhibit 2.6: Auto- rickshaws parked haphazardly along Gotri-Vasna Road in Vadodara
Source: CGM 2015



Map 2.12: Ridership volume at top twenty bus stop locations

Source: CGM 2015



Map 2.13: Percentage share of IPT vs bus users from same bus stops

Source: CGM 2015

The boarding alighting data shows a high volume of ridership around the Raopura and its surrounding areas (Map 2.12). Also, the percentage share of users (56%) opting for auto rickshaws over buses is comparatively high as shown in Map 2.13. This could be partially attributed to infrequent and insufficient bus service within the city coupled with an average trip distance of less than 5km. PBS becomes an attractive option in such a case to provide sustainable mobility alternative to users.

e) Pedestrian and Bicyclists

The city has an existing NMT share of 40%, of which 21% commute on foot and 19% on bicycle. Recently, several pedestrian walkways have been constructed on arterial roads and a 1km stretch of bicycle track was constructed on Palace Road. The city's average trip length by foot is 1.3km and 3.9km[7] by cycle. As seen in most Indian cities, lack of NMT infrastructure lowers pedestrian and bicycle safety. Some issues pedestrians and cyclists face on Vadodara's streets are: unsafe junctions, lack of footpaths and poor traffic management. Improving the NMT infrastructure and increasing road safety can further augment its use.

Kamati Baug Cycle Infrastructure

Exhibit 2.7: Bicycle pathway, Kamati Baug

Source CGM 2015

Sayaji Garden, popularly known by the name Kamati Baug, located next to the riverbank of Vishwamitri, has 28 bicycles kept for public use within the garden area. The park attracts more than 2,000 people daily, which includes daily joggers and tourists. People visit the park to exercise, visit the zoo, botanical garden, planetarium and museum located within the garden limits. Kamati Baug also features a dedicated bicycle track connecting the entire park. Maintained by VMSS, the manual bicycle share system of Kamati Baug, although small with 4 bicycle stations spread across 0.46 sq km of park area, attracts a lot of people who use the bicycles on a daily basis. The visitors of garden can take a free ride of 30 minutes between 9:00 to 10:00 am after depositing valid ID proof. The log book records an average of 18-22 user entries per day in an hour. Planners conceived the bicycle share system of Kamati Baug as a pilot project to observe the uptake of bicycles and the acceptance of the system. Users find it safe and enjoyable to ride cycles on dedicated bicycle paths in the park's secure environment. Such facilities when extended outside of park can have a similar level of acceptance as a viable commuting alternative available to both residents and tourists.

[7] *CMP, Vadodara 2012*

Exhibit 2.8: Cycle share parking in Kamati Baug

Source: CGM 2015

f) Vehicle Growth

The city has registered vehicular growth of 7.6% p.a. in the last 10 years. Cars and two wheelers together constitute about 87% of the registered vehicles in Vadodara, with two-wheelers as the dominant share at 76%. The share of public transport vehicle growth (bus) is only 0.3%[8].

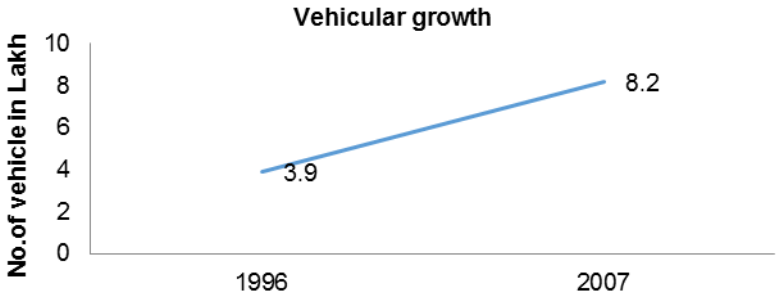


Exhibit 2.9: Vehicular growth in a decade, Vadodara

Source: Integrated Public Transit System, VADODARA 2007

g) Air Quality

High concentration of dust from unpaved margins of roads on the outskirt of the city and construction material within the city limit has raised an alarm in Vadodara. The quantity of Suspended Particulate Matter (SPM) in the Nandesari area is above industrial standards. Also, some of the residential areas near the Dandia bazaar and the fire station show higher levels of SPM. In terms of SOx and NOx, the levels are thankfully well within the standards but are on the rise with the rise in vehicles in the city.

[8] *Integrated Public Transit System, VADODARA 2007*

Exhibit 2.10: Status of ambient air quality (AAQ) in Vadodara (once in a year 2004-05)

Location and name of the place*	SPM	SOx	NOx
GPCB Office, Racecourse	214	3	21
GIDC-Makarpura	160	26	56
M15Vijaynagar,Harni	112	10	21
Dandia Bazar, Nr.Nyaymandir,	246	19	28
At Petrol Pump, Sayajigunj Police Chowki	197	5	18
31, Prerna Park Society, Gorwa	217	10	16
Nandesari CETP	305	19	30
GPCB Office	169	11	19
Dandia Bazar	292	17	27
Standards (rural and residential areas)	200	80	80
Standards (industrial areas)	500	120	120
All the values are in µg/m 3 = microgrammes per normal cubic meter & average. *Yearly average is calculated on the criteria of CPCB, i.e. at least 104 samples (24 hrly) per year/station.			

Source: CDP Vadodara

h) Road Accidents

Vadodara Traffic Police has initiated several awareness programs for road safety in the last five years and as a result the number of accidents over has reduced considerably during this time period. However, as seen from the Exhibit 2.11: the share of fatal accidents has been more or less consistent. Slow moving traffic, comprising of pedestrians and bicyclists are more vulnerable to road accidents and hence measures to ensure their safety should be prioritised.

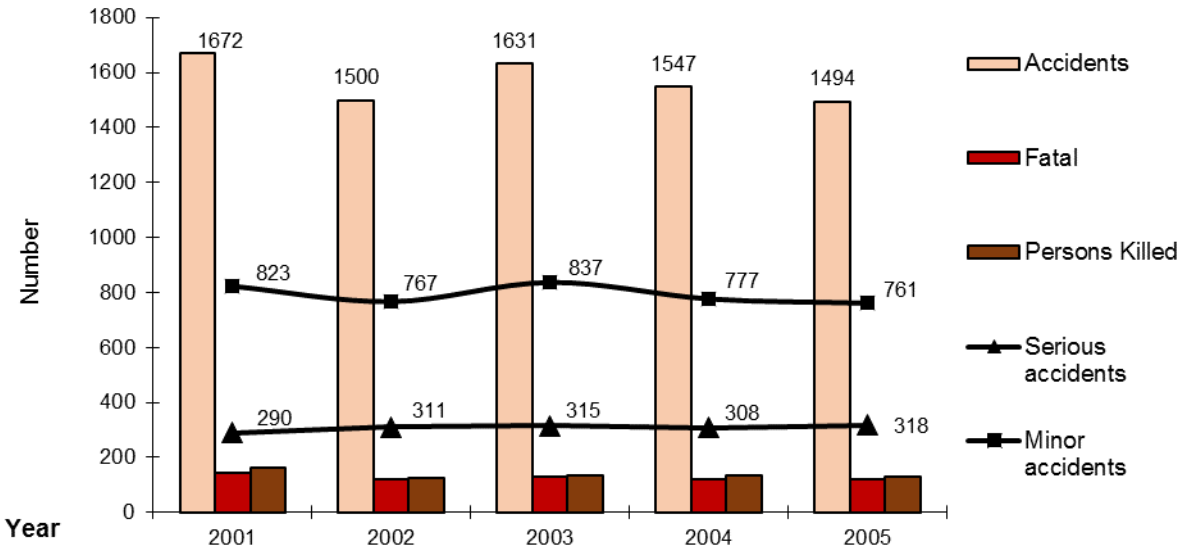


Exhibit 2.11: Road accidents of Vadodara, 2001-2005

Source: Integrated Public Transit System, Vadodara 2007

2.2. Readiness of Vadodara for PBS

2.2.1. Critical Issues in Vadodara

After studying the baseline characteristics of Vadodara thorough city travel characteristics, three key issues related to urban transportation were evident. These issues must be addressed on a priority basis while planning any new transportation system in the city, in order to ensure successful implementation of a PBS system.

ISSUE 1 – Lack of efficient public transportation within the city limits: The existing intra-city modal share for the public bus service, VTCOS was 6% in 2012. Low frequency and irregular service pushes people to use rickshaws and 2 wheelers, especially for short trips (1-3 km) in the city. These semi/private modes account for 50% of all trips in the city. Integration of PBS with an efficient transit system is being adopted by cities worldwide to extend the reach of transit by providing a first- and last-mile transportation solution or filling the gap in transit underserved areas.

ISSUE 2 – Infrastructure Constraints: Vehicle ownership continues to rise in Vadodara with an increase in registered vehicles of 7.6% p.a. in the last 10 years. While road capacities have not increased with the same pace, this implies the number of vehicles being added to Vadodara's road network may surpass its capacity. Bicycles provide great space efficiency, and are considered the most sustainable alternative to conventional modes of travel, especially for compact cities like Vadodara.

ISSUE 3 – Increasing pollution levels: Increase in vehicular ownership threatens to increase the pollution levels in the city. As bicycling is synonymous to being eco-friendly, a well-planned PBS system can make Vadodara safer from an environmental perspective.

2.2.2. Opportunities in Vadodara

There are several reasons why a safe, efficient and cost-effective transportation system would be successful in Vadodara. Two main opportunities for the potential success of a PBS system include:

OPPORTUNITY 1 – Compact node of activity generators: This offers the biggest opportunity for a PBS system as both the origins and destinations are within comfortable bicycling distances, especially for the younger demographic (15-44 years) who are most likely to use this mode.

OPPORTUNITY 2 – Proposed BRTS: If implemented, the PBS system can work in tandem with the proposed BRTS lines to provide last mile connectivity to the users.

2.2.3. Benefits of a PBS System over Bicycle Renting

While the viability of the bicycle as an alternative mode is established through the discussion above, the benefits of a PBS system over a bicycle rental system are provided below:

BENEFIT 1 - Serves short trips: Vadodara is an old city with a compact centre. The high concentration of employment, institutional, and service-oriented uses within 5km distances suggests a high number of short trips for errands and other purposes, which can be well served by a PBS system.

BENEFIT 2 - More trips can be served: A PBS system will allow a higher concentration of bicycle stations within a constrained geographic boundary. Since a PBS system will allow users to rent cycles for short durations, it will also allow more potential users per bicycle and more trips can be converted to bicycle trips.

BENEFIT 3 - Bicycle security: The lack of safe bicycle parking is a deterrent to using a bicycle regularly. Since PBS will do away with the need for bicycle parking, more people will be encouraged to cycle.

2.3. Creating a Shared Vision and Setting Goals

The 2012 Comprehensive Mobility Plan (CMP) of Vadodara defined a vision statement for this rapidly growing medium sized city which is likely to attain metropolitan status in a couple of decades. The vision is to *"change the transport and land use development in a manner that they become economically viable, efficient, socially equitable and environmentally progressive to facilitates mobility for the city."*

Goals envisaged by the CMP, Vadodara 2012 include:

- Reduced level of motorised travel,
- Less dependence on personal transport,
- Improved public transport accessibility for socially excluded segments of society,
- Develop a technologically efficient and competitive public transport system that offers alternate options to personal modes for a wide variety of trip purpose

'MAKING VADODARA A VIBRANT CITY THROUGH ECONOMIC SUSTAINABILITY AND HIGHEST STANDARDS OF SERVICE DELIVERY IN THE COUNTRY'

- City Development Plan, Vadodara

TO DEVELOP SUSTAINABLE URBAN TRANSPORT SYSTEM AND CATER TO THE COMPLEX DEMOGRAPHY CULTURE & LAND USE TRANSFORMATIONS' MOBILITY NEED.

- Comprehensive Mobility Plan of Vadodara, 2012

'TO PROVIDE APPROPRIATE SOLUTION FOR INTEGRATED PUBLIC TRANSIT SYSTEM CONSIDERING SOCIO-ECONOMIC CONDITIONS, TECHNICAL CAPABILITY, INSTITUTIONAL SYSTEMS AND FINANCIAL CONDITIONS.'

- Integrated Public Transit System, 2007

Exhibit 2.12: Visions excerpts from Vadodara's existing plans

The vision statement and objectives stated in the CMP clearly establish Vadodara City administration's commitment is to foster sustainable transportation through high quality Public Transport and NMT facilities. PBS can play an important role in influencing mode choice and thereby contributing to sustainable mobility. A bicycle sharing system will lead to increase in the demand for high quality NMT infrastructure and help promote walking and cycling in the city. A well connected bicycle network will not only improve accessibility, but also increase the catchment of public transport by offering sustainable choices for the first and last mile. A good PBS system can help shift more people from private motorised modes to public transport and bicycles.

Aligned with the CMP, the Vision for the PBS system for Vadodara can be to **"Reduce dependence on motorised modes of transit, by creating safe and easy access to shared bicycle systems, as a sustainable travel alternative to motorised short trips."** Objectives that are required to achieve this PBS Vision are:

- Create awareness about the advantages of cycling.
- Create bicycle supportive infrastructure.
- Increase public transit connectivity by offering a cheap and sustainable mode of access from farther distances to and from transit stations.
- Provide the convenience of a bicycle being available within a 2-3 minute walking distance from anywhere within the PBS zones by planning high density of PBS stations.
- Reduce pollution levels to acceptable limits by promoting sustainable transport principles for daily commuting needs.
- Make PBS an integral part of all transport & urban planning related projects and policies.

2.4. Setting Goals

Vadodara can set goals to be achieved through the implementation of a PBS. Suggested goals include:

- Increase bicycling modal share over the next 5 years by 5%.
- Provide safe bicycling physical infrastructure across the city within 5-10 years.
- Ensure first and last mile connectivity to upcoming BRTS and existing activity nodes through PBS.

A detailed baseline assessment has to be conducted to fine tune and establish the facts which need to be monitored on an annual basis. Such periodic assessment would help to judge the implementation standard of a PBS system.

2.5. Institutional Support, Plan and Policies

Although there are opportunities for PBS implementation in Vadodara, they would have to be backed by institutional support and budgets for implementation. The absence of these can constrain the implementation of a successful PBS system. The various agencies involved in the implementation are shown below in Exhibit 2.13.

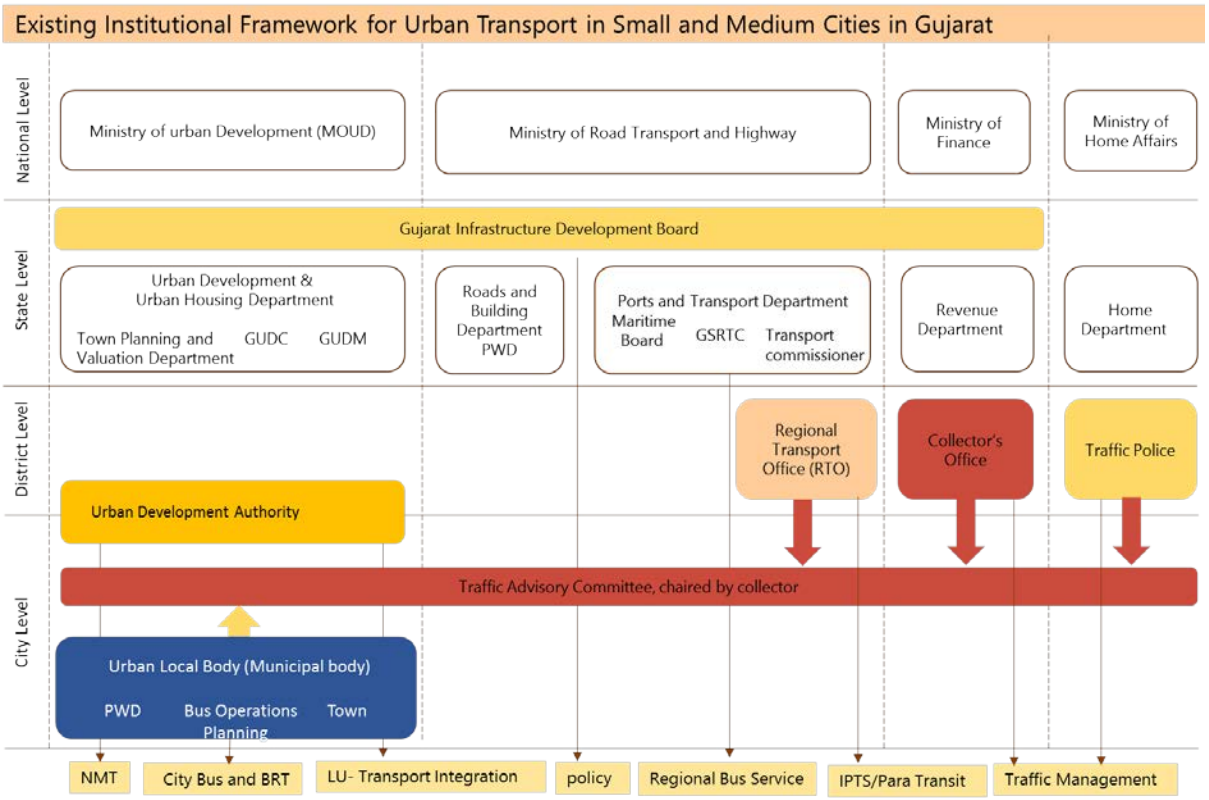


Exhibit 2.13: Existing institutional framework for urban transport in small and medium cities in Gujarat

Source: UMC 2013

Functions performed by the city's municipal body, the Vadodara Mahanagar Seva Sadan (VMSS) include prescribing and enforcing building regulations, safeguarding public land from encroachments, maintaining public safety, building infrastructure and amenities, constructing and maintaining city roads and preparing town plans. Besides these functions, the municipality shoulders responsibility for economic development, social justice, urban poverty alleviation and the promotion of art and culture in the city. The city government reports to the State – Urban Development and Housing department which is responsible for Policy making and oversight. The institutional structure of Vadodara city, is headed by the Municipal Commissioner who also functions as a team leader. The entire technical, administrative and financial staff reports to the Municipal commissioner.

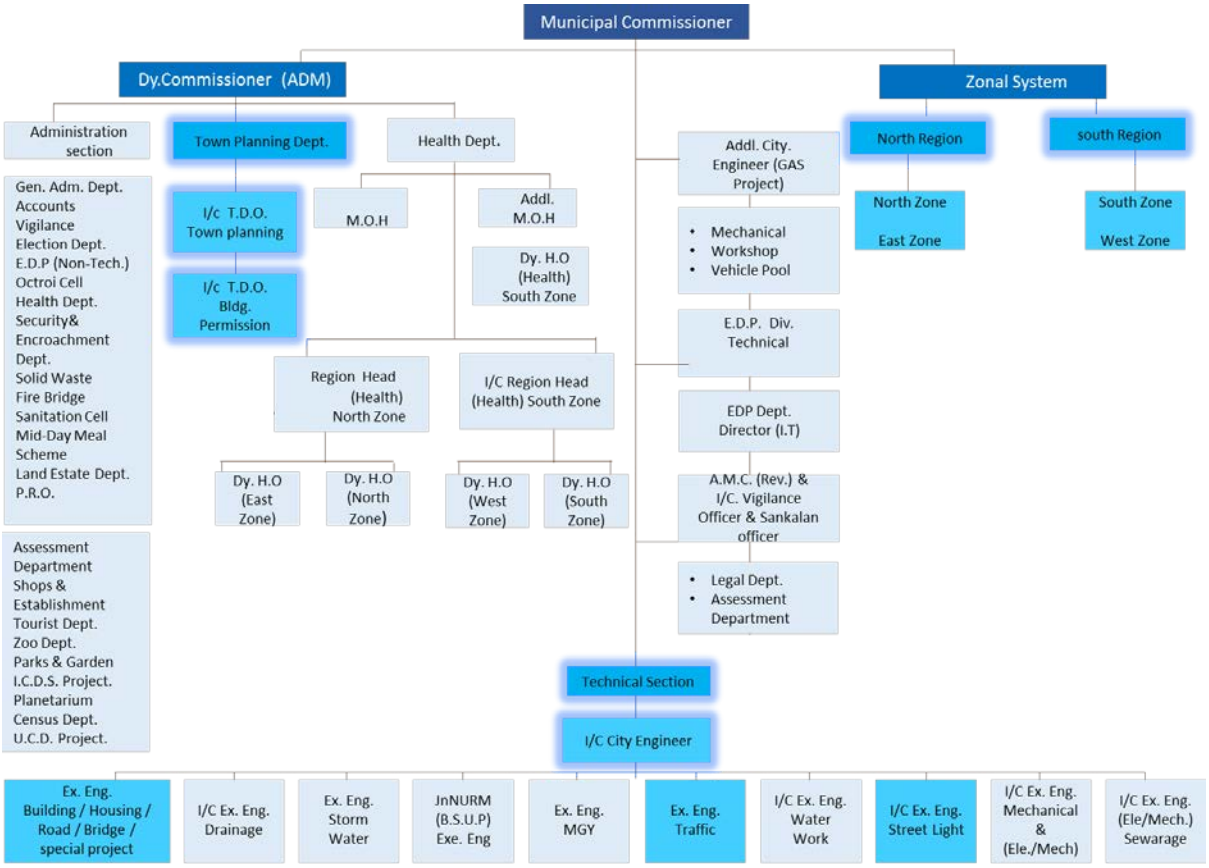


Exhibit 2.14: Institutional structure of Vadodara ULB

Source: VMSS

Currently Vadodara does not have a notified institutional support or cell for NMT, although it manages the same through the Roads or the Projects department on a case-to-case basis. Information on city's institutional support was gathered in cooperation with the nodal officer in VMSS. (Refer Exhibit 2.14)

Exhibit 2.15: Assessing institutional support in Vadodara in consultation with VMSS

Parameters	Remarks
Is there any existing administrative structure for sustainable transport or NMT in VMSS	No
Is there any existing administrative structure for sustainable transport or NMT in VUDA	No
Any talk/ seminar/ proposal of program related to NMT/ ST in VMSS or VUDA	No

Source: CGM 2015

However, city/ national level plans and policies have been adopted by the municipality that may influence the implementation of a bicycle share program in Vadodara. These are further discussed below.

1) National Urban Transport Policy, 2006; Prepared by MoUD
2) City Development Plan (CDP), Prepared by CRISIL for VMSS
3) Comprehensive Mobility Plan (CMP) 2012, Prepared by SREI for VMSS
4) Integrated Public Transit System (IPTS) 2007 prepared by VMSS survey by RITES

NUTP 2006 has elaborated on the importance of NMT, safety issues for walk and cycle. It has also mentioned that the government of India would support;

(i) Construction of safe pedestrian crossings at busy intersections and high density traffic corridors.

(ii) Formulation and implementation of specific "Area Plans" in congested urban areas that propose appropriate mix of various modes of transport including exclusive zones for NMT.

The **City Development Plan (CDP),** Vadodara, 2005 included the 'City Investment plan and Financial strategies' for roads, bridges and flyovers. Wherein there is mention of taking care of city's traffic condition and has proposal of allocating INR 396 crores over 6 years' time period (2006-12). CDP has also mentioned city's need and requirement of road widening, construction of new bridges, rails, underpasses as solution to cater rising traffic[9]. However, there was no mention of NMT infrastructure as a separate strategy in the CDP.

The **Comprehensive Mobility Plan (CMP)** prepared in 2012, envisioned developing a sustainable urban transport system for the city. The document has detailed surveys and findings on the city's mobility pattern and characteristics. It also has proposals for developing a 'Transport Development Fund', allocating budgets for projects and establishing a 'Traffic Engineering and Management cell' to strengthen the institutional setup. Some of the projects proposed to improve the city's mobility include; design and construction of NMV lanes, construction of BRTS system, improvement of city bus service, construction of pedestrian facilities and foot over bridges, construction of parking complexes, intersection improvement, construction of an intercity bus terminal, construction of flyovers and road widening. (Detail of proposed projects is provided in Appendix – D).

CMP also proposed to construct exclusive bicycle tracks 2 -4m wide each on either side of sidewalks (depending upon demand) on several roads (list of constructed and proposed roads given in Appendix – E and Appendix – F respectively). The CMP also mentions that the cycle tracks must be discontinued 30 m before the approaches on all junctions to allow for safe merger and movement across the road intersections.

Integrated Public Transit System (IPTS), 2007 envisioned providing public transit systems that caters to different socio-economic groups. The document proposes to improve public transportation, by refining the bus service and introducing a BRT system. The report also recommended creation of 'Unified Metropolitan Transport Authority' (UMTA).

VMSS has also commissioned a Detailed Project Report (DPR) on the Bus Rapid Transit System (BRTS) for Vadodara for which implementation is yet to happen. Besides, the city has worked on improving the intersection design of Harni Road and Vasna Road. (More detail on projects done on road and bridges is provided in the Appendix – E).

2.5.1. In-house Technical Capacity

The in-house technical capacity was assessed with assistance from VMSS. Currently, the technical staff of VMSS are not trained to work with issues of Non-motorised Transport or any other sustainable transport system. It was revealed that though the authorities have no relevant training on NMT, they are aware of PBS systems and its needs and requirements for the city of Vadodara.

The city lacks an institutional setup to undertake focused NMT planning and projects. The technical capacities of the staff need enhancement through focussed training and capacity building programs and involvement of experts in the field.

[9] *CDP Vadodara 2005, page 8-86*

Exhibit 2.16: Potential VMSS staff whose capacity can be built through a pilot program.

Sl.no.	Personnel/ Designation	Education and formal training/ specialist	Experience in transportation field	Exposure to NMT or ST projects/ programs	Knowledge about cycle sharing
1	Town Planner	-	-	-	-
2	Exec. Engineer Special Projects	B. Civil Special Training in road engineering	Several road project within Vadodara	Yes. Attended South Korea to study their NMT system	Yes
3	Exec. Engineer Traffic	Training in traffic and management	Involved in Traffic Management with Traffic Police of Vadodara.	No	Yes
4	Exec. Engineer Street Light	B. Electrical	Involved in street electrical work at city level	No	No

Source: CGM 2015

2.6. Budget Availability

Vadodara Mahanagar Seva Sadan allocates 7.5% of its budget for construction of new roads, footpath, bridges and maintenance & repairs of road and transport related infrastructure (such as traffic signage, paving, and encroachment removal). Of the total money allocated for road and its infrastructural development 5-6% is for new construction and remaining 94%-95% is for maintenance and repairs. Exhibit 2.17 and Exhibit 2.18 show a comparative analysis of the city's budget in 2011 and 2012. The city has primarily three sources of revenue: 1) Revenue from Property Tax, 2) Revenue from; and 3) Development Tax and Grants from State Government. The revenue collected is put to develop and maintain public infrastructure, public health, welfare, regulatory functions, public safety, and development activities. (Source: Municipal Budget, VMSS 2011-13)

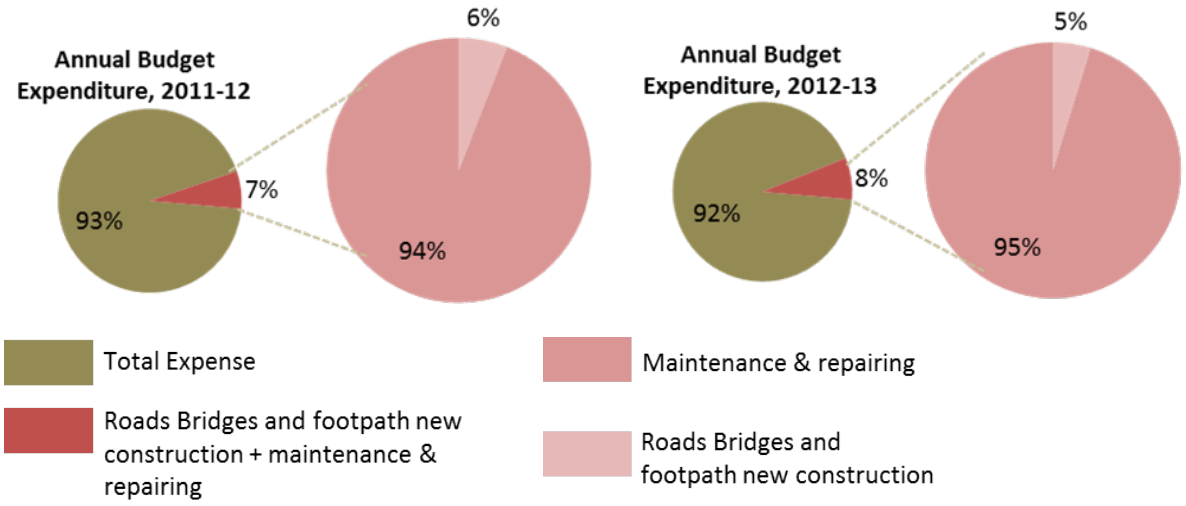


Exhibit 2.17: Percentage share in construction and repairing of road bridge footpath

Source: Vadodara municipal budget

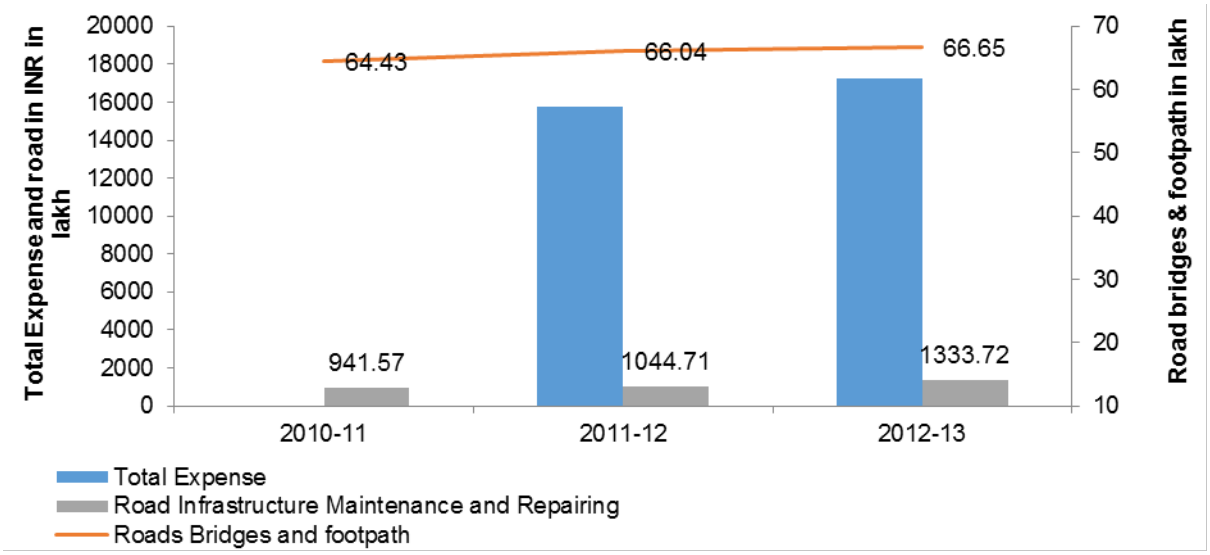


Exhibit 2.18: Trend of revenue allocation for transport

Source: Vadodara municipal budget

2.7. Stakeholders Interactions

As a part of developing the City Specific Plan for Vadodara PBS system, extensive stakeholder consultations and interactions were carried out to streamline and consolidate the thought process on how to plan and implement the most beneficial PBS system. These interactions were focussed to establish some facts as to where the PBS has to be planned, scope, size and funding availability for implementing the PBS system. This section briefs the opinions shared by each stakeholder during the interactions.

Exhibit 2.19: Stakeholders of Vadodara PBS

Sr. No.	Stakeholder	Current Role
City Government		
1.	Vadodara Mahanagar Seva Sadan	The VMSS is the elected governance body in Vadodara. The main duties of VMSS include building regulations, safeguarding public land from encroachments, maintaining public safety, building infrastructure and amenities, constructing and maintaining city roads and preparing town plans
2.	Vadodara Urban Development Authority	Is the urban planning agency for the Municipal corporation and adjoining 98 villages of Vadodara, Vaghodia and padra taluka
3.	Kamati Baug Welfare Association	Trust that is responsible for maintenance of Kamati Baug
5.	Vadodara Traffic Police	Enforces traffic rules and regulations in Vadodara
Academic Institutions		
6.	M. S. University	Vadodara's premier education institute
Civil Society		
7.	Centre for Green Mobility (NGO)	Is an NGO dedicated to providing sustainable & innovative solutions for mobility that help in achieving better liveable environments

Sr. No.	Stakeholder	Current Role
8.	Cyclone Cycling Club	Are groups of cycling enthusiasts that organise cycling trips in and around Vadodara
9.	Baroda Cyclist Club	

Source: CGM 2015

2.7.1. Vadodara Mahanagar Seva Sadan

The Vadodara Mahanagar Seva Sadan expressed the need to implement the PBS system over a controlled pilot area, before implementing it to a city wide scale. The controlled pilot study would help the city learn about implementation of a PBS system before scaling up the initiative. They suggested that the first phase of the project be carried out around the MS University campus as a pilot. The initial coverage area under pilot implementation went through multiple iterations, starting from an initial study area of 2.9 sq km to 10 sq km finally. The Corporation has agreed to set aside a budget of 4-5 crores for the project and hopes that the project implementation receives some patronage from the University as well. An Expression of Interest was floated for the pilot project in March 2016 for an initial coverage area of 6 sq km. The Land and Estate department at the Corporation expressed the need to develop a fee structure for advertising at the docking stations. This could add to the revenue pool for the project.

2.7.2. Maharaja Sayajirao University (MSU): Architecture Faculty and Students

MS University is willing to support PBS initiative in Vadodara. The architecture college has shown special interest in the initiative by offering student design services for the hardware components like docking stations and branding exercises. They have also agreed to provide space for a docking station in front of the college.

Students and faculty members from the University have suggested that a smaller system with 120-150 cycles could be a safe starting point for the project. They have requested that the PBS system be supported with infrastructure like changing rooms/showering facilities. Such facilities could be either provided by the government under the plan or by the University by increasing the area of the rest rooms around docking stations. Students emphasised the need to shade the street for environmental comfort, especially for biking during summer months. Students demanded that the docking stations be placed near the hostels from where they often walk to their colleges.

2.7.3. Kamati Baug Welfare Association

There currently exists a bicycle share program that operates successfully in Kamati Baug. The Association wishes to upgrade and promote biking inside the park for recreational purposes. They hope that the PBS project could provide upgraded docking stations at the entrance and at the pause moments inside the park.

2.7.4. Traffic Police

The traffic police has whole heartedly come out in support of the PBS initiative as it would relieve the congestion on roads.

A summary of the stakeholder interactions throughout the planning stages is provided in Appendix – C. In principle, the stakeholder interaction emphasised that the PBS system should be implemented in and around the Maharaja Sayajirao University campuses, upgraded in Kamati Baug and then spread across the city in consecutive phases. Using the university campuses as a starting point, the authorities hope to showcase the PBS project and attract peoples' attention and investment. The stakeholder consultations were extremely beneficial in helping to define the initial pilot area and PBS functionality.

2.8. Initial Scale and Scope of Proposed Coverage Area

The potential area for the PBS system implementation initially has to meet the demand and the feasibility requirements to justify the PBS system for that region in all respects. Population is consistently growing in Vadodara and is expected to surpass 22 lakhs by 2021.[10] It is proposed that a PBS system be planned for the entire municipal limits of Vadodara in subsequent phases to extend the advantages of public transport throughout the city as a long-term vision for sustainable population growth. In the immediate future, a trial phase should be planned around the Maharaja Sayajirao University (MSU) campus, to introduce residents to the idea and set the stage for large scale implementation in the future.

In the year 2012, the municipal limit of Vadodara expanded from 125 sq km to 159 sq km However, trip data, crucial for planning PBS systems collected from the CMP is only available for the pre-2012 city limits. Hence, due to data limitations, the pre 2012 municipal area of 125 sq km has been considered as the study area for PBS.

2.8.1. Guiding Principles for Vadodara PBS Location Identification

The network for the PBS system will need to be refined based on certain guiding principles that are specific to Vadodara. Below are the identified objectives for PBS that will serve as design guidelines for detailed planning:

(i) The PBS system must help solve the basic issues that were identified in Vadodara viz. lack of alternative mobility options, unchecked growth of private vehicles within constrained inner city areas and increasing levels of pollution.

(ii) The PBS system must be able to build on the existing cycling culture of the city[11] and provide a viable option to captive cyclists.

(iii) The system must meet the need & expectations of the various stakeholders who have shared their thoughts from various perspectives.

(iv) The potential locations for the PBS system should be based on stakeholders' local experience and their assessment of demand.

(v) The system must be planned near activity zones where the major bottlenecks exist in terms of the daily transportation needs of people.

[10] *As per Vadodara BRT DPR 2013*

[11] *As per the 2012 CMP 19% of the city uses cycles as a means of public transit*

CHAPTER III: ENABLE

3. ENABLE

The “Enable’ step focuses on proactive tasks that will help build commitment to the project at the conception stages, ensuring success during implementation. These tasks are initiated early-on in the process and must continue throughout the course of the project.

3.1. Establish Leadership Support

VMSS is recommended as the agency to spearhead the implementation of the PBS Plan. However, for successful implementation, gaining support from political leadership will be critical. The Plan recommends establishing a Technical Assistance Committee (TAC), consisting of city leadership, technical staff and key stakeholders. The TAC shall help in:

- Identifying land for locating PBS stations,
- Facilitating public outreach and awareness for the PBS scheme,
- Developing partnership with private entities for funding opportunities,
- Reaching out to local vendors for creating local economic development opportunities.

The TAC may also provide VMSS with the necessary technical support by reviewing the project at important stages of implementation.

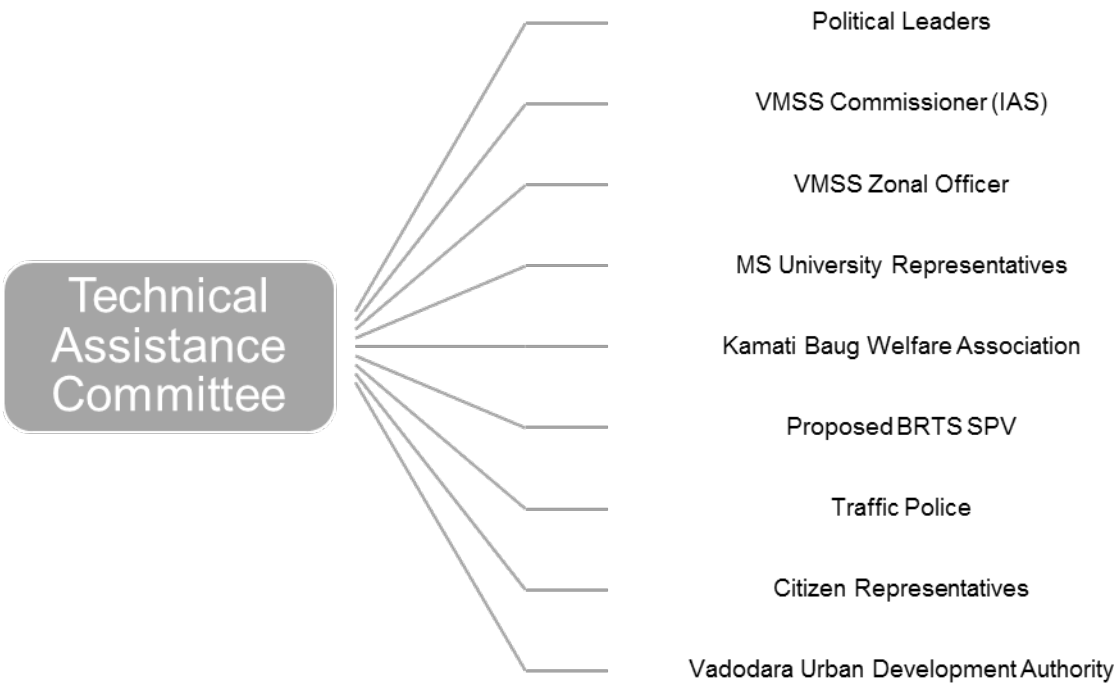


Exhibit 3.1: PBS Technical Assistance Committee (TAC)
Source: CGM 2015

3.2. Building Technical Expertise and Issue Awareness

Currently employees of VMSS have no formal training on design and management of NMT or PBS systems. Further, lack of PBS systems in the country makes it difficult to anticipate the kinds of problems a municipality will have to face while implementing the system[12]. The VMSS will have an opportunity to learn from the experiences of the pilot phase. To assist with this process, VMSS should

[12] *Although Vadodara has a functioning PBS system working inside Kamatibaug its limited in scale and bounded. This is very different from implementing a PBS project at a city scale.*

hire a Project Management Consultancy (PMC). The PMC's primary role will be to handhold the municipality through the design, building, operations and transfer (DBOT) of the PBS project. The PMC's scope of work may include drafting the necessary contracts, hiring a DBOT contractor to implement the project, offer transaction advisory services and possibly conduct monitoring and evaluation (M&E) of the system post-implementation. Ideally, the M& E consultants should be different from the PMC to avoid any conflict of interest during the evaluation process.

3.2.1. Create Awareness and Enable Public Participation

The bicycle is a popular mode of travel in Vadodara. Although the willingness to cycle helps in implementing a PBS system, it does not assure its success. VMSS should continue with its plan to implement a PBS project on a pilot scale, in an area where success is assured, and use it to promote PBS activities in other parts of the city. In addition, to create a modal shift from motorised means to PBS, it must be branded as a healthy lifestyle choice. VMSS will have to work with agencies that can help in branding and advertising the PBS system through print and other media. The involvement of MSU students in awareness and outreach efforts will help in changing the perception of cycling in the city.

Once PBS is implemented at a large scale, a push to use the system can be created through supporting initiatives such as Raahgiri and car free days. Once the PBS system is sustained, the intensity of the outreach activities can be minimised.

During the trial phases, the PMC and M&E consultants should build onsite and web based platforms to allow the public to give feedback through surveys and opinion polls. This feedback can provide important information for monitoring and evaluating the PBS efforts in the city and help plan consequent phases.

3.2.2. Develop Partnerships for Long Term Success

The PBS system is envisioned as an integrated component of a larger transportation vision including other planned infrastructure projects. There is therefore need for continuous partnership between the implementing agencies of the PBS system, PT systems, and VMSS employees working on NMT improvements in the city, especially encouraging exchange of technical knowledge. The PBS system should support other means of public transit and not compete with them for ridership. Poaching riders can cause monetary losses to the implementing transit agencies, leading to inefficient implementation of the transit systems. The coordinated impact of PBS implementation and other infrastructure projects should be studied regularly. This will enable far reaching benefits of sustainable transportation in Vadodara.

3.3. Align PBS with Other Initiatives

One of the key elements in making a PBS system successful is to integrate PBS with other initiatives to attract citizens to use bicycles. Such initiatives should motivate people to shift to a more sustainable mode of transport. It is recommended that Vadodara set up an NMT Cell or at the very least hire a sustainable transport coordinator. This cell or coordinator would work with the PBS project management team and the Technical Assistance Committee (TAC) to identify and develop initiatives that would create support for the PBS system. The recommended strategies that would help set the stage for a PBS system in Vadodara include:

1) Establishment of NMT-only streets in educational campuses, to promote cycling within institutions. The MSU has indicated its willingness to use PBS as a catalyst to prioritise NMT within its campus.
2) Integrate planning for BRTS and PBS in Vadodara, including integrated fare management, and other commuter-friendly services.
3) Employee credits for NMT users, in the form of bonuses or other incentives. This would help build a culture of cycling to work.
4) Events such as cyclothons help people who have not cycled for years to get back on a bicycle.

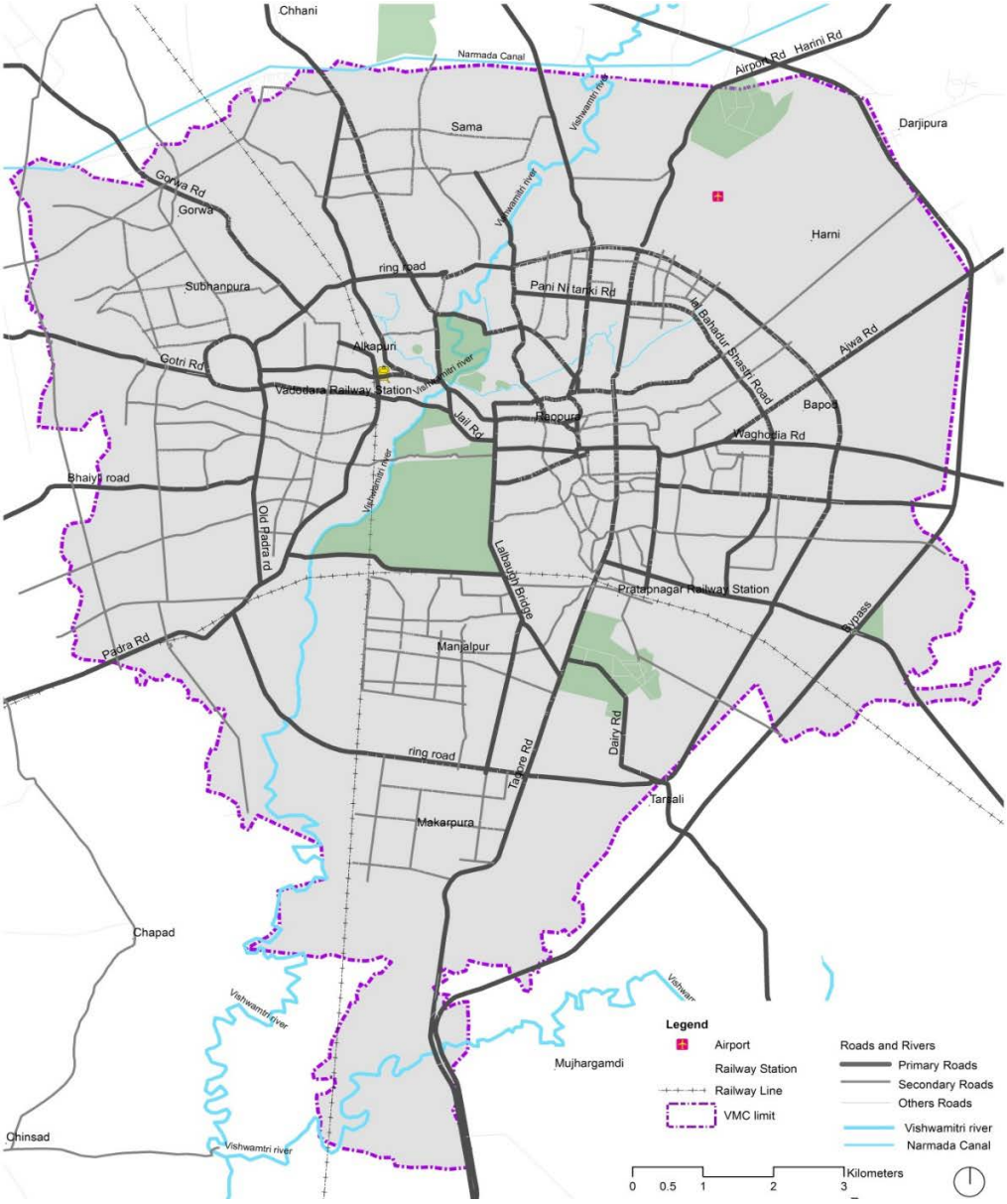
CHAPTER IV: PLAN + DESIGN

4. PLAN + DESIGN

The Plan + Design Chapter contains a series of proposals related to implementing PBS components built upon the proposed PBS network which evolved through the exercise undertaken in the Assess Chapter. This chapter presents recommendations for providing stations at an appropriate spacing so users can easily access bicycles; ensuring that the system is not too small to be effective; and identifying an appropriate dock-to-bicycle ratio to balance capital and rebalancing costs. It also includes proposals to determine the station locations and type of PBS technology.

4.1. PBS System Phasing

The PBS system for Vadodara is detailed based on the baseline characteristics of the city and stakeholder preferences. This section finalises the spread and extent of the PBS system for the city. The PBS system follows a systematic phasing approach by implementing along potential corridors first and then building upon them in a phased manner to achieve the city level PBS system network in the long term.



Map 4.1: Study area for Vadodara PBS

Source: CGM 2015

4.1.1. Criteria for Phasing

Splitting the overall delineated study area into various phases for PBS implementation is a task which involves several considerations beyond just technical or financial reasons. The selected Phase I especially, should have a huge potential for a PBS system, which can pave way for the subsequent phases by showcasing success. Certain criteria to phase the project have been considered as under:

1. Potential to complement the existing transit network
2. Potential to connect major attraction and production nodes
3. Availability or ease in creating safe infrastructure to support the system
4. Potential for the system functioning to be tested efficiently and streamlined accordingly
5. Driven by potential demand expectations
6. Availability of land for the core PBS Stations and the distributed PBS Stations

4.1.2. Proposed Phasing:

Vadodara's proposed PBS system has been divided into three phases based on desired timeline for implementation – short term, mid-term, and long-term. To delineate the phases, population, land use, road network, PT stops & routes, IPT stops & routes and traffic generating activity map were overlaid and the potential areas that overlap, with maximum production and attraction of trips possible, were considered for the first phase, Phase II included areas with the high potential of growth and phase III included rest of the city to ensure PBS network for the whole study area.

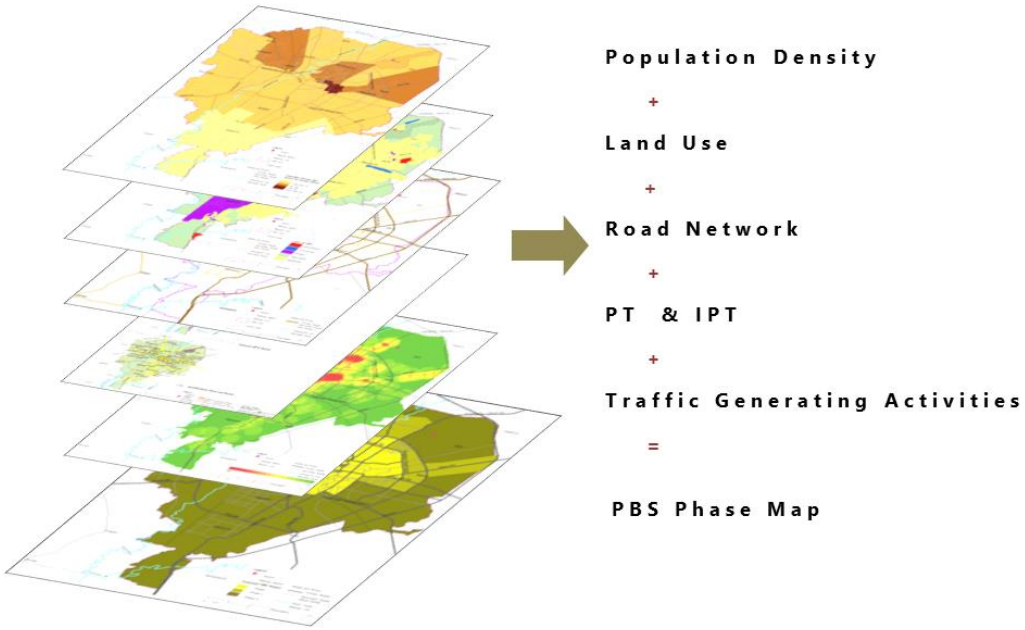


Exhibit 4.1: Phasing methodology, Vadodara PBS

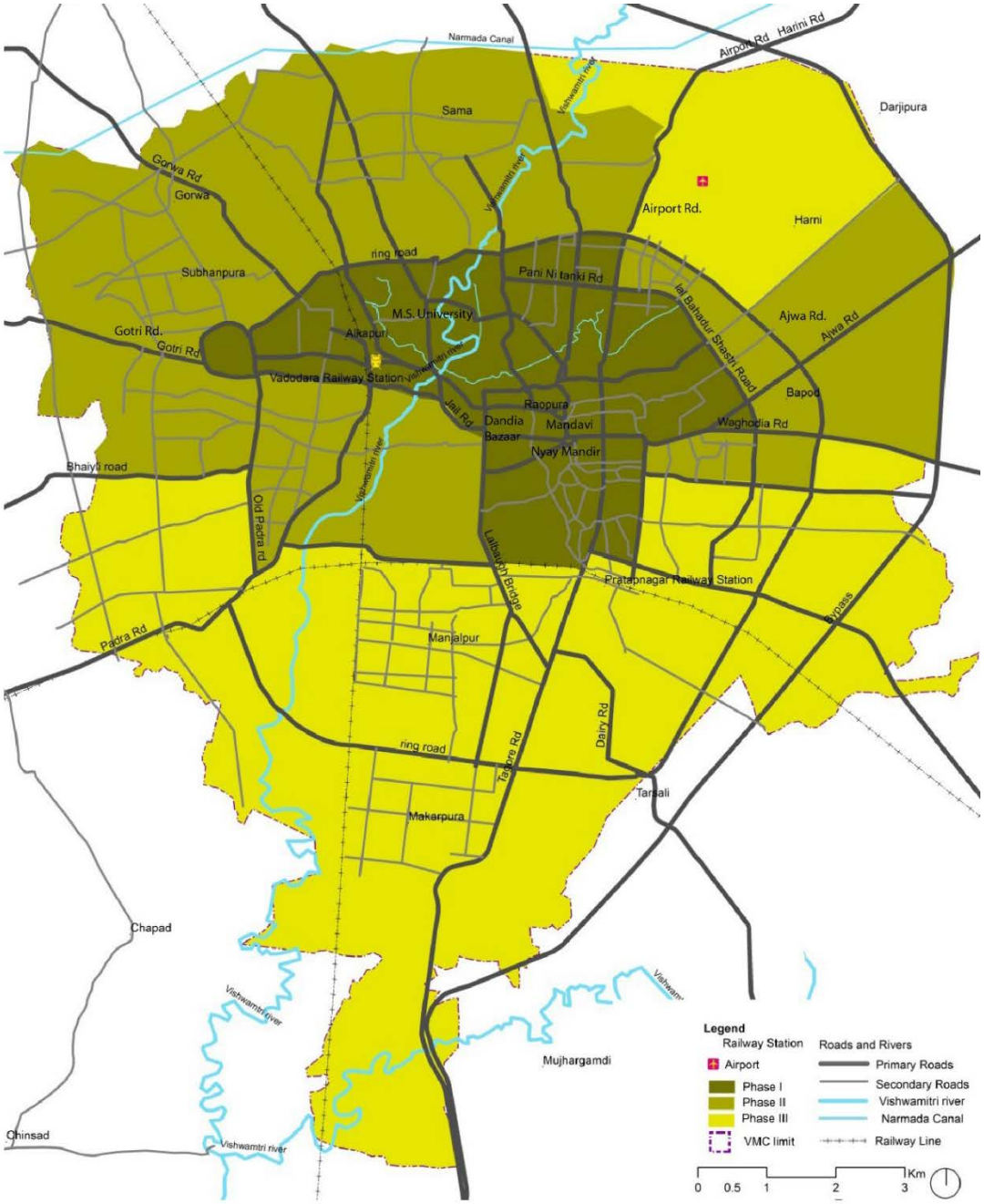
Source: IBI Group

Vadodar's proposed PBS system can be divided into three phases. Phase I is the inner city region which historically has had the highest number of activity areas and a high population density. Phase II includes areas with high potential for growth, mainly the industrial areas in the city and Phase III includes the rest of study area to ensure denser PBS network coverage.

Exhibit 4.2: PBS phasing

	PHASE I Has potential to create maximum PBS trips Areas: **Raopura, Mandvi, Nyay Mandir, Dandia Bazaar, Railway station, M.S University area**	**PHASE II** Include areas with high growth potential Areas: **Ajwa Road, Gorti Road, Airport Road**	**PHASE III** expands geographical limit, Include areas with growth potential Areas: **Makarpura, Dairy Road**
POPULATION DENSITY (Map 2.2)	**High population density**. Largely covering areas with more than and equal to 300ppha	**Moderate population density**. Largely covering areas with more than or equal to 150-300ppha	**Moderate to Low population density.** Largely covering areas with less than 70ppha to 150ppha
LAND USE (Map 2.3)	Includes **residential population, major administrative offices** like- VMSS building, Main office of traffic police, Survey office, post office, **commercial areas, market places, recreational places, educational institutes**	Includes largely **residential areas** and **some industrial areas**. Residential growth is observed along the major roads of Gorti, Ajwa and Airport	Includes **mostly industrial area** and sparsely populated **residential areas**
ROAD NETWORK (Map 2.4)	Includes the **Ring Road, Pani ni Tanki Road**,**other arterial roads** along railway station and within the old city –Raopura, Nyaymandir, Khanderao Market, Dandi bazaar	The **major arterials** – Ajwa Road, Gotri Road, Airport road that are **radiating from the city centre** and is observing development along the corridors	**Other arterial roads** that connects the northern city with southern part. The old Padra Road, GIDC road, Baroda Dairy Road,
TRAFFIC GENERATING ACTIVITY (Map 2.5, Map 2.6, Map 2.7, Map 2.8)	**Dense** number of **PT and IPT** stops. **Existing railway station, bus intercity terminal** **High density** of commercial, recreational, public, religious places and schools colleges & other institutions Includes kamatibaug Sayaji garden	**Moderate number of PT and IPT stops** **Moderate density** of commercial, recreational, public, religious places and schools colleges & other institutions	**Sparse number of PT and IPT stops** **Low density** of commercial, religious places and moderate schools colleges & other institutions Also, Includes Pratapnagar railway station and Viswamitri Railway station
PT & IPT (Map 2.9, Map 2.11)	Existing PT and IPT service available **High demand of ridership** Includes the proposed phase I BRTS network	Existing PT and IPT service available **Moderate demand of ridership** Includes part of proposed phase I BRTS network	Existing PT and IPT service available **Low demand of ridership** Includes proposed Phase I and II BRTS network

Source: CGM 2015



Map 4.2: PBS phase map for Vadodara

Source: CGM 2015

The preliminary distribution of PBS stations across the phases to maintain a density of 10 stations per sq km[13] is shown below:

Exhibit 4.3: Preliminary PBS system coverage of all the phases under PBS implementation

S.No	Phase	Coverage Area (Sq.km)	No of Stations
1	1	17.8	178
3	2	45.1	451
4	3	62.1	621
Total		**125**	**1250**

[13] *As per the PBS Guidance Document*

4.2. Data Analysis and Demand Assessment

This section explains how demand analysis for bicycles, docks and stations in a PBS system has been undertaken from the available data sources. While this is a data driven examination, the final recommendation for system launch and phasing will take into account the suggestions and concerns of the Urban Local Body (ULB) and stakeholders (discussed in Chapter 2).

The calculation of potential demand is based on the two approaches as detailed in this section.

Approach 1 – Minimum Station Density: The first approach uses the optimum station density as the primary parameter for determining system size. This approach is intended to ensure a network coverage and density that increases the viability of using the system. A system with sparsely located stations are not likely to be used for short-distance trips. To use this approach however, one must be assured of system patronage because of the presence of the following factors:

- A population density over 200 persons per hectare[14]
- A mix of residential, commercial and institutional uses
- A high proportion of young floating population (in the age group of 15 to 45 years)

Since the area identified under Phase I has all of the above features, this approach is considered as the primary method of demand estimation. Future phases are also planned with this method assuming that population densities will increase over time.

The calculations are based on the guidelines mentioned in the PBS Guidance Documents as shown in the Exhibit 4.4 and Exhibit 4.5:

Exhibit 4.4: PBS guidelines as per guidance document

S. No	Guidelines as per Guidance Document (GD)	
1	10 to 15 stations per square km of PBS influence area	
2	Number of bicycles in Small Stations	10
3	Number of bicycles in Medium Stations	20
4	Number of bicycles in Large Stations	40

Exhibit 4.5: Approach 1 - PBS system size estimation

S.No	Phase	Coverage Area (Sq.km)	No of Stations	No of Bicycles
1	1	17.8	178	1800
3	2	45.1	451	4500
4	3	62.1	621	6200
Total		**125**	**1250**	**12500**

* Assuming all stations are small stations, 10 bicycles per station in 178 stations result in 1800 bicycles

Approach 2 – Minimum Mode Shift: This approach is based on the modal shift estimations i.e., probability of people who are likely to shift to the new system. In a PBS system short trip makers have the highest willingness to shift. Exhibit 4.6 shows the distribution of trips - mode and distance wise in Vadodara; and highlights the distance and ranges that have the highest probability to shift to PBS over their existing mode of commuting.

[14] *Paris, which has one of the most successful PBS systems in the world has a population density of 210 persons per hectare.*

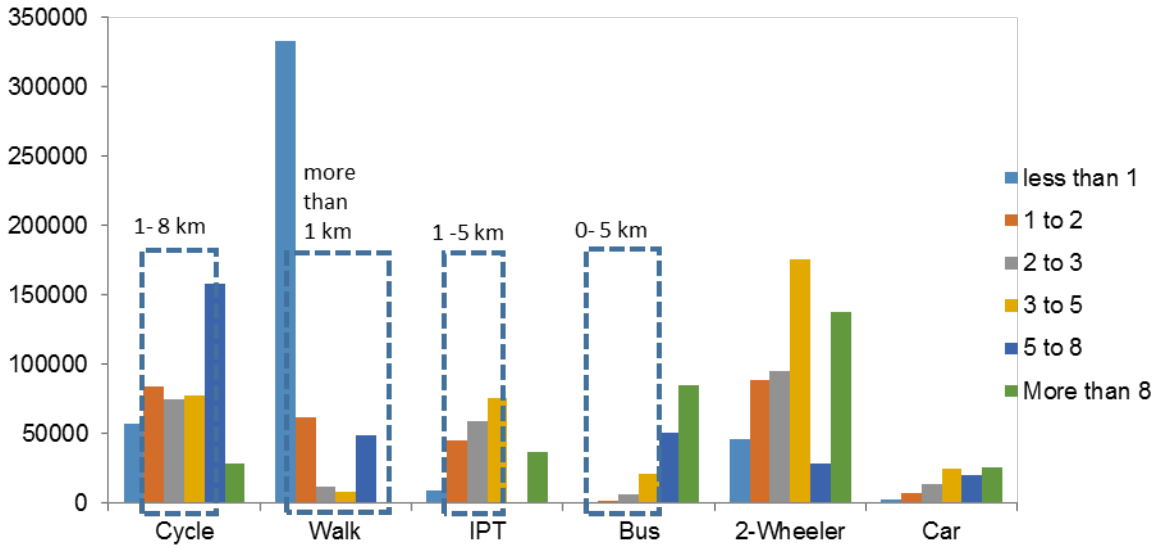


Exhibit 4.6: Trip distribution of trips based on mode and distance

Source: CGM 2015

The potential modal shift is determined using the following key assumptions:

- Pedestrians, cyclists, transit and IPT users are most likely to shift to PBS. 60%[15] of the total 20.11 lakh daily trips in Vadodara are made by walk, cycle, IPT and bus.
- Trip lengths between 1 and 5 km are most likely to shift to PBS. This has also been substantiated by a pilot willingness to shift survey that was carried out in the city. 68%[16] of the total trips are less than 5km.
- The peak demand, required to estimate required fleet size, is assumed as 10% of the total demand.

Exhibit 4.7 demonstrates how these assumptions led to the calculation of PBS demand estimates.

Exhibit 4.7: Potential PBS demand estimation

S.no	Assumption	Estimated Demand
1	Total Daily Trips	20,11,200
2	Total trips made by walk, cycle, transit and IPT (60%)	12,06,720
3	Trips from (2) that are shorter than 5km (68%)	8,20,570
4	Peak hour demand (10% of total daily trips)	82,057
5	Catering to 30% of Full Demand	24,617
6	Phase I Demand (10% of total city-wide demand)	2,462

The potential demand for PBS exceeds the required number of bicycles derived from Approach 1, which is the minimum required demand. The design factors for planning the first phase of the Vadodara PBS are primarily based on Approach 1, resulting in the proposed system design.

The demand estimations should be used only as guiding principles for designing the overall PBS System. Aspects such as practical site conditions and potential demand based on perceptions of people would play a major role in defining the scale and size of the larger system. The number of bicycles here are calculated purely assuming that all the stations are small sized stations. Based on the actual site survey and conditions the exact station sizing and number of such stations (small, medium and large) shall be identified and the bicycles would be recalculated. However, the minimum number of bicycles which is 1,800 will have to be provided as per the approach.

[15] *CMP Vadodara, 2012*

[16] *CMP Vadodara, 2012*

Another important consideration while designing the PBS System for the city should be the accessibility of bicycle and PBS Stations to the potential users, which would impact the acceptance of the system largely. To address this, the station density should be such that a bicycle is available at all potential origins and destinations across Vadodara and enough bicycles are present based on the area under PBS such that potential users need not walk for more than 4 to 5 minutes in search of a PBS Station anywhere in coverage area.

4.3. Determining Station Location and Size for Phase I

Bicycle stations should be placed in safe, accessible and visible locations. Ideally, stations should be placed in close proximity to bicycling infrastructure (ex. bicycle lanes, shared use paths, etc.) to increase connectivity to the jurisdiction's bicycle network. Stations should be roughly at uniform distance from one another. The size of a station is a function of the anticipated demand attraction of a particular area. Station's locations depend on the actual environment. A bicycle share station should be placed at on-street parking bays, on pedestrian walkways, adjacent to bus shelters and BRTS exit gates.

4.3.1. Station Location Criteria

The general rules followed in locating stations are as follows:

1. Station distance at should be between 200- 400m to ensure mostly dense and uniform coverage in high demand area. Minimum coverage includes 10 PBS stations per sq km.
2. Stations should be near mass transit stations or transit stops.
3. Stations should be located preferably near bicycle lanes/tracks, if present, or places along the street that are safe to access by bicyclists.
4. Stations are best situated on or near junctions, so that users can access and egress from multiple directions.
5. Stations should be located inside residential cores but preferably accessible from the streets.
6. Stations should be located near important public institutions or places like, school, colleges, parks, markets, commercial areas and other activity nodes.

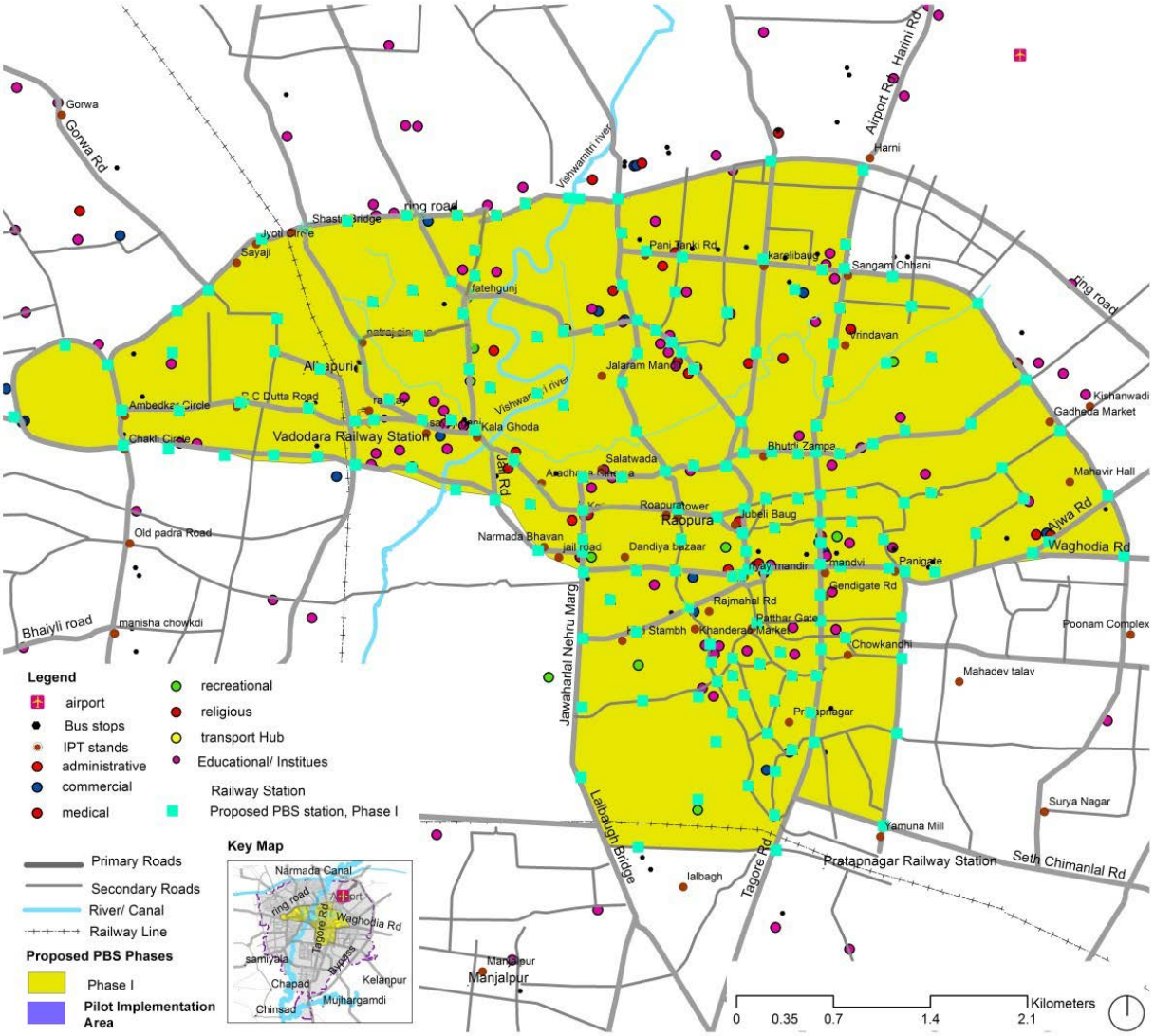
Following the above given guidelines, PBS station locations were delineated on the basis of population density, road network, transit nodes and activity map. Preliminary identification has resulted in 178 stations within the Phase I area, to maintain a density of 10 stations per sq km. The proportion of large, medium, and small stations have been developed to accommodate the required fleet size of 1800 bicycles. Large, medium and small stations are proposed to be able to accommodate 40, 20 and 10 cycles respectively[17].

The final locations of the stations will involve consultation with VMSS, public and concerned stakeholders along with ground truth verification.

Exhibit 4.8: Proposed system design for phase I, Vadodara PBS

Area	17.8sqkm
Minimum No. of Bicycles	1800
Large Station (up to 40 cycles)	40
Medium Station (up to 20 cycles)	80
Small station (up to 10 cycles)	60

[17] *PBS Guidance Document*



Map 4.3: Preliminary identification of PBS station locations for phase I

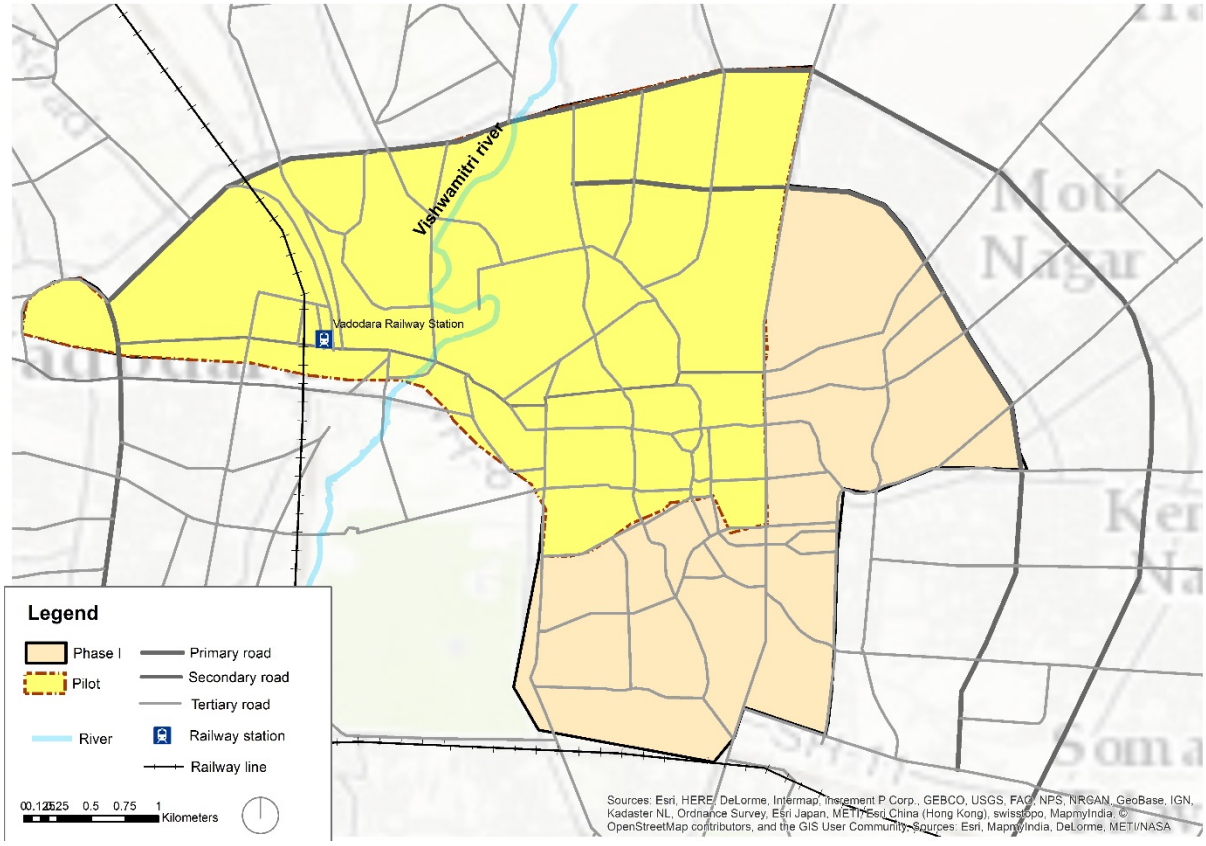
Source, CGM 2015

Exhibit 4.9: A manned PBS station located under a flyover in Ahmedabad along the BRTS route

Source: Walkability Asia

4.3.2. Pilot Implementation under Phase I

Even though the detailed plan for Phase I has been prepared, the interactions with stakeholders revealed that present budgetary constraints and lack of knowledge about PBS necessitates identifying a smaller area from the proposed Phase I for pilot implementation.

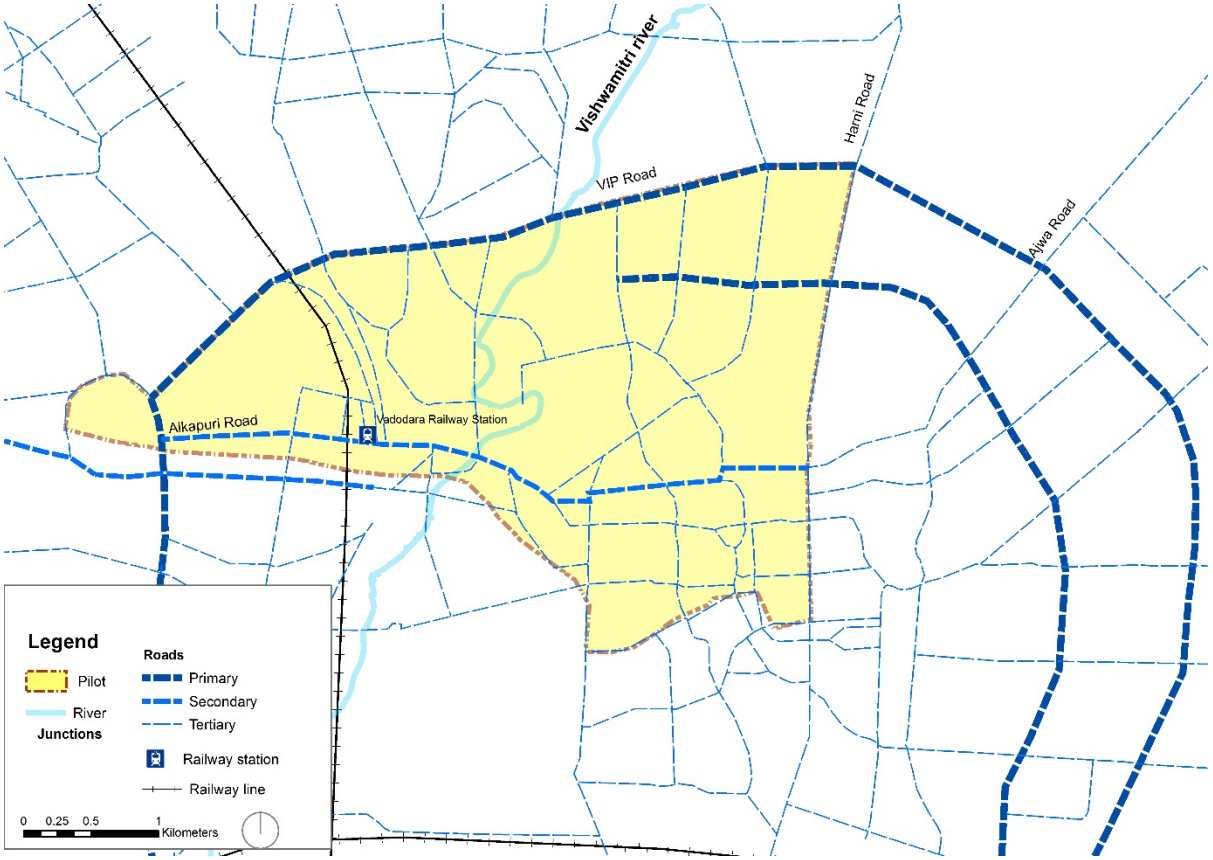


Map 4.4: Pilot in phase I

Source: CGM 2016

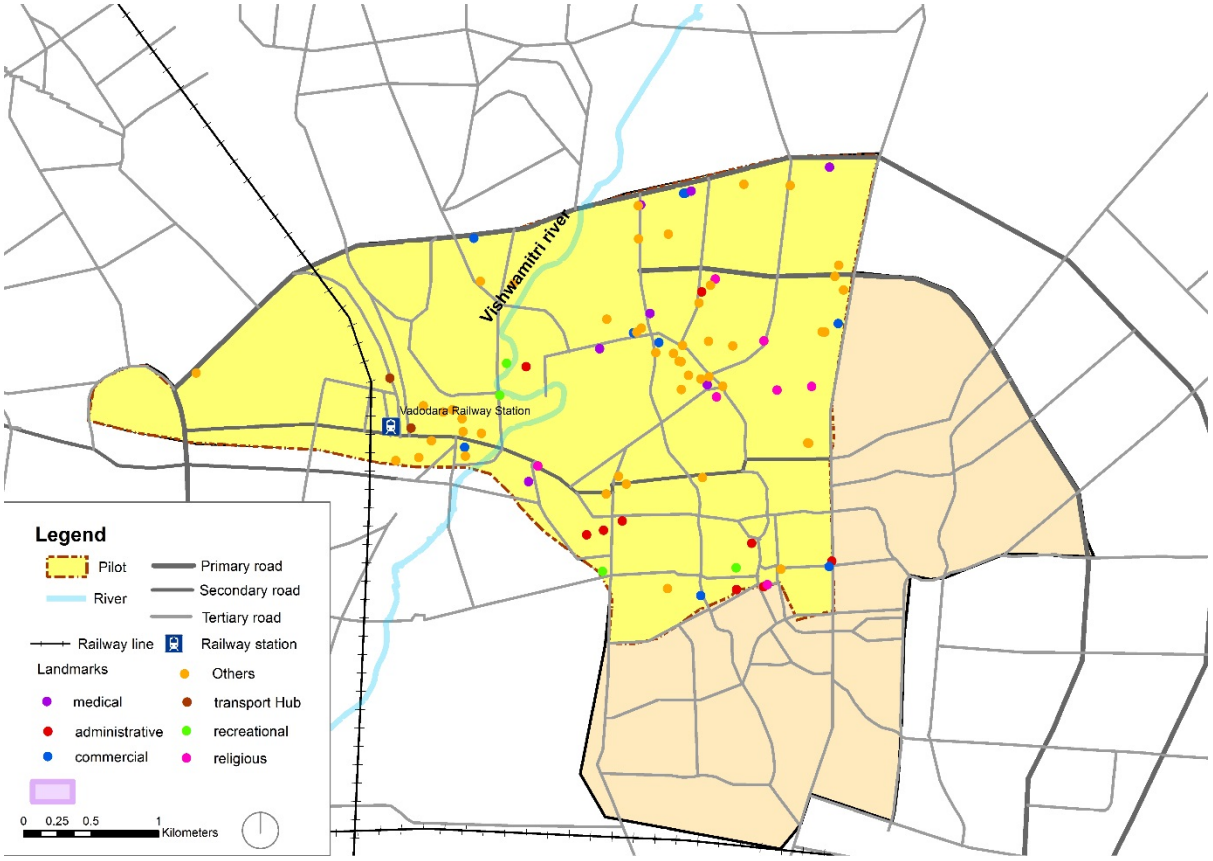
The stakeholder interactions have indicated that PBS implementation at a pilot scale at MS University campus and Kamati Baug. Authorities will help generate optimism about the success of a PBS plan. If implemented at MS University campus, given the high number of students who would willingly accept cycling as a means of transportation to their colleges, the potential of success is high. The nearby Kamati Baug already has a bicycle sharing system in place which can be connected to the larger PBS system and upgraded. Authorities hope that the pilot shall help resolve issues that arise during implementation and also attract other users and investment into the subsequent phases.

The map below shows the activity zones in the area surrounding the MS university campus and Kamati Baug. The hostels and educational institutes are located at an ideal 3 km radius of the campus. The museum and the zoo are activity areas within Kamati Baug. These activity areas were used to draw a pilot boundary for the project show in Map 4.7. The pilot area measures 10 sq km.



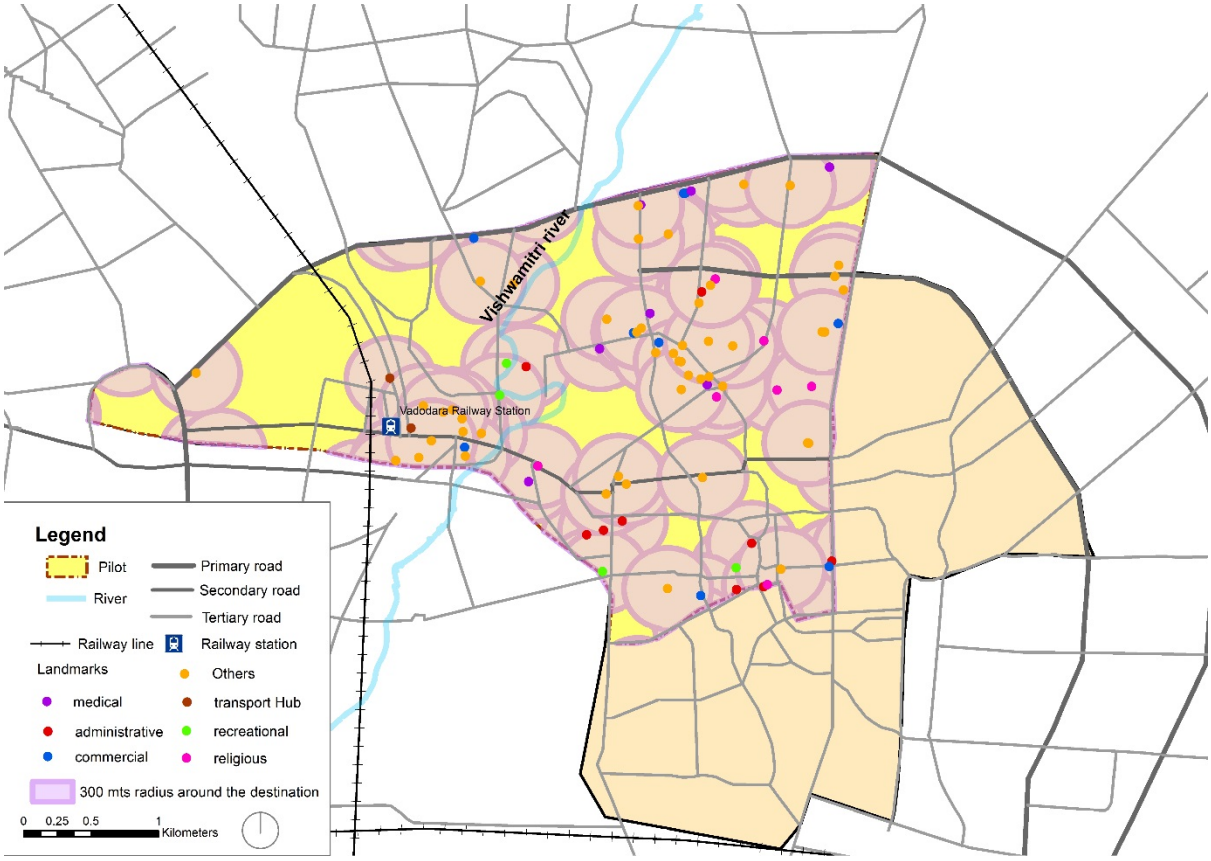
Map 4.5: Existing street network in pilot area for Vadodara PBS

Source: CGM 2016



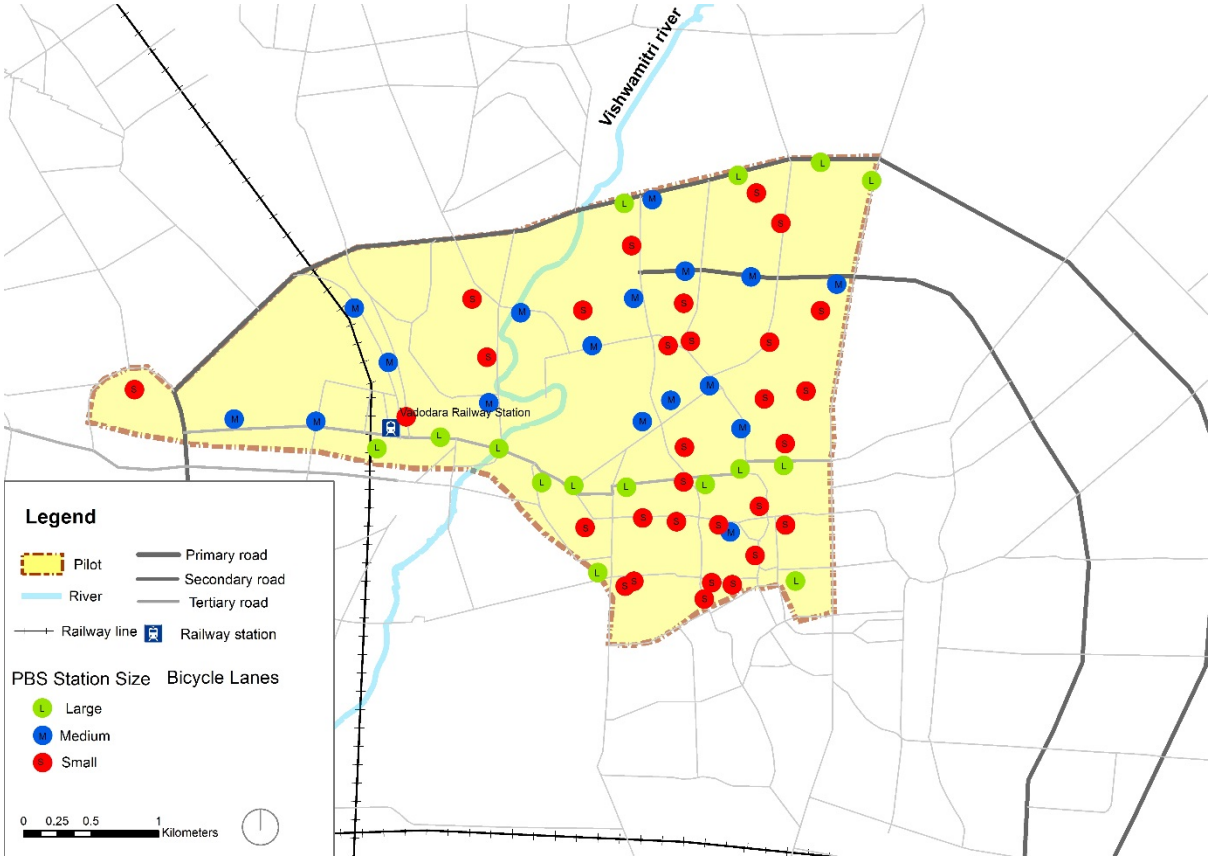
Map 4.6: Activity areas in pilot area for Vadodara PBS

Source: CGM 2016



Map 4.7: Pilot area boundary delineation around activity nodes

Source: CGM 2016



Map 4.8: PBS station locations

Source : CGM 2016

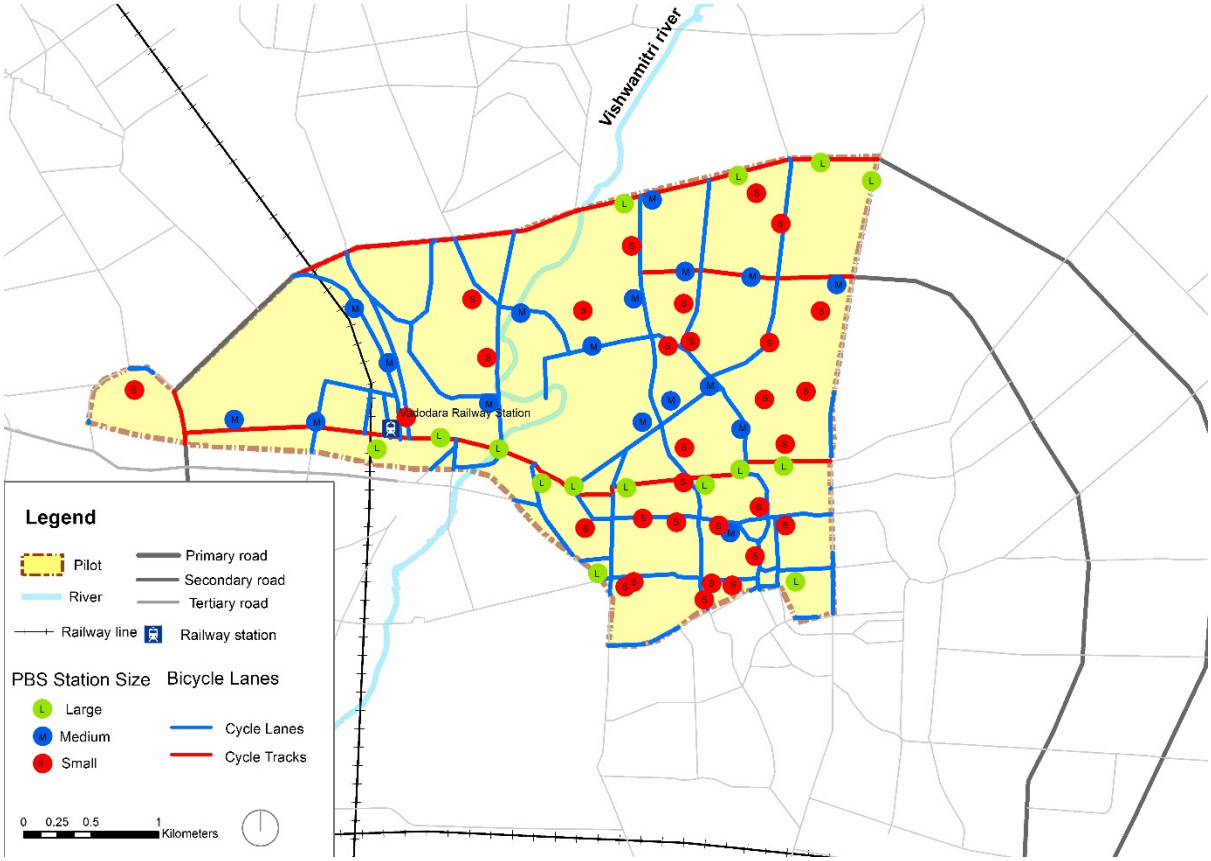
The pilot area measures 10 sq km. The proposed fleet size for this area is shown below.

Exhibit 4.10: Proposed fleet size for pilot, Vadodara PBS

Area	10sqkm
Total No. of Stations	**62**
Large stations	15
Medium stations	17
Small stations	30
No. of Bicycles based on station sizing	**910**
Spares (10%)	91
Total No. of Bicycles to be deployed	**1000**

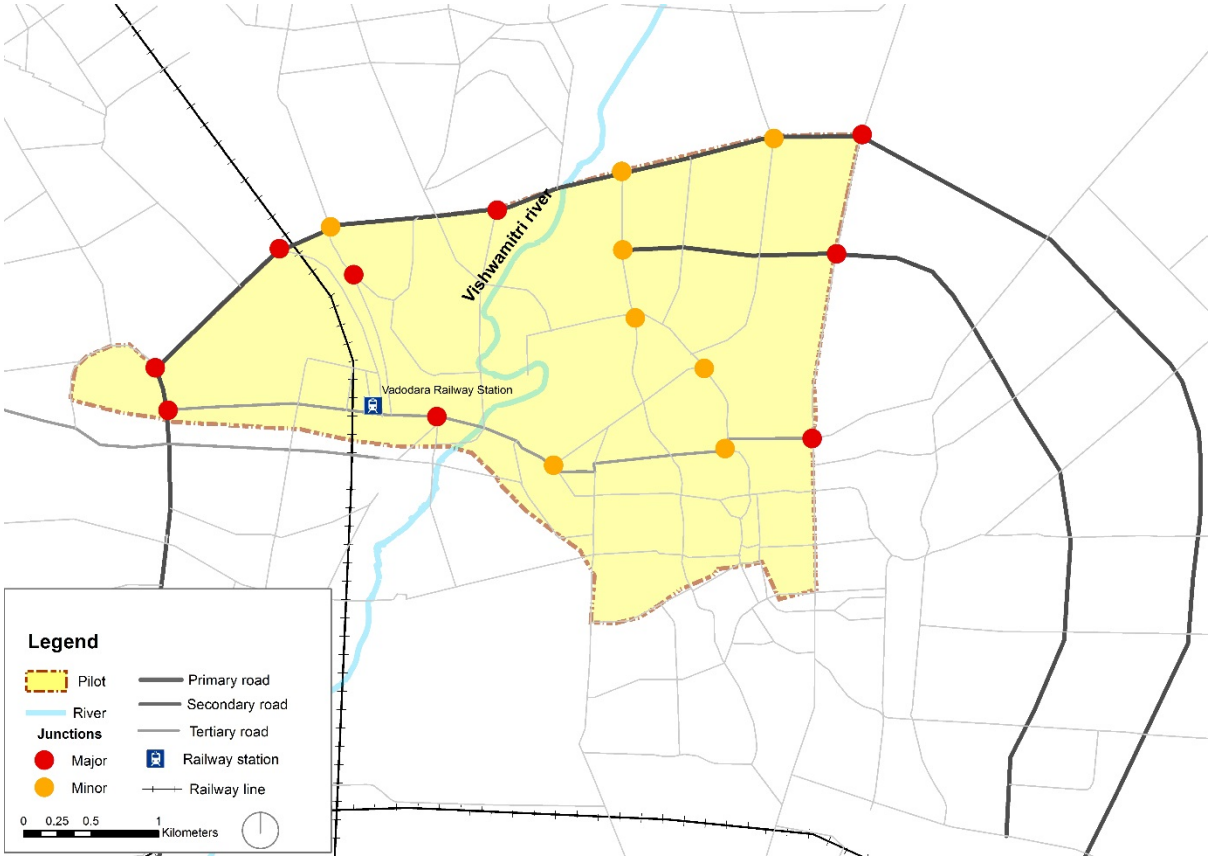
As shown in Map 4.8, PBS station locations are identified such that they are within a 5 min walking distance (300 mt) from the activity areas. Depending on the intensity of the activity zone, within which the station is located, two station sizes have been delineated. Fifteen (15) large stations will accommodate 40 cycles, seventeen (17) medium stations will hold 20 cycles and thirty (30) smaller stations will hold 10 cycles plus spares respectively. Assuming that the technical departments will generate the greatest amount of traffic, the large sized stations are located around them. The pilot PBS scheme shall deploy 1000 cycles across 62 stations. The station sizes could be modified if observed demand is lower or higher than estimated.

It is recommended that an open design competition be floated by the Municipal Corporation to collect ideas for branding the system and designing the docking stations. This will allow MSU students to participate in the planning process. Also, the VMSS will need to develop bicycle facilities such as cycle tracks and shared lanes indicated in the Map 4.9 to improve safety of bicyclists in the pilot area.



Map 4.9: Cycle lanes to support PBS

Source: CGM 2016



Map 4.10: Proposed junction improvements to support PBS

Source: CGM 2016

4.4. Level of Automation of PBS System

Given the expectations of the city authorities and potential users, a fully-automated PBS system is felt as the most appropriate type of system for Vadodara. An automated system will have sensors, computers and IT based communication to undertake the registration process, payment system, check-in and check-out of a bicycle at stations by user itself and does not necessarily require interaction with system staff to utilise the system. Automated systems have an advantage to operate 24 hours with machines processing tasks and an IT system linking each mechanical task to a validation process.

Exhibit 4.11: Proposed Components for pilot implementation of a fully-automated PBS system in Vadodara

Component	Quantity required for pilot project
Bicycles	1000
Docks (Electronic)	1500
Payment Terminals	62
Redistribution Vehicles (1 per 100 cycles)	10
Control Centre	1
Maintenance Garage	1
Incremental Component (GPS on cycles)	1000

Though the capital cost of fully automated system is on a higher side, the entire process of management is a lot easier and thus has comparatively a lower maintenance cost. Automated bicycle sharing systems in general have automation components fit to the basic bicycling system infrastructure. This section details some of these features which can be used for the Vadodara PBS.

Desired functionalities of the system are also described in Appendix – A: PBS Expression of Interest released by VMSS. This EOI has been released for pilot implementation across an area measuring 6 sq km. However, after consultations with VMSS, this area is planned to be increased to 10 sq km as presented in this plan.

4.4.1. Basic Components of proposed PBS System

4.4.1.1. Bicycles

The main component of the PBS system which are bicycles generally equipped with internal brakes, enclosed chain, adjustable seat, mudguards, and reflective strips for safety, front and rear lights, bell, kickstand, portable lock, handlebar mounted basket and wide tires. Since the city is fairly flat, the bicycles to be used to Vadodara PBS system will be ungeared. The bicycles will be equipped with GPS units for tracking the bicycle in real-time.

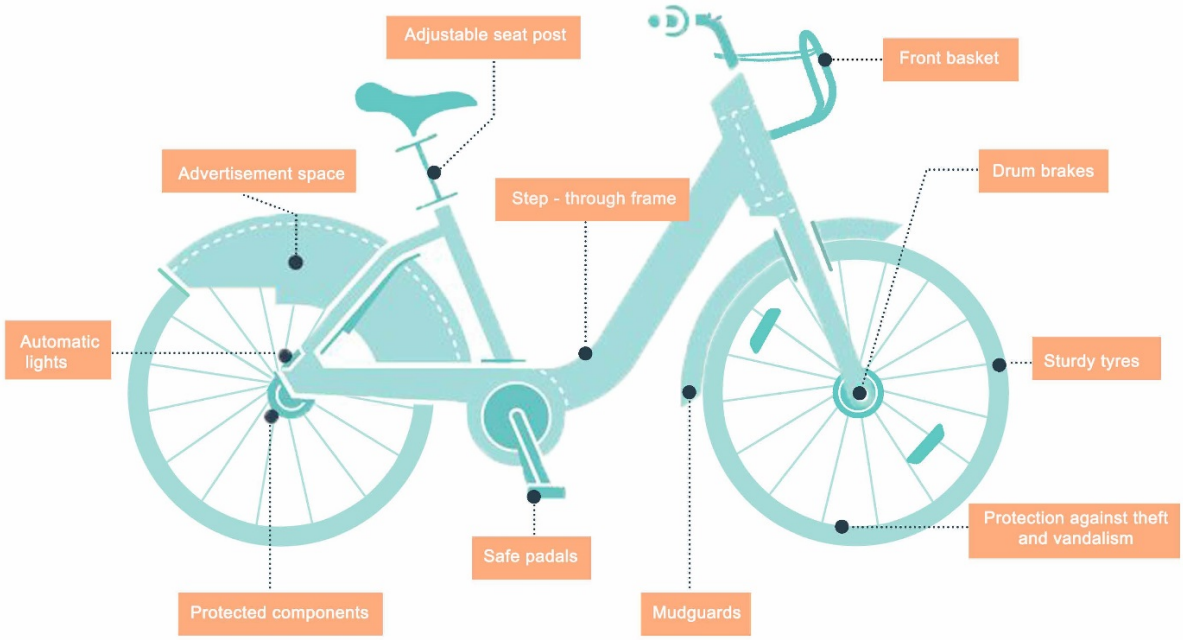


Exhibit 4.12: Components of the proposed Vadodara PBS bicycle
Source: adapted from Guidance Documents, IBI Group

4.4.1.2. Docking Stations

Beam-style docking stations are recommended for the Vadodara fully automated PBS system. The space requirements with the beam dock will be 1.5 sqm per dock. The small, medium, and large stations will require 15 sqm, 30 sqm, and 60 sqm respectively. The docking station will be equipped with specialised coupling systems to lock the bicycle to racks. Stations should be connected over an internet network in general and can be solar powered at times.

Exhibit 4.13: Beam-style docking stations proposed in Vadodara
Source: Barcelona, Source: Duan Xiaomei, Itdp-China.org

4.4.1.3. Bicycle Issuance Mechanism

The automation will allow the Vadodara PBS stations to be unattended. However, personnel may have to be employed during peak hours for security and user assistance. A user will be authenticated to check-in a bicycle at the stations using appropriate means by swiping a smartcard or magnetic stripe card. Multiple options to register as a user should be provided to encourage bicycle usage. An easy registration process will encourage visitors and tourists to Vadodara to use the PBS system. New user registration and access process should be handled at terminals/ kiosks located at the stations which are custom made and specially designed. The kiosks should have several advanced features such as new user registration using touch screens, communication using internet, payment mechanisms, user authentication, recharging of existing user account, account de-activation etc. These kiosks can help replace a station attendant once the system is stabilised and people are used to using the PBS system.

4.4.2. PBS Enabled with Intelligent Transportation Systems Features

Fully automated PBS systems provide real time information on websites about bicycle availability at a particular docking station. Routing assistance is provided by including detailed maps with features like marking of the bicycle lanes, weather updates, traffic updates and safety advisories in most of the cases.

An IT system can store, retrieve and transmit information, and can connect the actual hardware of the bicycles, docks, terminals with control centre and in essence is the link between the various communication portals. The application of information technology made PBS a cost-effective transportation solution on a grand scale. Before the introduction of IT systems, a typical PBS would rely heavily on human resources. A geo-fence can be created around a fixed area in the vicinity of the PBS stations coverage which would alert the operations staff in case a bicycle is taken beyond this geo-fenced region. Technology can now play a huge role in reducing theft and vandalism of cycles especially because of real-time tracking of bicycles.

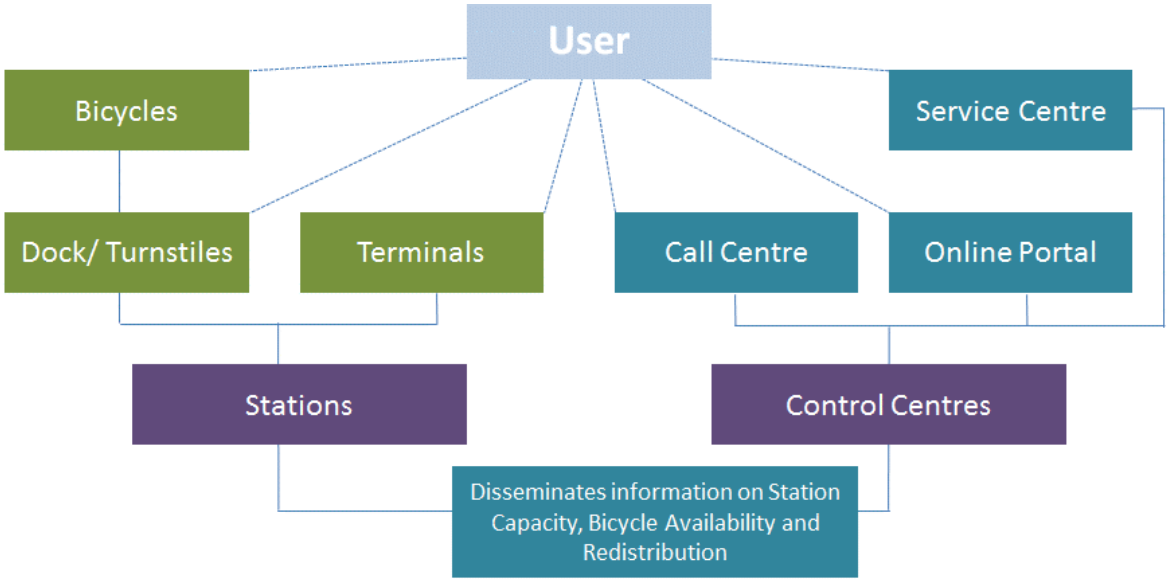


Exhibit 4.14: Information flow in a PBS system

Source: Diagram Adopted From Schroeder, 2014

Therefore considering the shortcomings of manual based system and its associated theft, vandalism and poor utilization of resource; Vadodara PBS is proposed as a fully automated PBS system. In fully automated system the IT application is high; it involves application of automated docking system, use of terminal, mobile based applications and use of smart card/ key for access. The information dissemination and tracking of accurate information depends on robust communication network. Fully automated systems are third generation systems and are becoming most common bicycle sharing schemes all over the world.

The PMC and VMSS, with the advisory body, bicycle vendor, technology provider, and depending on funding, will need to decide on the optimum technology that the system wants to provide to its users.

4.4.2.1. User Registration and Validation

An efficient IT system allows people to register, pay and use the PBS system with ease. It allows users to alter, check or update their accounts, and to have their changes take immediate effect. Payment processing is also automated and instantaneous, making even small payments cost-effective, and eliminating the possibility of users avoiding payment. The IT system validates individual user while checking in/ out a bicycle from PBS station.

The system will give out smart card or key to its user after an authenticating process. Key fobs are plastic emblems that use an RFID chip. The smart card or key is kept by the user and placed on the dock or terminal to identify and receive a bicycle.

Exhibit 4.15: Left- Smart Card, Right-Key of Barclay Cycle Hire (now renamed as Santander Bike Hire System, London)

4.4.2.2. Bicycle Tracking

As mentioned earlier, the fully automated PBS system in Vadodara will use GPS and Radio Frequency Identification Devices (RFID) to track the movement of bicycle and the authenticated user. The RFID tag will identify the user and is housed in a card or a key, and the GPS will identify the bicycle and is housed in the bicycle. User records generally include the type of account or subscription, good or bad standing with the system, previous trip data, and any balance on the account. Information on the bicycle could include its location at any point in time, trips it has made, and repairs it has undergone.

4.4.2.3. PBS Control Centre

A control room or operational centre serves as a central space where a large physical facility or physically dispersed services can be monitored. In case of PBS, control centre will serve the user with information and also coordinate with the online portals, and keep account of bicycle whereabouts, by monitoring the IT data. Control rooms install multiple electronic displays and control panels conducting video surveillance and recording for security and personnel accountability purposes. They are manned 24 hours to ensure continuous vigilance. Typical functions of a control room include:

- Fleet management
  - Disseminate information regarding redistribution of bicycles.
  - Response to the breakdown of bicycle reported by station in charge or user.
  - Tracking of bicycles through GPS.
- User interface management
  - Provide information to user on bicycle/ dock availability via app, SMS, phone call
  - Authorization of smart card/ key or code used by the user to sign in the system at any PBS station.
  - Maintain website and disseminate information through online –via app, SMS, phone call, about station location, and subscription detail, user fee and other information concerning users.
  - Terminals act as interface between the user and control room in this process as well.
  - Track information of user through RFID tags installed in their smart card/ key or code generated through terminals.
- Central fare collection monitoring
  - Centrally manage the fare collection.
  - Auditing of the fare revenue collected.
- MIS reporting and operational performance management
  - Staff management.
  - Prepare daily weekly and Monthly reports.

4.4.2.4. Data Tracking and Dissemination

The amount and accuracy of information that can be collected and analysed is dependent on the IT system. Besides the trip pattern data, the IT system can also provide information on user profiles and preferences that can be used to adjust the operational and revenue models and maximise efficiencies. The IT functionality of a system can also lend itself to a larger utility such as allowing public use of the system data. If data from the PBS system is made available to the public, the user experience could be enhanced by making use of a broad array of applications that can communicate this tracked data in simple, relevant formats. For example, several smartphone apps have been developed for many current PBS systems that allow a person to simply tap their phone to find the closest station and its current capacity. Some apps also show bicycle sharing stations, their capacity and their locations relative to other transport options and points of interest. Trip planning apps utilizing

real-time availability at stations can suggest routes, times and availability of a PBS compared with or in conjunction with other modes of transport.

The Control Centre shall relay station capacity to the different user platforms, such as station terminals, websites, phone apps and other transport operators. Communicating the availability of bicycles and open docks at various stations will help the operator manage the redistribution system, and users to get informed about bicycle availability and station information.

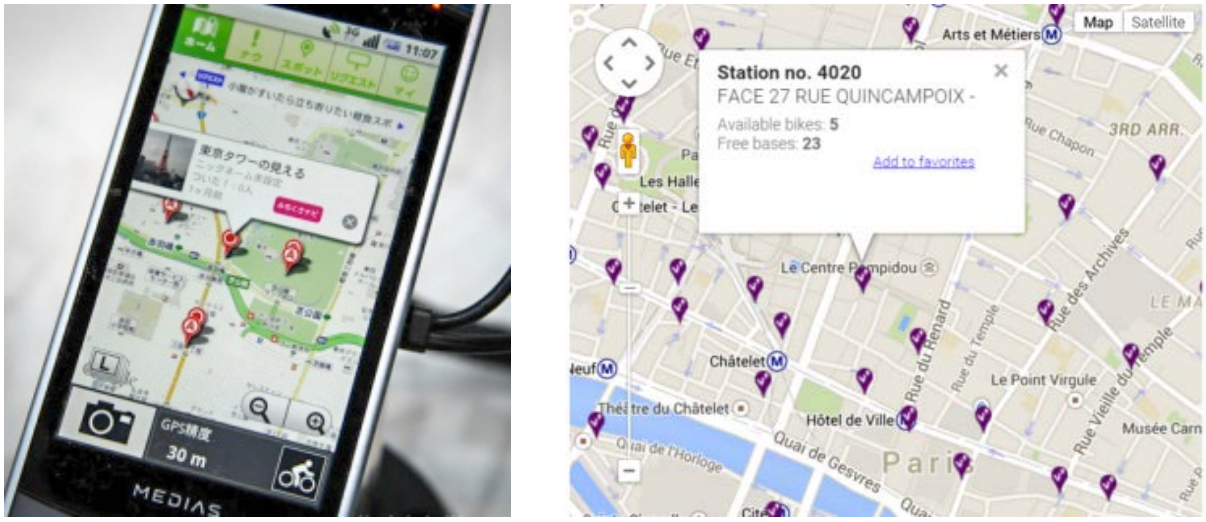


Exhibit 4.16: Left- A Bicycle-Finding smartphone app in use, China. Spot Cycle Delivers similar functionality for Smartphone-Bearing PBS users in Europe and the U.S.A. (Schroeder, 2014), Right- online portal showing the real time information of bicycle availability

A summary of the proposed PBS components in Vadodara along with design quantities are provided in the Exhibit 4.17:

Exhibit 4.17: Principal PBS components proposed in Vadodara

Component	Item	Quantity
Hardware	Non-Geared Bicycle with GPS	1000
	Dock (Electronic)	1500
	Terminal at PBS Station	62
	Redistribution Vehicles	10
	Maintenance Vehicles	1
Civil Infrastructure	Control Centre	1
	Station - Small	30
	Station - Medium	17
	Station - Large	15
	Maintenance Garage Set-up	2
Software	Central Software	1
	Mobile and Web Applications	1

4.5. PBS Branding

Branding is essential to create an identity for Vadodara PBS. An efficiently designed bicycle sharing system requires a befitting identity and promotion for continued support of users. A bottom-up approach in creating a brand identity helps in creating a feeling of ownership among citizens. Combining branding efforts with communication and outreach efforts help in creating dual advantages- creating awareness and developing an identifiable identity for the system.

The Vadodara PBS branding identity must strive to establish the right image in the customer's mind. The PBS system name should be relatable to the locals who use the system. It should allow a layperson to associate himself/herself with it. Many PBS systems tag its city's name with colloquial words related to cycling or transport to give the system a very distinctive identity.

A PBS logo helps in the creation of brand identity for the system and acts as a signature that symbolises the entire system. PBS logos should be designed to be illustrative, symbolic & textual or any combination of these three. It functions as a unique identity, and through colours, fonts and images they provide essential information about the system that allows the users to identify with the system's core brand.

Boosting the system name and logo with a tag line or slogan helps to define and highlight the aspects of the system. The PBS tag lines in general need to stress on the health fitness aspects, carbon saving, easy access, convenience of transport system and modernity of the system. The new systems image, brand name, logo and slogan should be protected by trademark and copyrights. The copyright should be held by the public authority and not by any of the related private sector firms such as the operators or marketing firms.

The students from the MSU Architecture department have expressed interest in contributing to this part of the PBS design. VMSS must find a way to integrate their inputs into the design process. A private consultant can help VMSS in creating the platform for conducting design competitions and other interactive events to get the best ideas on board.

Exhibit 4.18: System Logo, from left; Ahmedabad Mybyk, Mumbai Cycle Chalao, Bengaluru Namma cycle, Bengaluru ATCAG, Paris Velib, Boston Hubway, Barcelona Bicing.

Source: IBI Group

CHAPTER V: INVEST

5. INVEST

Invest provides an overview of the financing tools- public funding sources, sponsors and other revenue sources that is essential for long term viability of the system in Vadodara.

Capital expenditure (CAPEX) for Vadodara PBS includes the assets- cycles, docking stations, terminals, software, maintenance equipment, redistribution vehicles and control centre. Along with the capital cost for staff, it also involves installation, marketing, and website creation cost.

Operational cost (OPEX) includes salary of staff, replacement parts, fuel for service and redistribution vehicles, electricity, insurance, administrative costs, and depreciation on assets. In the proposed study, cost of each bicycle is almost 18% of total capital cost. These bicycles have been proposed with GPS, RFID tags, and identical spare parts installation. The reason for investing on good bicycles is to ensure their durability and reduce the chances of theft and vandalism.

Exhibit 5.1: Capital cost components and pilot phase quantities

Component	Item	Quantities for Pilot Implementation
PBS System	Bicycle	1,000
	Dock (Electronic)	1,500
	Terminal at PBS Station	62
	Control Centre	1
	Redistribution Vehicles	10
	Maintenance Garage Set-up	1
	Installation + Project Management cost	Lump sum
Civil Infrastructure (PBS Stations)	Station - Small	30
	Station - Medium	17
	Station - Large	15
Total CAPEX		
Incremental Components	Geared Cycle (INR)	0
	Bicycle with GPS (INR)	1,000
Total CAPEX with Incremental Components		

Source: IBI Group

5.1. Capital Costs

The PBS System for Vadodara shall be developed under 3 different phases as explained in the previous Chapters. Based on the area, the number of bicycles and docking stations have been finalised.

Exhibit 5.2: PBS infrastructure and station detailing

Phase	Area (Sq. Km)	Bicycles	PBS Stations			
			Small	Medium	Large	Total
Pilot	10.0	1,000	30	17	15	62
1 (including pilot area)	17.8	1,800	60	80	40	180
2	45.1	4,500	151	200	100	451
3	62.1	6,200	251	250	120	621
Total (1+2+3)	**125.0**	**12,500**	**462**	**530**	**260**	**1,252**

Source: IBI Group

The following are the unit rates taken for the various components of the Capital investment required for the PBS implementation. The costs for a completely automatic, semi-automatic and a manual system have been presented in Exhibit 5.3.

The basic difference between these systems is the level of automation.

Exhibit 5.3: Infrastructure (CAPEX) - unit rates in 2015 in INR[18]

S. No.	Infrastructure (CAPEX) - Unit Rates in INR				
	Unit Cost	Units	Automatic	Semi-Automatic	Manual
1.	Ungeared Bicycle	1,000			15,000
2.	Dock (Electronic)	1,500	70,000	-	-
3.	Terminal at PBS Station	62	2,20,000	1,00,000	10,000
4.	PBS Station - Small	30	1,00,000	5,00,000	5,00,000
5.	PBS Station - Medium	17	2,00,000	8,00,000	8,00,000
6.	PBS Station - Large	15	3,00,000	12,00,000	12,00,000
7.	Redistribution Vehicles	10			8,00,000
8.	Control Centre	1	2,00,00,000	20,00,000	-
9.	Maintenance Garage Setup	1			8,00,000
10.	Installation + Project Management cost	Lumpsum	30% of total		
	Incremental cost				
11.	for Geared Bicycle	0	5,000		
12.	for Bicycle with GPS	1,000	2,000	-	-

Source: IBI Group

Notes:

1) *The Terminal at PBS Station for a Semi- Automatic System would work along with a computer/ tablet enabled with a smart card reader. For a manual system only paper tracking is proposed.*
2) *The land acquisition costs for none of the infrastructure such as PBS Stations, Garage or Cycle lanes has been taken into account. The VMSS along with other stakeholders shall contribute to the land required for developing the System.*
3) *The Unit cost mentioned in the above table against PBS Stations is only the set-up cost and not the civil construction cost. In case of the Semi- Automatic and Manual Systems, the cost of a container (Similar to Ahmedabad) or a bicycle cage type (Similar to some bicycle stations in Vadodara) to hold the bicycles is proposed and the cost for such component is considered in the above table.*
4) *For the semi-automatic system, a user account management module with smart card system is proposed at the control centre level.*

[18] *From market rates provided in PBS Guidance Document*

Based on the unit rates mentioned in Exhibit 5.3 the total CAPEX for the phase-wise and Pilot PBS implementation is detailed below. Considering various factors, **an automatic PBS System is recommended** to be implemented for the Pilot Phase in Vadodara which would cost around INR 26.14 crores (Rs. Twenty Six Crores Fourteen Lakhs). The overall outlay for all the 3 phases of PBS system for Vadodara is presented in Exhibit 5.4.

Exhibit 5.4: Total CAPEX cost for pilot and each PBS phase (excluding supporting civil infrastructure)

All Figures in INR	*Pilot*	Phase 1	Phase 2	Phase 3	Total (Crores)
Automatic	**26,13,75,000**	71,06,00,000	173,96,87,500	225,99,62,500	**471.03**
Semi-Automatic	**9,34,75,000**	24,27,50,000	60,27,50,000	80,11,25,000	**164.66**
Manual	**7,87,12,500**	20,20,00,000	50,45,12,500	67,36,37,500	**138.02**

Source: IBI Group

5.2. Operational Costs

There are several people required to manage the PBS System once implemented. The roles and responsibilities of each of the required personnel are identified in the Exhibit 5.5 below:

Exhibit 5.5: Roles & responsibilities of PBS operations personnel

S. No	Role	Responsibility
1.	Operations Manager	Responsible for overall PBS operations and management of the PBS project and ensure customer satisfaction
2.	Shift In-charge	Shall be responsible for their respective shift for managing PBS operations at desired service levels
3.	Control Centre Operators	Shall be a nodal point of contact for information dissemination and ensuring the circulation of cycles and monitoring of the performance of PBS
4.	Customer Service - Call Centre	Shall support customers on resolving queries, information and complaint redressal
5.	Administration	Shall support routine office administration and project functions
6.	Human Resources	Shall be responsible for recruitment, training, payroll and other HR related functions
7.	Marketing Manager	Responsible for marketing and advertisement of PBS and public outreach
8.	Accounts	Responsible for accounting, cash management and bank transfers
9.	Station Attendant	Shall support customers in issuance and receiving of cycles and to ensure minimum cycles are maintained in co-ordination with Control Centre
10.	Point -of Sale Operators	Shall be responsible for distribution of smart cards/ passes and collection of cash and refunds
11.	Driver	Shall be responsible for driving of redistribution vehicles and circulation of cycles.
12.	Helper	Shall support redistribution vehicle driver in shifting of cycles
13.	IT Support	Shall be responsible for maintenance and upkeep of IT and other automated system deployed on the project
14.	Workshop Mechanics	Shall be responsible for maintenance and repair of cycles
15.	Guard	Shall be responsible for security of the premises and material in the workshop, stores and Control centre.
16.	Cleaner	Shall be responsible for regular cleaning of cycles and PBS stations

Source: IBI Group

Exhibit 5.6 presents the operational manpower requirement for managing the PBS System at various levels of automation.

Exhibit 5.6: Personnel requirement under PBS system for the pilot project (1,000 bicycles)

Location	Operational Personnel	No. of Personnel for Automatic System	No. of Personnel for Semi-Automatic System	No. of Personnel for Manual System
Control Centre	Operations Manager	1	1	1
	Shift In-charge	3	3	3
	Control Centre Operators	8	5	0
	Customer Service - Call Centre	8	5	0
	Administration	2	2	2
	Human Resources Manager	2	2	4
	Marketing Manager	1	1	1
	Accounts Manager	2	1	2
Field Operations	Station Attendant	0	149	149
	Point -of Sale Operators	24	24	0
	Driver	24	24	24
	Helper	24	24	24
Support Team	IT Support	8	5	0
	Workshop Mechanics	5	5	5
	Guard	4	4	4
	Cleaner	14	14	14
	Office Helpers	2	0	4

Source: IBI Group

Based on the manpower estimates discussed above, the total operating costs (OPEX) for the pilot PBS phase, including other costs such as administration, maintenance, insurance, and other expenses are calculated and shown in Exhibit 5.7:

Exhibit 5.7: OPEX cost for pilot PBS system

OPEX Cost per Year in INR			
Component	**Automatic**	**Semi- Automatic**	**Manual**
Man-power	1,60,80,000	2,82,12,000	2,44,56,000
Spare Parts	59,63,400	11,25,000	7,70,700
Office & Garage Rental	36,00,000	36,00,000	36,00,000
Fuel Costs	73,00,000	73,00,000	73,00,000
Cycle Repairs & Maintenance	12,00,000	12,00,000	12,00,000
System Insurance	25,93,750	9,34,750	7,87,125
Replacing Missing Bicycles	3,00,000	3,00,000	3,00,000
Replacing Faulty Bicycles	4,50,000	4,50,000	4,50,000
Administration & Miscellaneous Costs	42,81,430	29,81,950	28,81,565
Total OPEX Cost per Year	**4,17,68,580**	**4,61,03,700**	**4,17,45,390**

Source: IBI Group

From the above table, it can be observed the OPEX costs for fully automatic operations are lower than a semi-automatic system.

5.3. Supporting Infrastructure Costs

Apart from the CAPEX and OPEX costs for supporting a PBS System, the following additional infrastructure costs may be incurred during the pilot phase. The unit costs shown here are derived from market rates for the highest grade construction quality.[19]

Exhibit 5.8: Cost for developing supporting civil infrastructure for pilot project

Component	Item	Quantity	Unit Cost (INR)	Cost (INR)
Intersection Improvement	Minor	10	10,00,000	1,00,00,000
	Major	7	25,00,000	1,75,00,000
Cycle Lanes	Improvement of Existing Bicycle Lanes	0	1,00,000	NA
	Lane Demarcation (New)	31.3	2,00,000	62,60,000
	Dedicated Cycle Tracks (New)	10.6	30,00,000	3,18,00,000
Total Cost (INR)				6,55,60,000

Source: IBI Group

5.4. Overall Costs for Pilot PBS System

The total cost for implementation of the pilot PBS System inclusive of capital cost for PBS components and the supporting infrastructure is **INR 32.69 Crores** (Rs. Thirty Two Crores Sixty Nine Lakhs). The **annual** operating cost for the pilot phase is estimated at **INR 4.17 Crores** (Rs. Four Crores Seventeen lakhs).

5.5. Funding and Revenue Sources

In order to diversify its funding and revenue sources, VMSS could potentially evaluate one or more of the following alternatives to augment the system's financial gap:

Direct Funding:

Funds for capital expenditure will need to be collected through direct funding sources listed below. A bank loan should also be considered to pay for a portion of the capital expense. Such loans would need to be repaid through funds collected from revenue collection and cross-subsidy sources.

- **Municipal Budget:** Financing PBS through direct government subsidy is the most cost-efficient way of ensuring benefits to the system. Allocation from city's resources can provide the necessary impetus to the system. The VMSS has expressed interest to finance the pilot phase of PBS in Vadodara using funds allocated in the Municipal budget.
- **Transit-linked Funding:** The proposed BRTS can bring in a component of PBS funding from the annually budgeted amounts.
- **Grants:** VMSS can also apply for funding from the State or the Central Government under various sustainable transport schemes for planning purposes or include the proposal as part of its Smart City Proposal for future funding.
- **Funding through Corporate Social Responsibility (CSR) Activities:** CSR funds from the private sector could be channelled towards expansion of the PBS system in future phases. CSR contribution could either be made to a non-profit organisation funding the system, or be made in kind by developing NMT infrastructure and PBS stations in selected areas.

[19] *These rates are based on market rates observed in several parts of the country. Small variations may be possible in local rates.*

Direct Revenue

Direct revenue collections from user fees and subscription fees will help in repayment of loans and pay operational costs. The amount of revenue that is collected depends on the fare structure. The proposed fare structure for the Vadodara PBS pilot has been illustrated in Exhibit 5.9. It is recommended to have the initial 30 minutes as a free ride, followed with INR 10 fares for every extra 30 minutes. This is will discourage long term use and keep more cycles in circulation.

Exhibit 5.9: Fare structure for Vadodara PBS

One time Annual Registration: INR 300	To be renewed every year after signing in. Validation of residential address by operator before being given to the commuter. Each member of the family pays separately, gets a separate card. INR 100 may be charged for loss of card, duplicate card issued after re-validation of residential address
User Fee in INR	**Time**
INR 0	First 29 minutes
INR 10	30 – 59 minutes
INR 20	60 – 89 minutes
INR 30	90 – 119 minutes
INR 40	120 – 149 minutes
Registration methods:	Website, Mobile Application, Hard copy at Bicycle Stations.
Operation:	Smart Card, SMS, Multi-utility Card

Assuming 2000 subscribers of the pilot system and an average 100 daily trips longer than 30 minutes:

Estimated Annual Revenue = INR 6,00,000 (from subscription) + INR 3,60,000 (from user fees) = INR 9,60,000

Cross Subsidies

Cross subsidies will form the largest portion of the continual earning. Primary forms of cross subsidies proposed include:

- **PARKING CHARGES:** Charges from parking is a good way to generate revenue from the streets and use them for the PBS System. A detailed parking assessment should be carried out by the municipality to assess the potential revenue from the Parking fees implementation. As there is parking fee being collected at several locations in Vadodara, proper mechanism should be put in place to route the same resources to PBS System through stake-holder interactions.
- **ADVERTISEMENT FEE:** Advertisement on each PBS station and cycle has potential to generate revenue for the PBS System. Advertisement fee will be charged for first 3 years. The following is the assumption of revenue generation from advertisement. (Exhibit 5.10). Advertisement plays a major role in generating revenue sources and an approximation of the revenue potential from this source is presented in the Exhibit 5.10.

Exhibit 5.10: Potential revenue from advertisements

Potential advertisement charge from each PBS station/month	10,000
Potential revenue through advertising per sq.ft.	INR 250 per sq.ft. per month
Potential advertisement charge from each cycle	INR 100 per month

Source: IBI Group

5.6. Operational Model

It is proposed that the Vadodara PBS system should be owned by the municipal body and operated by private participation under service based contracts. Private vendors will operate the system against a fixed-monthly fee from the government as service charges. These charges will be based on performance measurements that will act as incentives or penalties to the operator. The operator shall agree to Service Level Agreements (SLA) in the contract. The system will run on revenue generated from user fee, subscription fee, parking fee and advertising fee. After system is in place, a corporate sponsor maybe invited for overall branding of the system. (Refer Exhibit 5.11)

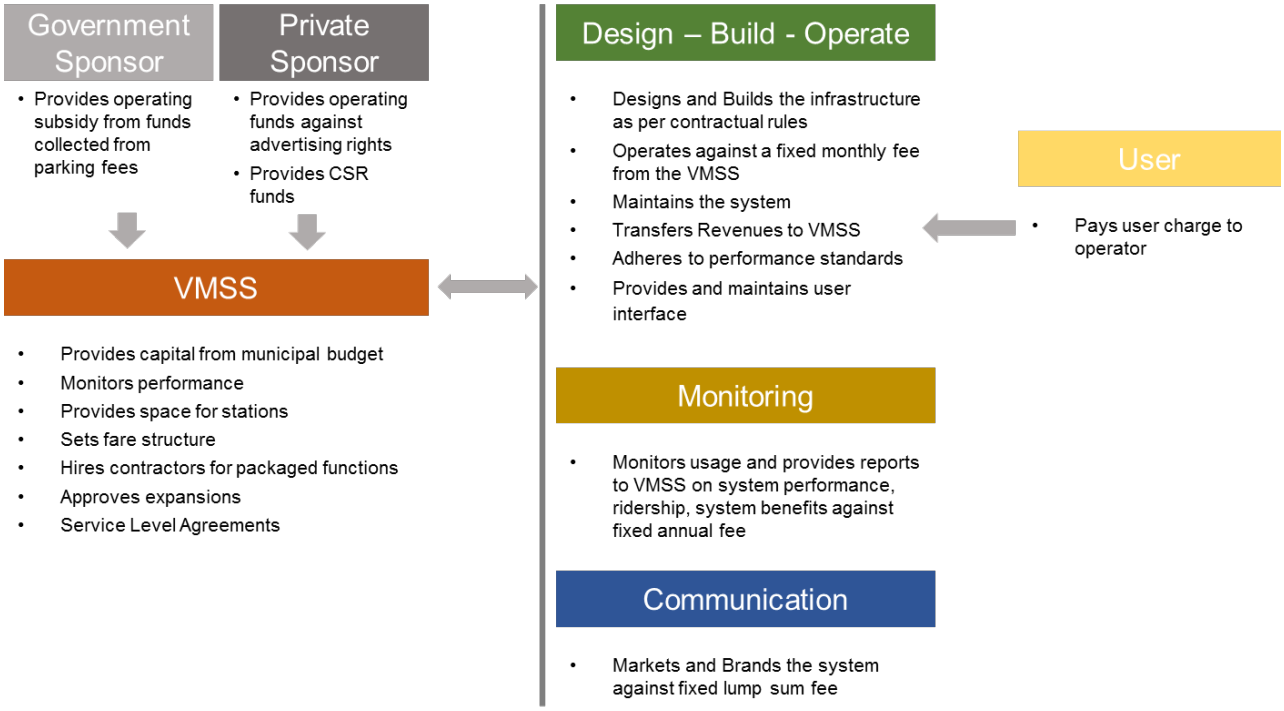


Exhibit 5.11: Operation model of proposed Vadodara PBS

Source : IBI Group

CHAPTER VI: IMPLEMENT

6. IMPLEMENT

6.1. Establishing an Institutional/ Monitoring Structure

Defining the roles and responsibilities of various governmental agencies is a crucial step in implementing the recommendations of the PBS Plan.

The following agencies will have a vital role to play in the implementation phase:

1) **VMSS**: Is the nodal body for the implementation, management and operation of PBS, and will be responsible for overall viability and sustainability of the PBS system. The Deputy town planner of the planning cell shall be responsible for the implementation of the system in the city and supported by the teams given below.
2) **PMC:** The project management consultants shall handhold the VMSS through the designing, building operating and transfer process. PMC shall be responsible for:
    a. Preparing the DPR
    b. Day to day project management
    c. Writing tenders
    d. Bid process management
    e. Hiring DBOT and M&E contractors
    f. Training the VMSS staff on operations and management (with help from DBOT contractors)
    g. Ensuring a smooth transition from DBOT contractors to the VMSS
3) **Project Implementing Agencies**: The implementing agencies will be hired by the PMC to implement the PBS project. It shall comprise of the following units:
    - **Design, Build, Operate, and Transfer Contractors:** The contractors shall:
        a. Build the project (procure equipment, installation).
        b. Operate it for a period of 2 years and then hand over the project to the VMSS to run.
        c. The DBOT contractors shall in coordination with PMC hold training workshops on operations and management for the VMSS.
    - **NMT Infrastructure Contractors:** The infrastructure contractors shall:
        a. Build NMT infrastructure, including segregated and mixed cycle tracks as well as other streetscape amenities in accordance with the Planning and Design Guidelines for Non-motorised Transport, 2014 and Urban Road Codes, 2012.
        b. Undertake Intersection improvements as per design guidance provided by the PMC.
    - **Monitoring and Evaluating Consultants:** The M&E consultant shall monitor the system at different stages of building and operation. They shall
        a. Set up collection systems and collect relevant data regarding implementation, shift in modal share, ridership etc.
        b. And write a report on the learnings from the implementation of the phase 1 of the PBS project.
    - **Design and Branding consultants:** The Architecture department is willing to help VMSS in its efforts to brand the project and design the stations, (atleast for the pilot phase of the project). Hence, a separate design and branding team, consisting of volunteering students and consultants who can guide the efforts should be setup for the project.

4) **Technical Assistance Committee:** The TAC should be set up as early as possible engage the various stakeholders, namely, city leadership, officials and NGOs from the initial stages of the project. The role of the TAC will be advisory and meet with VMSS at regular intervals.

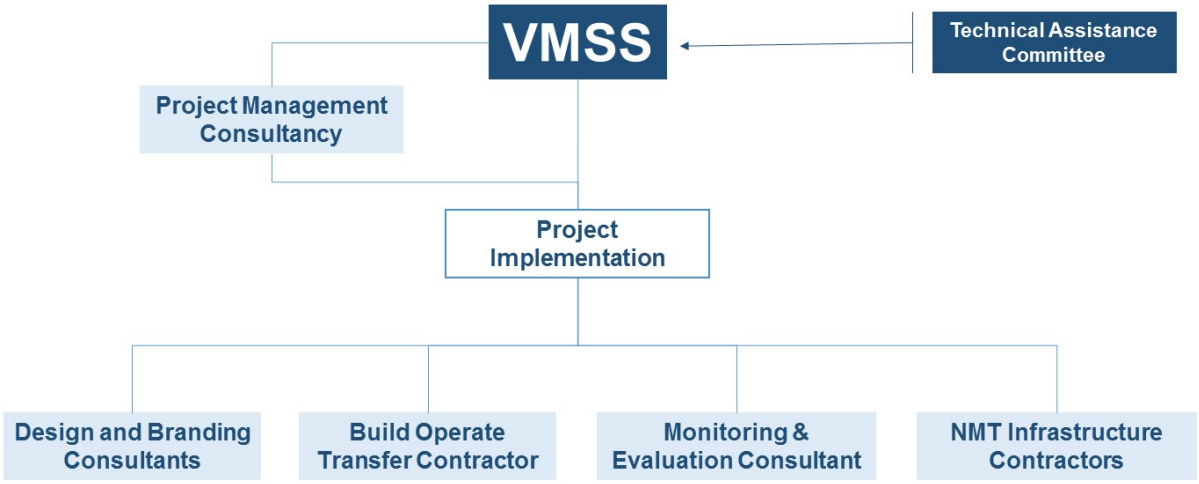


Exhibit 6.1: Proposed institutional structure for PBS implementation

Source: IBI Group

6.2. Project Framework Roles and Responsibilities Matrix

Activities from previous chapters have been categorised in a matrix with roles and responsibilities assigned to various identified authorities. This matrix shows the authorities that are primarily responsible for undertaking the task or is supportive to pursue the task.

Exhibit 6.2: Roles and responsibility matrix. Source: IBI Group

Activities/ Authorities	VMSS	PMC	Design and Branding	BOT	M&E	TAC
Create a project team	P					
Hire a PMC	P					
Elect a TAC	P					
Identify funding sources	P	O				S
Prepare DBOT contract documents		P				S
Hire DBOT contractor		P				S
Prepare M&E consultant		P				S
Hire a M&E consultant		P				S
Procuring equipment		O		P		S
Project implementation- installation of station, hardware, recruitment of staff, launch of web based applications,		O		P		S
Branding and advertising		S	P			
Testing of system- IT, hardware, trail run		P				S
Operations		O		P		S
Monitoring of operation		O			P	S
Handling over the project to transit authority	P	S				S
System optimization	P					S
System expansion	P					S

P: Primarily Responsible, S: Support, O: Oversight

6.3. Activity Scheduling of PBS

The activities that Vadodara will have to undertake to implement the system are demonstrated graphically below. It is expected that implementation of the pilot PBS system in Vadodara can be accomplished in 13 months from start of the project.

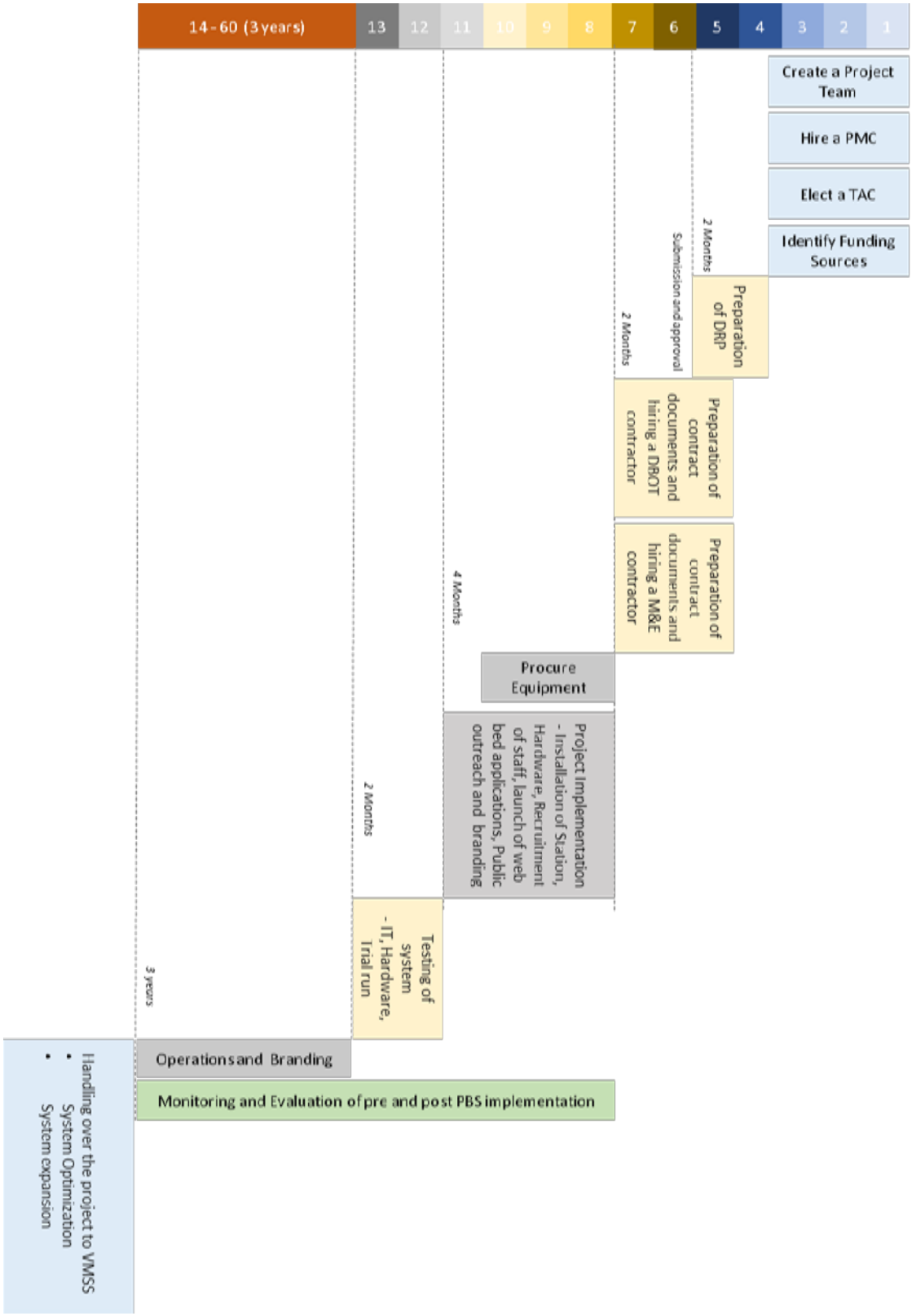


Exhibit 6.3: PBS activity scheduling

Source: IBI Group

6.4. Performance Standards for Operations

Performance evaluation is very critical for VMSS to ensure good quality of service to the users and also to utilize the resources efficiently for the achieving the project objectives. The performance evaluation of system also helps in expanding the system with corrective measures from the experience. The various measurable parameters such as station inspection frequency, bicycle maintenance frequency, amount of bus fleet availability, etc. are measured continuously by an independent agency or by VMSS using which the performance of DBOT contractor is evaluated. All the parameters should be compared with the values of parameters defined in the service level agreeement. The service level agreement shall be defined for the system based on intended level of services and availability of resources. A sample SLB to incentivise and reward the operator for excellent performance and penalise for non-performance. (adapted from a similar exercise) is appended in Annexure I).

The following flow chart in exhibit 6.4 shows the briefly the methodology suggested for performance evaluation of operator.

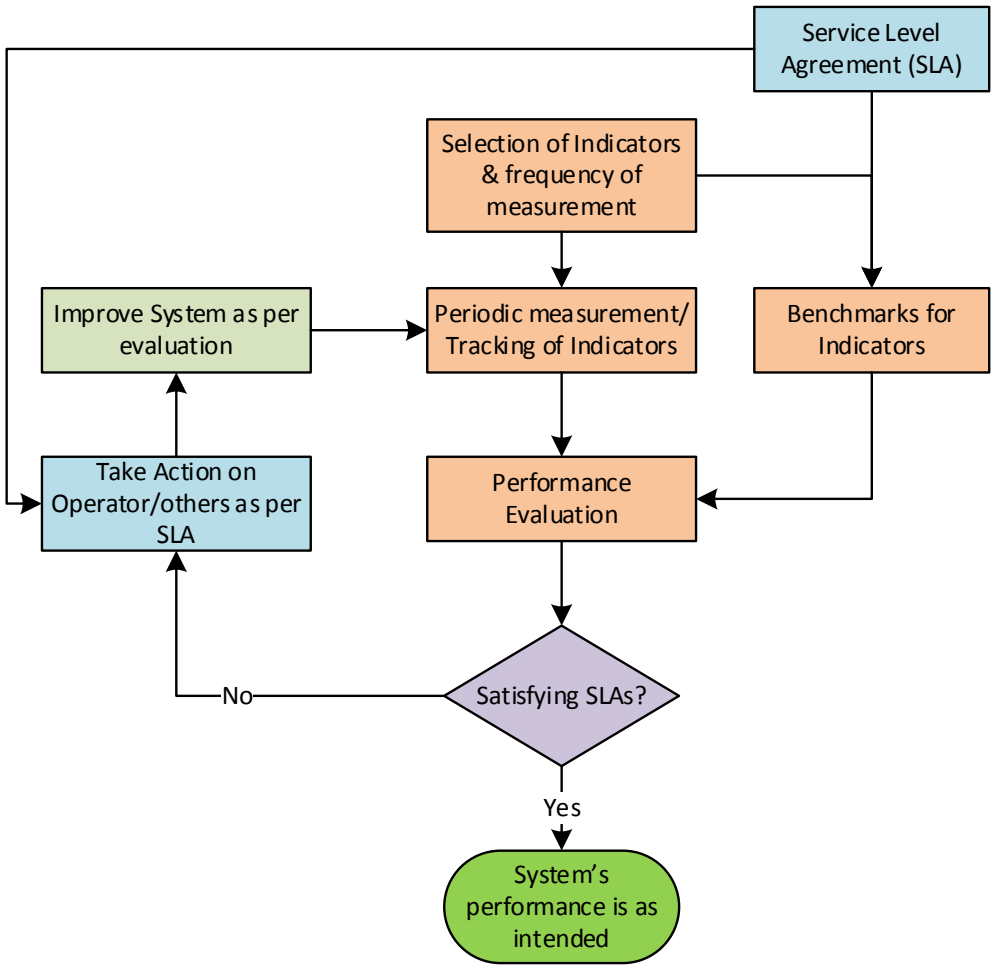


Exhibit 6.4: Suggested performance evaluation methodology

Source: IBI Group

6.5. Communication and Outreach

Preparing a communication and outreach plan is one of the several straregies to increase awareness regarding the PBS systems and its benefits to concerned stakeholders. The information is distributed through multi-channel platforms including print media, press releases, advertising in movie theaters, broadcasting (radio and television), ward-level meetings, and social media channels. VMSS will have to undertake the following tasks as part of its communication and outreach strategy:

- Hire a communication consultant and create a communication strategy.
- Organise public events, promotional campaigns, and workshops to reach out to the community. Social marketing also provides avenues to integrate the system with existing transport system. The existing stigma of using bicycles as mode of commute needs to be changed with the help of public events and social marketing.
- Develop a multi-fold media strategy covering announcements in newspaper, magazines, community flyers, radio and television.
- Involve key political and administrative figures to send messages about cycling and healthy living.
- Identify brand ambassadors who can help create a positive image of cycling.
- Interact with media and communication professionals and share information of the goals and operations of the system.
- Use social media platforms to engage with youth.
- Design special programs for targeted users.
- Hold public debates and write articles on blogs, newspapers and websites on the benefits of cycling and its impact on the city's health and environment.

6.6. Capacity Building Programmes

Trainings are an effective way to ensure that PBS has the required in-house technical and political support from the people who are directly or indirectly involved with running the system. Capacity building programs help stakeholders visualise desired results better, especially during the initial stages when the gains from the system are gradually unfolding. It is beneficial, in the longer run, to have in-house expertise on management of the system.

Training and capacity building programs for government officials should include imparting knowledge of system planning, design and operations. The capacity building programs should be held regularly even after system implementation for long term success. The proposed capacity programs include:

1. **NMT Demand Assessment Techniques** – This program should include interactive workshops where VMSS urban/transport planners are trained in demand assessment techniques. Attendees should also receive training on use of software and survey technologies for improving efficiency of the processes.
2. **PBS System Planning** – Participation of VMSS employees during the planning process, either through planning workshops or consultative sessions will help in developing technical expertise for PBS planning. At the end of their contract, before hand-off, the DBOT contractor should provide formal training sessions to VMSS planners on interpreting the reports produced by the MIS reporting software and using them to adapt PBS services to respond to demand.
3. **Design of PBS Components** – VMSS employees should be included in training workshops and system testing demonstrations held by the PBS system vendors. Regular consultative workshops, conferences or study tours are encouraged to learn about the state-of-the-practice and technological innovations.
4. **PBS System Operations** – The DBOT contractor should conduct individual system operations training sessions to provide hands-on training on (a) operating the fleet management software, fare collection software, and user interfaces; (b) operating the MIS reporting software to produce monthly/annual reports; (c) operations and maintenance of the bicycle fleet and redistributing vehicles; (d) operations and maintenance of the permanent infrastructure such as stations and terminals; (e) personnel management; and (f) fare determination and revenue management.

APPENDIX – A

EXPRESSION OF INTREST FOR IMPLEMENTATION AND OPERATION OF PUBLIC BICYCLE SHARING SYSTEM IN VADODARA CITY

Vadodara Municipal Corporation

MARCH 2016

1 | Sign & Stamp of Bidder

CONTENTS

VADODARA MUNICIPAL CORPORATION

EXPRESSION OF INTREST FOR IMPLEMENTATION AND OPERATION OF PUBLIC BICYCLE SHARING SYSTEM IN VADODARA CITY.

VMC invites Expression of Interest (EOI) from the interested operator of implementation and operations of Public Bicycle Sharing system with necessary infrastructure for the area of 6 sq km.

Bidding Procedure:

The complete set of EOI document for work can be obtained from the office, at the address "OFFICE OF THE EXECUTIVE ENGINEER, SPECIAL PROJECT DEPARTMENT, KHANDERAO MARKET BUILDING, RAJMAHEL ROAD, VADODARA-390209 during working hours on payment of demand draft (towards EOI documents fee) for an amount of **INR 10000/** drawn in favor of Municipal Commissioner, VMC payable at Vadodara. Alternatively, the EOI document can be downloaded from the website www.vmcegov.co.in. In this case demand draft of documents fee shall be furnished with EOI in separate cover. Hard copy of Biodata/Company Profile document for implementation and operations of Public Bicycle Sharing system should reach at the address mentioned below on or before **22/03/2016 upto16-00hrs** by **RPAD/Speed Post only**. To, Deputy Municipal Commissioner, Record Branch Rajmahel Road, Khanderao Market Building, VMC. Vadodara, GUJARAT.-390209.

P.R.O. No. /15-16 MUNICIPALCOMMISSIONER

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1. GENERAL INSTRUCTION FOR EOI

1.1 VMC is planning to implement the Public Bicycle Sharing (PBS) System for Vadodara City (Area Coverage-6 sq.km.) which will have 40 PBS stations, 500 bicycles and 750 docks.

1.2 The project is to be executed through private party who has implemented and operated (At least one completed work) the PBS system within last 10 years. **Capital cost for the project (As per the works mentioned in Annexure A) will be provided by the Government/VMC. Operator will be given fixed price per bicycle to operate and maintain the system in addition to advertisement rights on bicycles and stations. Operator has to adhere to service level bench mark given by the corporation.**

1.3 VMC reserves the right to accept any or reject all the EOIs at their sole discretion without assigning any reason thereof.

1.4 VMC shall have right to call for clarification/original of the supporting document for verification, as deemed fit and also to cross check for any details as furnished by contractors/clients/consultants etc. Agencies shall have no objection whatsoever in this regards.

1.5 Attached is the prescribed format of qualifying details. Interested, parties may use this format & add additional information as part of annexure, if they wish to.

1.6 The offer shall contain hard copy of completed Document giving following details:

- 1.6.1 Organization Profile along with details of incorporation, strength and constitution.
- 1.6.2 Names and Designation of the heads of the organization.
- 1.6.3 Details of the systems designed/ operated/ equipment provided globally/ nationally along with specifications of the equipment.
- 1.6.4 Terms and conditions/ Participation mode with other government agencies on similar cycle sharing projects both nationally/ internationally.
- 1.6.5 Arrangement with the City government for the operations.
- 1.6.6 Details of the systems in-operation/ bid for in India.
- 1.6.7 Details of collaboration with Indian company/ details of registration in India, if applicable
- 1.6.8 Contact information of the Company with Email address, Phone number, Postal Address of the head office and all branch offices along with name of the representative.
- 1.6.9 Clients certificates regarding satisfactory handling of such projects.

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1.7 Application should reach on or before 16:00 hours on dated **22/03/2016** in sealed cover addressed

To,
Deputy Municipal Commissioner,
Record Branch,
Rajmahel Road, Khanderao Market,
VMC. Vadodara, Gujarat.-390209
By RPAD/Speed Post only.

1.8 Applications without required information or enclosures are liable to be rejected.

1.9 For further inquiry for this tender contact :-
Mr. Jignesh Shah,
Dy. Executive Engineer
Mo. No. 9825221875

SCOPE OF WORK:

VMC intends to implement and operate the Public Bicycle Sharing System for area of 6 sq. km. of Vadodara City. The intension is to Non motorised vehicles as last and first mile connectivity in order to encourage public transportation system by providing bicycles as an alternative mode to private vehicles and para transit modes. The scope of work consists of procurement of infrastructure, building bicycle stations and control centre for Information Technology used, adhering to benchmarks and specifications given by VMC. The bidders will get revenue against the Cycle Trips completed & advertisement right given. Against that bidder has to offer positive and negative premium to VMC.

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(To be submitted on the letterhead of Prospective Bidder)

Date: /03/2016

To,
The Municipal Commissioner,
Vadodara municipal corporation.
Rajmahel Road, Khanderao Market,
VMC. Vadodara-300209

Dear Sir

Sub: Expression of Interest for implementation and operation of Public Bicycle Sharing System

With reference to the above advertisement, we hereby file this **'Expression of Interest (EOI)'** to undertake the development of this project.

We understand that this is an initial expression of interest on our part and mere submission of this EOI does not entitle us to receive any documents or be invited to bid for this project.

Name and details of Applicant and its representative authorized to file this EOI:	
Full Name	
Designation	
Name of Organization	
Address	
Phones	
Fax	
Mobile	
Email	
Website	

Legal constitution of applicant : *(Public limited/Private limited/Partnership etc)**

Current nature of business or activities :*

7

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Last 3 (Three) years turnover of the Applicant /Lead developer :*(CA certified/IT certified)
FY 2012-13
FY 2013-14
FY 2014-15

Net worth of the applicant / Lead developer :*
(Computed from the latest audited balance sheet)
FY 2014-15

Name and details of Business House/Group to which applicant belongs:*			
Name of the Group	Group Company/ies	Primary Activity	Turnover (FY 2014-15)

Details of the systems designed/ operated/ equipment provided globally/ nationally along with specifications of the equipment, if any :*

Terms and conditions/ Participation mode with other government agencies on similar cycle sharing projects both nationally/ internationally, if any :*

Arrangement with the City government for the operations:*

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Details of the systems in-operation/ bid for in India:*

Details of collaboration with Indian company, if applicable:*

Clients certificates regarding satisfactory handling of such projects:*

Note: * Applicants shall attach documents/brochures/corporate literature and give more details which you may feel necessary to justify profile.

I/We declare that the information stated hereinabove is accurate.

Signature:

Full Name:

Designation:

Organization:

Address:

Date:

VADODARA MUNICIPAL CORPORATION
Rajmahel Road, Khanderao Market, Vadodara-300209

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Evaluation

Bid Process Criteria (EOI Stage) for Selection of Bidders for implementation and operation of Public Bicycle Sharing System at Vadodara.

Stage-I: Invitation of EOI

Expression of Interest (EOI) is invited in prescribed format for understanding the response from the bidders. Interested agencies shall submit their offer to VMC on or before 16:00 hours on dated **22/03/2016.**

Stage-II: Short listing of EOIs

Criteria:

VMC shall shortlist the agencies on the basis of qualifying document submitted. Short listed agencies shall be asked to make presentation for their proposals. VMC authority may ask any agency to incorporate their suggestions in their presentation or a common design may be prepared incorporating important features from the design of all the bidders.

Stage-III : Call for Financial Bid

On Approval of final Planning/Design, VMC shall ask to the qualified bidders for the financial bid to submit separately.
Note :- VMC may ask the bidder to submit the financial model for implementation and operation of PBS system.

VADODARA MUNICIPAL CORPORATION
Rajmahel Road, Khanderao Market. Vadodara-300209

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SATELLITE IMAGE OF AREA COVERED UNDER PHASE-I FOR PUBLIC BICYCLE SHARING SYSTEM

Note : image not to scale, Source: Google earth

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Annexure A

1. Procuring, Installing, testing and operating a bicycle sharing system for Vadodara city for the required number of years with great service quality and customer experience.
2. Procuring hardware as specified:

    a. Bicycles: Low frame, RFID tag, with internal braking mechanism and 3 gear rear derailleur, front basket and lightweight bicycle with adjustable saddle and tubeless tires with headlamps and rear lamps and branding & equipped with GPS tracking system.

    b. Docks: RFID docks with card tapping mechanism and display, smart electronic locking, compatible with the bicycle.

    c. Terminal: with large LED display, rear advertising panel, keys for typing and swiping card/ or card tapping mechanism, software bundled and with GPRS, GPS and RFID tags.

3. Setting up of the Control and Calling Centre
    a. With required hardware and terminals for monitoring the bicycle sharing systems (at least 3 terminals)
    b. With data storage and backup mechanism for data protection
    c. Setting up the control centre with required facilities, air conditioning and internal facilities for people/ office staff.
    d. Setting up of large display panel for tracking of bicycles with GPS capabilities.
    e. Calling centre for hearing and noting customer complaints – at least 2 round the clock.
    f. Software to enable the above capabilities.
4. Interface

    a. Providing a graphically simple yet elegant web-based interface for customer and official purposes, complete with backend support and software support, integrated across systems and hardware with payment portals.

    b. Providing a mobile based interface for apple, android and windows for phones, well integrated across devices and payment portals.

    c. Setting up Customer Interface center/ Media centre for receiving complaints and providing support and information. The same shall also support the face book, twitter and other social profiles for the government, related to bicycle sharing system

5. Stations

    a. Designing, Constructing and Setting up of bicycle sharing stations, as per given plan, on street and off street, as indicated.

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b. Providing and getting approved a high quality, aesthetically pleasing, bicycle sharing station design in various modules with distinct identity and branding – getting it approved by government before execution.

c. Large stations to have adjoining facilities like drinking water, self-repair and fast food kiosk, medium sized stations to have facilities like self-repair and small food/ interaction centre, small stations to have manning capability if required.

d. Stations to be well integrated with street and with easy access to people and bicycles, without obstructing the walkways.

e. Stations to be shaded with trees, in case trees are existing. If not, trees to be provided.

f. Stations to have adequate sitting space for people

6. Service

a. Having the required fleet of trucks (modified) for transfer of bicycles within stations.

b. Having a bicycle storage and repair space of adequate size and area complete with tools and equipments.

c. Having required fleet of service vehicles available for quick response to incidents when reported.

d. Having optimal man-power to operate the entire system – Stations and Fleet, for 16hours in a day and Operations and Control Center, Calling Centre, for 24hours.

7. Outreach

a. Having a Media or Customer Centre for outreach through various mediums

b. Conducting user and experience surveys every 15 days and putting the results online with name, address and photographs of people interviewed.

c. Having a software interface to categorize the issues and putting them online as well.

d. Making partnerships with various companies to incentivize people to use bicycle sharing system through commercial offers.

e. Having a pleasing, simple yet communicative way of reaching out to people regularly.

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APPENDIX – B

DESIRED HARDWARE AND SOFTWARE SPECIFICATIONS

This section provides a list of specifications that are desirable but not binding for the purpose of this RFP. The DBOT Contractor is required to suitably modify the specifications as per the needs identified in the DPR.

Bicycle Specifications

A successful system will provide the following specifications for bicycles.

- Upright riding position for confident riding in traffic,
- Single-speed bicycle
- Lighting system compliant with all State and local laws that automatically illuminate when the bicycle is in use and remain on for at least two (2) minutes after the bicycle comes to a stop.
- Front, rear, and side reflectors
- Reliable and intuitive braking system
- Easy to operate, easy to mount and hold in stopped position
- Protection from grease, dirt, and tire spray, including enclosed drive train and full fenders.
- Cargo capacity for items such as a typical briefcase, book bag, and/or grocery bag weighing up to five kg, variety of sizes and configurations
- One size, which will fit users from 4’8” to 6’4” in height with tool-free seat only adjustment
- The bicycle shall be of unisex design with a frame that suits all individuals irrespective of gender
- Features designed to encourage ridership by women in traditional clothing
- Theft and tamper-resistant (potentially through use of components not compatible with other bicycles and/or requiring tools not commonly available)
- The bicycle shall be provided with a bell for alerting other road users if required
- The bicycle shall carry a unique ID for identification purposes
- Puncture-resistant tires
- Shall be provided with a front basket with a load carrying capacity of upto 5 kg without obstructing the movement of the handle
- Pedal-powered front/rear light system. Multiple power sources preferred.
- Kickstand or other device to allow bicycle to be supported upright
- Bicycles should look good in the urban environment and must be capable of being branded appropriately for a title sponsorship.
- Capacity for sponsorship or advertising that can be easily changed.
- The customer service telephone number on every bicycle with durable, weather resistant labels
- Colour customization
- Repair and maintenance manual included
- Parts and materials durable to withstand extreme weather conditions including extreme heat
- Useful life greater than five (5) years and a 5 year warranty preferred, but not required
- Fully protected or enclosed cables preferred
- Clearly visible space on bicycle for safety and instructional messaging
- If parts need to be modified or replaced if the software changes, they will be provided by the vendor at no cost.
- Equipment/software will be state of the art and easily upgradable.
- Active and/or Passive GPS tracking system integrated into the bicycle to recover missing or stolen bicycles, and to interface with website for personal health and performance data monitoring.
- Smart phone mount
- Ability to check in / check out without the use of a docking station

Docking Station Specifications

A successful system would address the following specifications for docking stations:

- Compliance with the Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995, and other requirements of the municipality, institution and/or private landowner in positioning stations
- Capacity to maintain security of the system during a power failure or loss of system communication
- Flexibility to install stations outside or in a covered area (e.g., parking garage).
- Capacity to issue real-time reports between stations and headquarters to report number of bicycles per station to facilitate re-distribution and locate bicycles needing repair
- Kiosk and map panel options that adhere to MCG specifications.
- Ability to operate without need to connect to electrical grid (this may be accomplished by solar power or other types of alternative energy sources, as feasible); including employment of a backup power source.
- Smallest feasible footprint to enable installation in a location currently used as a parking space or on a wide sidewalk with a layout that does not impede pedestrian traffic and ideally has no components that extend horizontally beyond the bicycle containment area footprint.
- Aesthetic compatibility with streetscape and neighbourhood context, both when station is full of bicycles and when it is empty
- Adequate space at kiosk for a lighted map indicating both station locations and bicycle routes
- Way-finding attributes that include maps and destinations of interest and nearby stations in English and Hindi.
- Ability to prevent out-of-service bicycles from being checked out, along with an indicator showing whether a bicycle is available or out-of-service.
- Unified look-and-feel of all stations within the network.
- Capacity to convey safety messaging, bicycle laws and warnings affecting cyclists in an easy-to-read format in all lighting conditions in English, and Hindi.
- Stations that are modular, easily relocated, require minimal time to install/remove and do not leave behind attachment points that could trip a pedestrian or impede traffic or parking.
- Useful life greater than five years.
- Can be deployed without kiosk
- Lighted space at each station for advertising panel
- Visible customer service phone number
- Stations must be able to be branded by a title or station sponsor
- Parts and materials are durable to withstand close proximity or exposure to extreme heat and dust
- Includes an installation and use manual
- Users can choose which specific bicycle they would like to rent
- Out of service bicycles are easily identified.
- Capacity for station and major components (bicycle, docks, terminal) to self-report malfunctions and mechanical problems.
- Clear and prominent instructions directing users how to report problems or a bicycle in need of repair
- If parts need to be modified or replaced if the software changes, they will be provided by the vendor at no cost.
- Ability to distribute fare media (i.e. key fobs or RFID cards) that can simplify the checkout process for casual users.
- Docking stations should be designed in such a way that they can be flexibly deployed on a variety of surfaces, grades, and configurations. No electrical service will be provided but in the event the System Operator chooses to obtain electrical service, all appropriate permits for electrical service and construction will be required.

Docking Station Terminal Specifications

- The primary purpose of the terminal at the docking station shall be to control the docks linked to it
- The terminal shall wirelessly communicate to its associated docks
- Each terminal shall be capable to control upto at least 15 individual docks
- The terminal shall be externally powered.
- A UPS having a back-up to carry out operations for at least 4 continuous hours during power outages shall be provided
- The terminal shall have a very user friendly and user interactive GUI for the user to perform the intended functions on it.
- The terminal shall be of touch screen type with at least 8" (diagonal) of usable & interactive touch sensitive screen
- The terminal shall be able to display a zoom-able map of the PBS System at desired resolution
- The terminal shall have the capability to be made completely solar powered (optional)
- The terminal shall be a stand-alone structure with good quality mounting arrangement on the floor of the PBS Station
- The terminal shall be able to produce different audible, visible and viewable alerts based on the transaction type
- The terminal shall have a capability to be upgradable with minimum modification to integrate it with a debit/ credit card machine for recharging the smart card without manual intervention
- The terminal shall be integrated with RFID readers (or similar) for smart card validation, receipt printing unit, biometric authentication (desirable) and necessary standard accessories
- Real-time information shall be displayed on the touch screen by fetching it from the central server.
- The terminal unit shall be ruggedised and shall be able to withstand Indian environmental conditions, be rust proof and with pleasing colors based on the branding scheme to be shared at a later stage
- The terminal shall be capable to be connected to the central server using internet and OFC communication system
- The terminal shall be able to perform self-diagnostics and send alerts to the central server in case of any mal-function

Bicycle Dock Specifications

- The primary purpose of the bicycle dock is to hold the bicycle securely in its position until it is released using proper authentication method at the connected terminal
- The user authentication shall happen using an RFID system or similar technology at the terminal which is wirelessly connected to the docks
- The dock shall preferably be based on electro-mechanic lock technology or equivalent
- The dock should have an indication of status based on colored LED lights
- The dock shall be modular and secure to move easily without much of civil work being involved
- The dock shall be designed for outdoor environment having at least IP 65 rating and rust-proof
- The dock shall have the provision of external power supply
- The dock shall also be powered internally using suitable back up power systems in case of power supply failure for at least 4 continuous hrs.
- The dock shall be able to produce distinctive sounds while releasing and locking a bicycle
- The lock attached with the dock should ideally lock the front wheel of the bicycle
- The designed life for the dock shall be at least 5 years under moderate usage conditions.

Redistribution Vehicle

The redistribution vehicle shall help to balance the bicycle requirement for addressing peak and off-peak demand fluctuations.

- The redistribution vehicle shall be able to carry at least 10 bicycles at any time without damaging
- The vehicle shall have mounting arrangements to secure the bicycles to avoid any collision and rupture during the movement of the vehicle to withstand acceleration and braking
- There shall be a provision to attach any towing facility at the rear of the vehicle in case of need
- The redistribution vehicle shall not deviate from any RTA rules and regulations as the internal design shall be modified to accommodate bicycles
- A closed container type vehicle is preferred as a redistribution vehicle
- Provisions for a tool kit and emergency medical kit along with minimum required fast moving spares shall be made in the design of the vehicle

Software Specifications

A successful system will address the following specifications for PBS software in each category:

Administrative

- Determining where each bicycle in the system is located in real time, and when it might have been lost
- Determine how many rides/km each bicycle has taken to facilitate maintenance.
- Produce a daily maintenance list for all system components
- Find disabled bicycles using the system
- Creating reports on usage and miles traveled on a system wide and bicycle----by----bicycle basis
- Shut down individual stations or the whole system temporarily
- Process for verifying user information via credit user information as well as adherence to current PCI (Payment Card Industry) standards (including chip-and-pin technology)
- IT system complies with current standards for data security, particularly for financial data, user names, and addresses. Describe any third party testing or verifications and liability and risk.
- The mobile app and website should communicate with PBS software system in real time
- Administrative functions of PBS software are accessible to PBS staff via web access from any internet-enabled location.
- Administrators and customer service representatives can access the functionality of individual stations / kiosks to assist end users.
- Administrators should be able to easily look up user accounts based on name, phone number, email, or user id.
- Administrators should be able to easily look up individual bicycles and stations for operational status
- Anonymised and scrubbed system functionality and data (ride and real time availability data, membership signup, payment, location based advertising) will be exposed to third party and open source software developers through secure APIs
- MCG or designated Operator will own the data generated by the system
- Software provides a comprehensive solution that helps the Operator streamline all aspects of the program, including managing fleet and equipment, customer service, finances, rebalancing, reporting, and pricing. Software is easily customizable and upgradeable.
- Software is easily configurable by the Operator to allow for various subscription types, reports, prices, or other features including the ability to administer discounts and promotions.
- Data including financial data is highly secure according to industry standards.

Website and Mobile Application

- System users can purchase memberships and agree to the terms of a liability waiver. Languages include English and Hindi.
- The website allows users to search for station locations through a variety of inputs (e.g. user-entered address, intersection or landmark names, selecting from an interactive map etc.)
- Members can access and update their membership information, re---- subscribe to the System and replenish their accounts
- Allows members to track their use of the PBS system
- Accessible from desktop computers and hand-held wireless devices such as PDA's, Smartphones, and web-enabled cell phones using browsers. Flash should not be used.
- Critical functionality does not use any extensions that are not pre-installed in the vast majority of browsers and any mark up or scripting should function correctly in all widely used browsers.
- Website and app should allow the operator to place advertising messages based on location
- Ability to indicate the closest station and number of bicycles to mobile or web user
- Routing and directional capabilities and support of the system's "Visitor Routes"

Kiosk and Payment Technology

A successful system will address the following specifications for kiosks and payment technology

- Ability to receive and manage all payments, fees, penalties, or other monetary transactions by users of the system
- Ability to accommodate different payment schemes including schemes that do not adhere to the industry standard
- Ability to provide ease of use to both "walk-up customers" and "subscribers"
- Adherence to industry standard data security and safeguards for financial and personal data of system users
- Ability to accept walk-up renters with agreement to liability waiver.
- Ability to interface with a unified electronic fare system
- The device and reader should be ISO 14443 compliant and capable of reading EMV cards.
- The security of the device be it card, phone, or fob should be equivalent to Mifare ultralight C or higher
- Limit on the number of subscriptions and walk-up rentals that can be purchased by one user or using one credit card.
- Touch-screen capabilities.
- Technology to accept and validate a variety of payment methods (e.g., cash, credit card, pay by phone)
- Legibility in all lighting conditions and operational in all normal weather conditions.
- Parts and materials durable to withstand coastal conditions including salt water and high humidity
- Flexibility to add features and modify terminal as needed.
- Ability to push software and/or firmware updates efficiently and with little downtime
- Automatic confirmation that subscriber's credit card is valid and has sufficient funds to cover charges if bicycle not returned (preferably before each bicycle is removed).
- Ability to use all major national and international credit cards
- Clear customer service number and instructions
- Include a process for facilitating users who desire to park a bicycle at a station where all docks are occupied
- A process for facilitating users who desires to get a bicycle at a station where all docks are empty
- Capacity to maintain security of the system during a power failure event or loss of system communication
- Instructions and interface available in multiple languages including English and Hindi.

- If parts need to be modified or replaced if the software changes, they will be provided by the vendor at no cost.

Data Services and API Specifications

The Vadodara PBS system will require daily and weekly performance reports. The Contractor will be expected to provide current performance measures on a real-time basis at the request of MCG or designated Operator or its representatives. The Contractor is expected to provide data on their website that is available to the public, which includes at a minimum the information regarding ridership, fleet performance and safety, customer service, and membership. The availability of data to the public is important to MCG to ensure that the public sees a return on investment for the use of public property and funds. All publicly available data should be made available as machine readable APIs.

A successful RFP would address the following specifications for data services and APIs:

- Database management system, including search functions and the possibility of using anonymised data for transportation planning purposes
- The Contractor will provide reports or enable access to MCG or designated Operator in accordance with an agreed upon schedule or on an as-needed basis
- All system data should be available in for immediate access for a period of one year, and archived indefinitely.
- The database is searchable and can provide both anonymised and non---anonymised reports as necessary
- Anonymised and scrubbed system functionality and data (ride and real-time availability data, membership signup, payment, location based advertising) will be exposed to third party and open source software developers through secure APIs
- Open architecture use as much as possible

Data Report

The Station Status for each active station in the system should, at a minimum, include the following data:

- Station number and identifier
- Station name
- Station address
- Station coordinates
- Station payment terminal availability (Does the station have the ability to process credit/debit cards?)
- Installed date
- Station status (open/closed)
- Station docks total
- Station docks available
- Bicycles currently available
- Broken bicycles at the station (if any)
- Last communication with the central computer system
- Last update from station

Ridership

- Number of trips per month
- Trip origin/destination by station
- Trips per time interval
- Percentage of trips per time interval
- Miles traveled per month

Fleet Performance and Safety

- Bicycles in service
- Fleet maintenance (number of bicycles inspected/repaired per month)
- Bicycles damaged per month
- % of time in service or available/in use
- Average response time inspect/repair a bicycles and return to service
- Average response time to remove damaged bicycles from service
- Membership/Pass Status
- Total number of users by membership
- New members
- Renewal rates

Customer Service Data

- Stations full or empty- number of instances
- Stations full or empty- time interval
- Stations full or empty- Percentage of instances per time interval
- Stations full- instances of additional time granted
- Stations full- Total number of extra minutes granted
- Rebalancing- Number of times bicycles picked up and dropped off at stations
- Customer service calls- Number of incoming calls and lost calls
- Average call length
- Average time to rebalance bicycles
- Average wait time for a customer call
- Customer call satisfaction

Trip Duration Data

- Trip/record identifier
- Start date and time
- End date and time
- Start station location
- End station location
- Bicycle number
- Membership/user type
- Miles traveled by trip
- Calories burned by trip
- Number of trips
- Ability for users to compare data versus “average user” or “similar user”
- Petrol saved per trip
- Average trips length and duration

Call Center Specifications

It is expected that the Contractor will assist MCG or designated Operator in setting up the Call Center. A description of the call center should include the number of anticipated customer service employees, and address the ability of customer service personnel to respond to voice, email, and text requests for help. In addition, the data systems should have the capacity to track customer service issues and generate status reports. The call center software and/or operating system proposed for use to handle, track and service calls must be specified must meet the following criteria:

- The system must be able to immediately aid users with mechanical issues and/or injuries.
- The customer service telephone number should be provided on every bicycle and station, with durable, weather resistant labels.
- There must be adequate staffing to ensure a maximum wait time of one minute, 24/7.
- The Contractor must present a program that ensures high customer satisfaction rating and allows the operator to address problems immediately.

APPENDIX – C

Summary of stakeholder interactions

A number of formal and informal consultations were held throughout the planning process with several stakeholders. A list of formal meeting held, comments received and how they were incorporated into the report is provided here. This is followed by detailed notes of all formal meetings.

List of Meetings and Workshops

SR. NO.	MEETING DATE	PURPOSE OF MEETING
1	5th June 2014	Commissioner, VMSS Introduction and project buy in
2	20th August 2014	Commissioner & Dhirenkumar N Talpada Discussions on internal capacity and project scope
3	22nd January 2015	Dhirenkumar. N Talpada, EE (Roads & Bridges) Consultation & data updates on street
4	5th March 2015	Kamati Baug Welfare Association Review of Kamati baug bicycle sharing initiative
5	3rd April 2015	Commissioner, VMSS Status updates, Presentation on pilot area selection
6	12th May 2015	MS University Discussions on coverage area around university
7	5th October 2015	Traffic Police Department Discussions on traffic co-ordination and PBS operations
8	12th December 2015	Jignesh J Shah, VMSS Consultation meeting
9	6th January 2016	Commissioner, VMSS Internal presentation on the PBS proposal
10	23rd February, 2016	Vadodara PBS Stakeholder Workshop Project presentation and discussions

Details of suggestions received

SR. NO.	MEETING DATE	SUGGESTIONS	RECIEVED FROM
1	5th June 2014	Suggestions on implementing PBS in a limited area, before implementing it to a city scale.	Commissioner, VMSS
2	20th August 2014	Opined that a pilot study would help the city learn about implementation of PBS.	Commissioner, VMSS
3	22nd January 2015	Suggestions on taking up University area as a pilot project, as there is a bicycle sharing initiative running currently.	Dhirenkumar Talpada, VMSS
4	5th March 2015	The current bicycle sharing programme is a successful initiative. It could be upgraded to provide better docking stations to promote biking within the park.	Kamati Baug Welfare Association
5	3rd April 2015	The newly appointed commissioner was appraised about the proposal.	Commissioner, VMSS
6	12th May 2015	Willing to support PBS, the architecture department offered design services for docking stations and branding. Willing to provide space for docking stations in the college. Suggested to start a smaller scale pilot project and requested to provide restrooms around docking stations, better shaded streets and docking stations to be provided at hostels.	MS University
7	5th October 2015	Supported the PBS initiative that could potentially alleviate congestion on roads.	Traffic Police Department
8	12th December 2015	Suggestions on coverage area of the pilot phase. Discussions on allocation of budget and necessary infrastructure.	Jignesh J Shah, VMSS
9	6th January 2016	Draft presentation for approval of the proposals, Discussions on implementation of the pilot phase and fare structure along with revenue mechanism.	Commissioner, VMSS
10	23rd February, 2016	University area is a good area for a pilot project and he pilot project could be made to stretch inside the campus of university as well.	Ms. Neha Sarwate
11	23rd February, 2016	PBS should work if the cycle is user friendly and can be used by all genders and ages. Also PBS should be environment friendly and should have shade along the tracks.	Ms. Nikita Lalwani
12	23rd February, 2016	Cycle tracks are a must and city should invest in having cycle tracks and safe cycling environments that are well-protected.	Ar. Mayur Saha
13	23rd February, 2016	Police has to play an important role in managing the tracks once they are built.	Dr. Mangesh Jaiswal
14	23rd February, 2016	Density of stations should be good and to be ensured that there is a station at every 300m or so. Every important place should be covered with having at least one station.	Mr. M.V.Patel
15	23rd February, 2016	The University campus should be made free of vehicles by the administration. Only walking and cycling to be allowed. Also it can play a part by designing the stations for the city.	Mr. Minesh Shah

APPENDIX – D

List of proposed projects in Vadodara CMP 2012| Source CMP Vadodara 2012

Project Code	Project Title	Project Description	Implementing Agency	Estimated Cost (INR crore)	Current Status
01	Construction of BRTS System in Vadodara City	With a view to prioritise and increase modal shift favouring public transport and to cater future transport demand, a MRT system has been proposed for Vadodara city by way of BRTS network. The project would include components like detailed design of BRTS corridors/terminals/bus stations, introduction of ITS technology for bus operations, fare collection system and at terminals/stations, social and environmental impact assessment. The total length of the proposed BRTS network is 82 km to be implemented in 3 Phases – 2011, 2016 and 2021.	VMSS	Phase I - 682 Phase II - 440 Phase 3 - 341	A pre-feasibility for Phase I is being finalised by VMSS
02	Improvement of City Bus Service in Vadodara City	At present, number of buses operating in the city is not sufficient to cater the demand. This has resulted in a lower modal shift towards public transport. Therefore to cater the demand it has been proposed to increase the fleet size and also introduce some special services so as to shift private vehicle passengers to public transport.	VMSS / ViTCOS	**Bus Fleet** Medium term - 225 Long term - 146	VMSS has privatised the intracity bus operations through ViTCOS and is enhancing the bus fleet from current 100 buses to 250
03	Construction of Pedestrian Facilities, Foot over bridge	The main objective of mobility plan is to mobilise people safely from one location to other. The locations have been identified where pedestrian facilities shall be provided. The sub projects would include detailed pedestrian plan and grade separated facilities. 1. Construction and improvement of sidewalks	VMSS	Sidewalks – 21 FOB - 13	Modalities for implementing FOB near Railway station is being finalised and construction of footpaths in the entire city has also been programmed.

Project Code	Project Title	Project Description	Implementing Agency	Estimated Cost (INR crore)	Current Status
		2. Construction of 8 FOB's			
04	Design and Construction of exclusive NMV Lanes	To promote NMV within the city it has been proposed to construct exclusive NMT lanes. The project details include preparing detailed plan for NMT lanes followed by detailed design and construction.	VMSS / VUDA		
05	Construction of Parking complex on PPP basis	Probable locations for off-street parking locations have been identified. The project would include detailing of parking facilities on PPP basis.	VMSS	Construction of 'off-street' multi-storey / surface car parks – 74	To be initiated by VMSS
	Intersection Improvements	Improvement of 20 junctions in the city and signalisation of Junctions	VMSS	2.5	Considerable progress has been made by VMSS
	Education measures	Development of Traffic Education and awareness modules	Traffic Police	2.4	-
06	Modernisation and Construction of Intercity Bus Terminal	Along with improvements in city bus service it is also essential to upgrade existing terminal infrastructure and construct new ones for providing better facilities. The project details include upgrading of existing terminal with IT technology, better parking facilities, construction of pedestrian facility for safe movement within the terminal. The other aspect of project is to design and construct new terminal facilities at identified locations with all above facilities. A total number of 17 terminals have been identified for improvement / modernisation out which 8 terminals will be new terminals	VMSS / VUDA	35	The augmentation of terminals will need some efforts from VMSS and VUDA
07	Construction of Truck Terminals	The project comprises of designing of truck terminal including all	VMSS / VUDA	100	The planning is being initiated by VMSS / VUDA

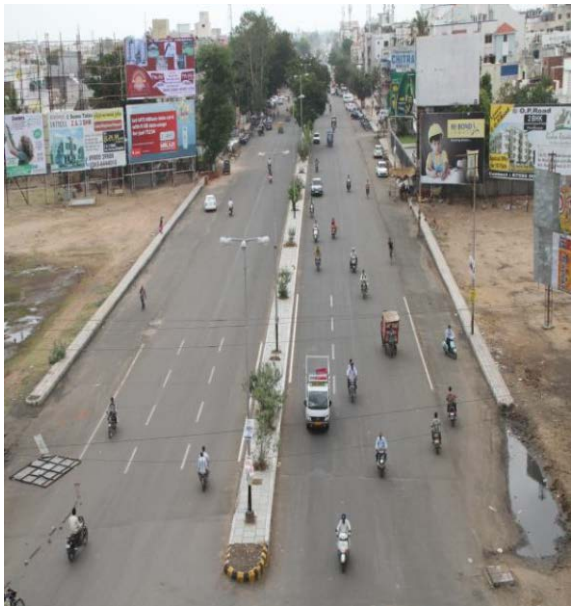
Project Code	Project Title	Project Description	Implementing Agency	Estimated Cost (INR crore)	Current Status
	(Transport Nagar)	facilities within it followed by construction activity. The truck terminals have been proposed at 4 locations in the city.			
08	Construction of Flyovers, ROB's	The locations for ROB's, Flyover have been identified in CMP document. The project would include detail engineering design and construction of the same. 12 ROB's have been proposed in the city.	VMSS / VUDA	270	The ROB proposals have been taken up for detailed studies
09	Widening of Roads	In order to reduce congestion and improve speeds on the major roads it has been proposed to utilise the maximum capacity of roads. The project includes widening of roads as per the details mentioned in the document.	VMSS/VUDA/PWD		
		1. Road widening / strengthening / upgrading of existing roads		Medium term - 536 Long term - 99	
		2. Construction of new roads including bypass system		Medium term - 500 Long term - 476	

APPENDIX – E

New projects of Road and footpath construction in Vadodara, VMSS| Source VMSS

1.	Location	Construction of 40.00 mtr wide Ring Road from Manekpark to L & T Circle to Race Cource Circle to Akshar Chawk to Vadsar to Sushen Circle to Soma Talav to Sardar Estate to Manekpark.
2.	Lane	Six (Both Side 3 lanes)
3.	Year of construction	2010.
4.	Cost	INR 57.00 Crore.
5.	Details of road	
	(1) Length of road	27.000 km
	(2) Carriageway (Service Road)	2 x 11.00 Mtr.
	(3) Divider	2.00 /1.00 Mtr.
6.	Name of Contractor	M/s.R.K. Construction
7.	Name of TPI	Certifications Engineers India Limited.
8.	Advantages	This road has created smooth flow of traffic and reduced accidents as a result of better riding surface. Also has saved fuel as well as time and reduced pollution.

1.	Location	Road from Lalbaug Bridge End to Munjmahuda to Akshar Chowk to Atladara Railway Station upto Municipal limit
2.	Lane	Six
3.	Year of construction	2012
4.	Cost	INR 10.38 Crore.
5.	Details of road	
	(1) Length of road	4.75 Km.
	(2) Carriageway	2 x 11.00 Mtr.
	(3) Divider	1 Mtr/2 Mtr.
	(4) Foothpath	2 x 2 Mtr.
6.	Name of Contractor	M/s. R.K.C. Infrabuilt Pvt. Ltd.
7.	Name of TPI	Certifications Engineers India Limited.
8.	Advantages	• By developing this road, there is ease of traffic towards Padra /Jambusar Road. • Due to widening of this road carriageway increased, which creates smooth flow of traffic and less accidents. Due to better riding surface there is saving in fuel as well as time and reduces pollution.



1.	Location	Road from Muktanand to Sangam Char Rasta to Mahavir Hall Char Rasta to Kaladarshan to Dabhoi Road (Inner Ring Road).
2.	Lane	Six
3.	Year of construction	2013
4.	Cost	INR 18.83 Crore.
5.	Details of road	
	(1) Length of road	7.500 km.
	(2) Carriageway	2 x 11.00 Mtr.
	(3) Divider	2.00 Mtr.
	(4) Foothpath	2 x 1.00 Mtr
6.	Name of Contractor	M/s. Rajkamal Builders Infrastructure Pvt.Ltd.
7.	Nameof TPI	Certifications Engineers India Limited.
8.	Advantages	Due to widening of this road carriageway width increased between Dabhoi Road and Karelibaug which creates smooth flow of traffic and less accidents, Due to better riding surface there is saving in fuel as well as time and reduces pollution.

1.	Location	R.C.Dutt Road
2.	Lane	Six
3.	Year of construction	2012
4.	Cost	INR 3.48 Crore.
5.	Details of road	
	(1) Length of road	1.600km.
	(2) Carriageway	2 x 8.50/2 x 5.5 Mtr.
	(3) Divider	2.00 Mtr.
6.	Name of Contractor	M/s. Simandhar Construction.
7.	Nameof TPI	Certifications Engineers India Limited.
8.	Advantages	Due to widening of this road carriageway will increase which creates smooth flow of traffic and less accidents, Due to better riding surface there is saving in fuel as well as time and reduces pollution

1.	Location	Construction of bridge and road on 40.00 mtr wide road connecting Dandiya Bazar and Akota	
2.	Lane	Six	
3.	Year of construction	2013	
4.	Cost	INR 46.00 Crore.	
5.	Details of Bridge/Road	**Bridge Details**	**Road Details**
	(1) Length of road	0.360 km	0.840 km
	(2) Carriageway	2 x 11.00 Mtr.	2 x 11.50 Mtr.
	(3) Divider	1.00 Mtr.	1.00 Mtr.
	(4) Cycle track	-	2 x 5.00 Mtr.
	(5) Footpath	2 x 1.50 Mtr.	2 x 2.25 mtr
	(6) Gardening	-	2 x 0.75 mtr
7.	Name of Contractor	M/s. Rajkamal Builders Infrastructure Pvt.Ltd.	
8.	Name of TPI	Certifications Engineers India Limited.	
9.	Advantages	This road connects old city to western part of the city which reduces traffic density on other parallel roads towards western part of the city. After construction of this road, there is saving in fuel as well as time and reduces pollution.	

1.	Location	Construction of service road from Manek Park Junction to Genda Circle to Akshar Chowk Road.
2.	Lane	Four
3.	Year of construction	2013
4.	Cost	INR 12.80 Crore.
5.	Details of road	
	(1) Length of road	9.000 km
	(2) Carriageway (Service Road)	2 x 7.00 Mtr.
	(3) Divider	2.00 Mtr.
	(4) Footpath	2 x 2.50 Mtr.
6.	Name of Contractor	M/s. Simandhar Construction.
7.	Name of TPI	Certifications Engineers India Limited.
8.	Advantages	By constructing this road wall to wall, atmosphere will be free from dust.

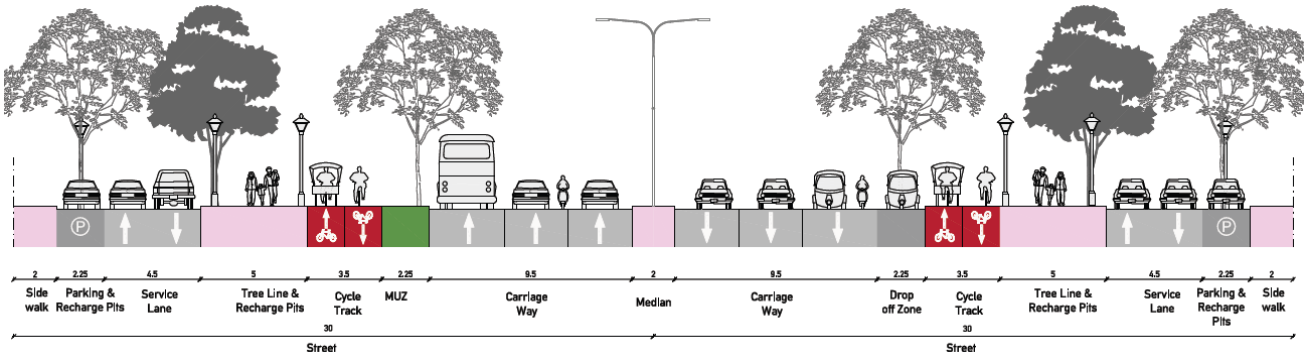
APPENDIX – F

List of roads proposed in CMP, Vadodara for construction of footpath.| Source CMP Vadodara

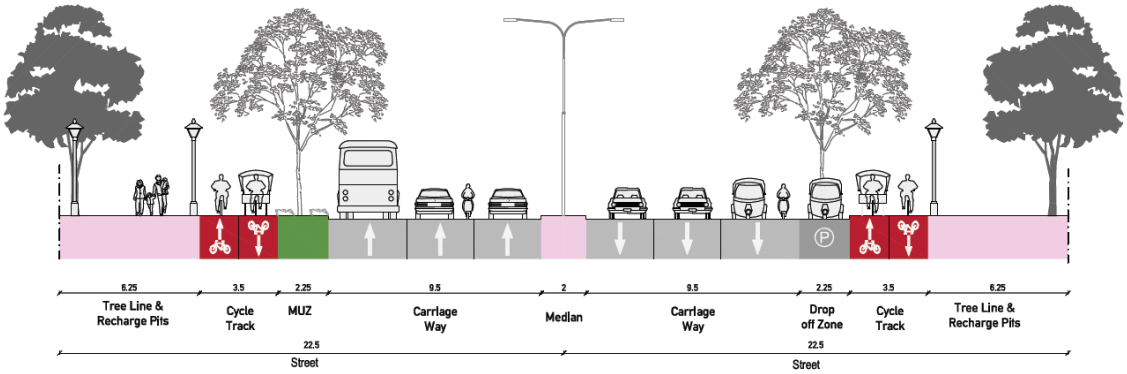
1. Old Padra Road from Aksar Chowk to Ambedkar Chowk
2. Wadsar Road
3. Outer Ring Road (University Road, VIP Road and section from harni Road to Soma talav
4. Inner Ring Road (Muktanand Road and Lal Bhadur Shastri Marg)
5. Tilak Road
6. Jail Road
7. Jawahar Lal Nehru Marg
8. Indira Gandhi Marg
9. Indulul Yagnik Road up to Makarpura
10. Old Mumbai Road (Kamati Bagh Marg & Dr Rajender Prasad Marg up to New Sama Road Junction
11. Alembic Road
12. Gotri Road from Race Course to Gotri Village
13. Akota Road
14. Jetalpur Road
15. Vasna Road from Old Padra Road to Tandalja

APPENDIX – G

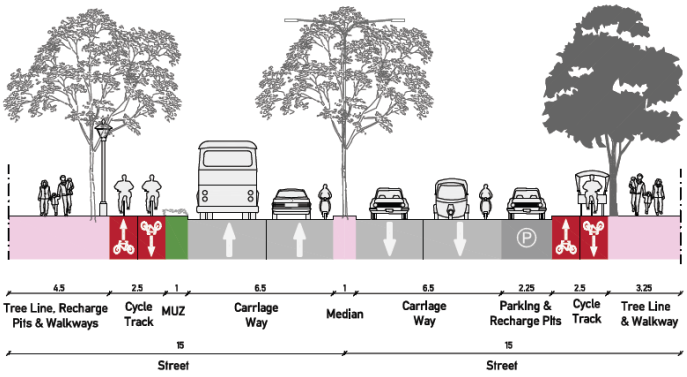
Typical cross sections of road with NMT infrastructure| Source: CGM



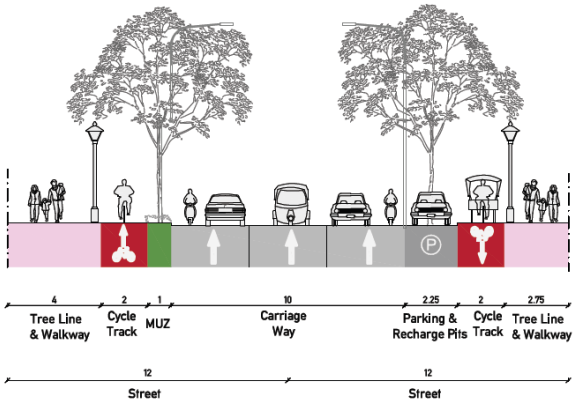
Typical 60m road section



Typical 45m road section



Typical 30m road section



Typical 24m road section

APPENDIX – H

Component & All Costs in INR		Item	Automatic			Semi- Automatic			Manual		
			Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
PBS System		Bicycle	2,70,00,000	6,75,00,000	9,30,00,000	2,70,00,000	6,75,00,000	9,30,00,000	2,70,00,000	6,75,00,000	9,30,00,000
		Dock (Electronic)	39,90,00,000	99,85,50,000	1,29,25,50,000	-	-	-	-	-	-
		Terminal at PBS Station	7,48,00,000	18,72,20,000	24,44,20,000	3,40,00,000	8,51,00,000	11,11,00,000	34,00,000	85,10,000	1,11,10,000
		Control Centre	2,00,00,000	2,00,00,000	2,00,00,000	20,00,000	20,00,000	20,00,000	-	-	-
		Redistribution Vehicles	1,44,00,000	3,60,00,000	4,96,00,000	1,44,00,000	3,60,00,000	4,96,00,000	1,44,00,000	3,60,00,000	4,96,00,000
		Maintenance Garage Set-up	32,00,000	72,00,000	96,00,000	32,00,000	72,00,000	96,00,000	32,00,000	72,00,000	96,00,000
		Installation + Project Management cost	13,46,00,000	32,91,17,500	42,72,92,500	2,01,50,000	4,94,50,000	6,63,25,000	1,20,00,000	2,98,02,500	4,08,27,500
Civil Infrastructure (PBS Stations)		Station - Small	60,00,000	1,51,00,000	2,51,00,000	3,00,00,000	7,55,00,000	12,55,00,000	3,00,00,000	7,55,00,000	12,55,00,000
		Station - Medium	1,60,00,000	4,00,00,000	5,00,00,000	6,40,00,000	16,00,00,000	20,00,00,000	6,40,00,000	16,00,00,000	20,00,00,000
		Station - Large	1,20,00,000	3,00,00,000	3,60,00,000	4,80,00,000	12,00,00,000	14,40,00,000	4,80,00,000	12,00,00,000	14,40,00,000
Total CAPEX			**70,70,00,000**	**1,73,06,87,500**	**2,24,75,62,500**	**24,27,50,000**	**60,27,50,000**	**80,11,25,000**	**20,20,00,000**	**50,45,12,500**	**67,36,37,500**
Incremental Component		Bicycle with Gears (INR)	-	-	-	-	-	-	-	-	-
		Bicycle with GPS (INR)	36,00,000	90,00,000	1,24,00,000	-	-	-	-	-	-
Total CAPEX with Incremental Components			**71,06,00,000**	**1,73,96,87,500**	**2,25,99,62,500**	**24,27,50,000**	**60,27,50,000**	**80,11,25,000**	**20,20,00,000**	**50,45,12,500**	**67,36,37,500**
Component		Item	Automatic			Semi- Automatic			Manual		
Supporting Civil Infra	Intersection Improvement	Minor	1,10,00,000	5,00,00,000	12,00,00,000	1,10,00,000	5,00,00,000	12,00,00,000	1,10,00,000	5,00,00,000	12,00,00,000
		Major	1,25,00,000	6,25,00,000	17,50,00,000	1,25,00,000	6,25,00,000	17,50,00,000	1,25,00,000	6,25,00,000	17,50,00,000
	Cycle Lanes	Improvement of Existing	2,00,000	-	-	2,00,000	-	-	2,00,000	-	-
		Lane Demarcation (New)	10,50,000	-	-	10,50,000	-	-	10,50,000	-	-
		Dedicated Cycle Tracks (New)	1,12,50,000	2,70,00,000	3,90,00,000	1,12,50,000	2,70,00,000	3,90,00,000	1,12,50,000	2,70,00,000	3,90,00,000
Total Cost of Supporting Civil Infra			**3,60,00,000**	**13,95,00,000**	**33,40,00,000**	**3,60,00,000**	**13,95,00,000**	**33,40,00,000**	**3,60,00,000**	**13,95,00,000**	**33,40,00,000**
Fully Loaded PBS System			**74,66,00,000**	**1,87,91,87,500**	**2,59,39,62,500**	**27,87,50,000**	**74,22,50,000**	**1,13,51,25,000**	**23,80,00,000**	**64,40,12,500**	**1,00,76,37,500**

APPENDIX – I

Service Level Benchmarks (Adapted from Bhopal RFP)

	S. No:	Performance Indicator	Explanation	Time	Acceptable Service Level	Compensation- Meeting the standard
Bicycle Distribution	1	High priority stations*- empty, peak hours	Percent of the time that high-priority stations are empty during peak hours	7am - 10 am & 4pm-7pm everyday	Should be less than 5% of the total time of operation	5% of the Operating Cost/ month
	2	High priority stations- empty, non- peak hours	Percent of the time that high-priority stations are empty during peak hours	Operating hours excluding peak hours	Should be less than 10% of the total time of operation	2.5% of the Operating Cost/ month
	3	Low priority stations- empty, peak hours	Percent of the time that high-priority stations are empty during peak hours	7am - 10 am & 4pm-7pm everyday	Should be less than 15% of the total time of operation	2.5% of the Operating Cost/ month
	4	Low priority stations- empty, non- peak hours	Percent of the time that high-priority stations are empty during peak hours	Operating hours excluding peak hours	Should be less than 20% of the total time of operation	2.5% of the Operating Cost/ month
Availability	5	Bicycle Availability	Average cycle fleet available per day	At 6 am or when the operations start in the day whichever is later	Should always be 95% or more of the total authorised fleet size	2.5% of the Operating Cost/ month
	6	Service Availability	Number of hours when the system is operational	Operating hours of the system	Should always be 100% of the agreed hours of operations (unless permission has been granted by BMC for otherwise)	2.5% of the Operating Cost/ month

Registration	7	Registration of Members	% of valid applications and registrations that are processed and membership issued within a day	All through the month	90% of all valid applications will have to be processed within 1 day of receipt of application	5% of the Operating Cost/ month
	8	Registration of Non Members or Renewal of Membership or Top up of smart cards	% of valid applications for non-members, renewals and top of smart cards within half an hour	All through the month	90% of all applications will have to be processed within half an hour	5% of the Operating Cost/ month
Maintenance	9	Availability of the Website and smart phone app	% of total time in a month when website and smart phone app is not available	All through the month	The website and smart phone app are available for at least 90% of the time during the entire month	2.5% of the Operating Cost/ month
	10	Maintenance Schedule	Following the pre-determined maintenance schedule	All through the month	The maintenance schedule is followed more than 90% of times as pre- determined	5% of the Operating Cost/ month
Usage	11	Ridership Level	Average ridership of the system per cycle/ day	All through the month	If the average ridership in the system is more than 4/ cycle/ day	5% of the Operating Cost/ month
	12	Memberships	Total Memberships/ month	All through the month	If the total no: of memberships for the system is 750 members or more	5% of the Operating Cost/ month
Awareness	13	Trial Users	No: of people who were riding during the trial riding sessions/ no: of unique trial sessions	All through the month	If the total no: of trial users is more than 500 unique users/ month & more than 10 trial sessions/ month with different groups	5 % of the Operating Cost/ month