CITIES DEVELOPMENT INITIATIVE FOR ASIA

FINAL REPORT
PART II- TRAFFIC AND TRANSPORTATION

EXECUTIVE SUMMARY

1. International Inputs for Revision of City Development Plan and Investment Programme Review,

2. Preparation of a Medium Term Investment Plan (MTIP) and Pre-Feasibility Studies (PFS) for

a) Integrated Traffic and Transportation Operational, Investment and Management Plan and

b) Integrated Environmental and Infrastructure Improvements for Slums in Vijayawada, India.

CDM Smith

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Executive Summary

1.0 Background

1.1 Study Background and Objectives

This report presents the results and recommendations of an urban transport Pre-Feasibility Study (PFS) conducted for the city of Vijayawada in collaboration with the Vijayawada Municipal Corporation (VMC) and the Cities Development Initiative for Asia (CDIA).

CDIA is a regional initiative established in 2007 by the Asian Development Bank and the Government of Germany, with additional core funding support of the governments of Sweden, Austria and Spain and the Shanghai Municipal Government. The Initiative provides assistance to medium-sized Asian cities to bridge the gap between their development plans and the implementation of their infrastructure investments. CDIA uses a demand driven approach to support the identification and development of urban investment projects in the framework of existing city development plans that emphasize environmental sustainability, pro-poor development, good governance and climate change.

Urban transport is one among the three components of the study; the other two are the revision of CDP and the infrastructure improvement for slums. PFS projects have been selected from a list of a preferred short to medium term projects through a prioritization process relying largely on stakeholder inputs. These proposed transport projects have been further developed and analyzed as two investment packages to the pre-feasibility level.

The study consists of two phases. Phase 1 deal with the development of a Medium Term Investment Plan (MTIP). Phase 2 covers follow-on Pre-Feasibility Studies (PFS) for the preferred investment programme aimed at interesting potential domestic and international financial institutions or private sector investors to participate in the programme.

1.2 Vijayawada City

Study area covers Vijayawada City, one of the smaller metropolitan cities in India, located in the State of Andhra Pradesh. The city has a population of 1.04 million (2011) and occupies an area of 61.88 sq kms. Since it is located at the junction of major rail and road networks, it serves as the economic center for coastal region of the state and acts as a major regional commercial hub. The study area is shown in **Figure 1**.

Figure 1 - Study Area

Vijayawada city has traditionally been the main agricultural market as well as a commercial centre to a host of wholesale and retail activities in southeastern Andhra Pradesh.

1.3 Strategic Setting

1.3.1 Economy of the City

All these city's economic activities generate a GDP for Vijayawada of about $3 billion (Rs. 16, 06,500 crore) in 2010. It is projected to grow to $17 billion (Rs. 91,03,500 crore) by 2025.

Agricultural commodities produced in hinterland finds its market in Vijayawada both for local consumption and export. It is a major trading center for processed Virginia Tobacco, cotton, turmeric and mangoes. Consumer goods, textiles, automobiles, industrial products are also traded in significant volumes in this area. The tertiary sector provides employment for 70% of the work force

Agro based industrial activity located in the city include solvent extract plants, rice mills, oil and dal mills etc. The city has more than 2,500 of these small scale industries.The industrial and other economic activities have diversified over the past few decades and have resulted in an influx of workers and a consequent growth in population.

There are two industrial estates in the area: one in Auto Nagar (340 acres) and the other in Kondapalli (450 acres), 16 km away from the city. Together both these estates are major industrial destinations and close to 2,500 enterprises operate in them providing substantial employment. Besides logistic hub for the storage and bottling of petroleum products, Kondapalli also houses Vijayawada Thermal Power Project (VTPP), a 768 MW gas-based LANCO power plant and Andhra Pradesh Heavy Machinery & Engineering Limited (APHMEL) factory. The second largest wagon workshop of Indian railways is at Rayanapadu situated between Kondapalli and Vijayawada.

1.3.2 City Development Patterns

In the early 50's, the city was mostly confined in the area between the Indrakiladri Hills, then started expanding eastward along the Bandar Road (former NH5) and thereafter along Eluru Road. With the setting up of Auto Nagar Industrial Estate and residential developments such as Vidyadharapuram, Bhavani Puram and HB Colony the development of the city spread towards the east. The Lanco thermal power plant (1980) and the residential township on the west along the NH-9 increased the city limits to the west.

Historically, the railway line acted as a barrier to the development of the northern region and Krishna River in the south limited the city's growth in that direction. Thus the city's growth has been mainly in the east –west direction as shown in **Figure 2**.

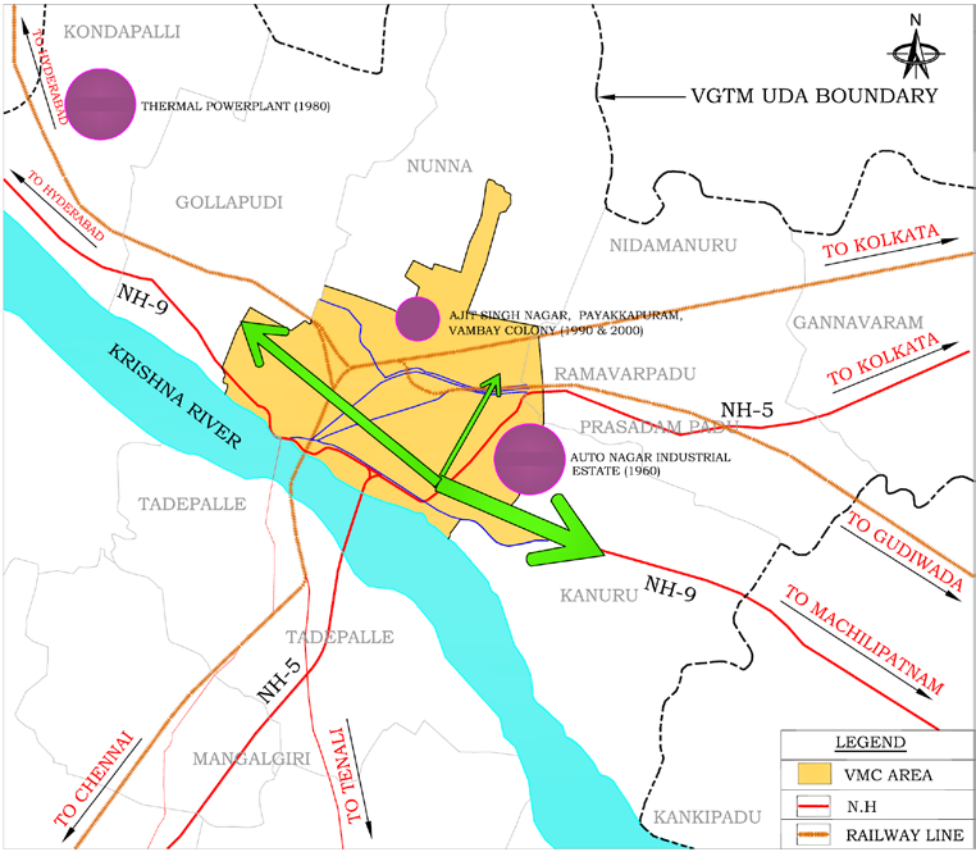

Figure 2 - Growth Direction of the City

1.3.3 Growth Potential of the City

The strategic location near the coast, and its location as a hub on the national highway and rail networks, lower labor costs, access to power and water resources, proximity to an airport, presence of good educational institutions and proximity to the hinterland, and a substantial industrial base offers Vijayawada a variety of opportunities for future economic development. A large portion of the state GDP already comes from the Vijayawada region. The state government is investing heavily in the region to transform it into an IT and industrial hub for Andhra Pradesh. Vijayawada is being touted as potential hub for manufacturing activities[1]. To support the potential economic opportunities significant industrial and other developments are proposed in the region by the state and national governments:

- Apparel Park (1,000 acres) is located within 25 km of the city;
- L&T Hitech City Limited, a joint venture between private sector and the Andhra Pradesh State Government (GoAP), is proposed as an IT/ITES SEZ Project spread over 30 acres of land opposite to Gannavaram airport.
- IT park with an area of 40 acres is being developed by VGTM-UDA in Mangalagiri;
- GoAP has plans to create a Mega Manufacturing and Investment Hub (MMIH) and an Industrial Corridor (IC), similar to the Mumbai - Delhi corridor.
- State government is proposing the Hyderabad-Vijayawada-Visakhapatnam Growth Corridor (HVVGC) to give thrust to industrial growth.

Besides industrial and commercial growth, the city sees some potential for tourism development which has been neglected.

In summary, there is a considerable potential for development in Vijayawada and the surrounding region; it is important for the city to provide an environment conducive to this growth. In part this can be addressed by having more efficient city service through improving transportation infrastructure. Not only does this improve the economic base of the city, but it enhances the social wellbeing of its citizens. As described below, the proposed programme does both.

1.4 Report Structure

The Pre-Feasibility Report on which this Executive Summary is based is structured as follows:

A. Executive Summary

B. Volume 1: Main Report

Section 1 - Overview of the study

1 (http://cii.in/PressreleasesDetail.aspx?enc=Rfr1Vsv+F7a9Ff7/lRGKxg==).

Section 2 - Development Issues

Section 3 – Short listing of Projects

Section 4 - Development Impacts

Section 5 - Economic Analysis

Section 6 - Municipal Finance and Funding Options

Section 7 - Implementation Arrangements and Action Plan

Section 8- Marketing Strategy

C. Volume 2: Pre Feasibility Report

Section 1 – Pre Feasibility Study for Package 1

Section 2 – Pre Feasibility Study for Package 2

D. Volume 3: Annexure

Annexure 1.1 - Service Level Benchmarking and Gap Assessment

Annexure 1.2 - Notes of the Steering Committee Meeting held on 18.10.2012

Annexure 1.3 - Prioritization Methodology for Transport Sector

Annexure 1.4 - Notes of the Project Prioritization Workshop held on 11.02.2013

Annexure 1.5 - Notes of the Steering Committee Meeting held on 01.03.2013

Annexure 1.6 - Notes of the Steering Committee Meeting held on 23.04.2013

Annexure 2.1 - Traffic Data Collection & Analysis

Annexure 2.2 - Notes on Road Safety

Annexure 2.3 - Rate and Quantity Analysis

2.0 The Proposed Urban Transport Programme

2.1 Assessment of Transport Needs

2.1.1 Vijayawada's Urban Transport System

Road Transport System: With the evolution of the city, the road network did not expand as rapidly as it should have; as a consequence road space occupies only 16% of the total land use area, which is below the standard norms of 25%. The length of all the city's roads is about 1,200 km. The main features of the arterial network are shown in **Table 1**. Traffic levels of the 2 National Highways (NH 5 and 9) are quite high. In addition, the city is criss crossed by an extensive rail network and 2 major canal networks. To the south, the Krishna River limits the boundary of the city to the south.

Table 1- Features of the Major Roads in Vijayawada

Sl No	Road Name	Length within city	Lane type	Median/Service road availability	Sidewalks (Footpaths	Traffic (PCU/day)	Land Use
1	NH 5	8 kms	4 lane divided	Median –yes Service road – yes	No	71,577	Mixed
2	NH 9	6 kms	4 lane divided	Median – Yes Service road – No	No	67,617	Mixed
3	Bandar Road	6 kms	6 lane divided	Median – Yes Service road – No	80% length	NA	Commercial
4	Eluru Road	6.5 kms	4 lane divided	Median – Yes Service road – No	80% of length	40,778	Mixed
5	Tunnel Road	5 kms	2 lane undivided	Median – No Service road – No	60% of length	42,960	Mixed
6	Gopal Reddy Road to PSC Bose Road via ITI road	8 kms	Mix of 2 lane undivided & 4 lane divided	Median – yes (partial) Service road – No	No	55,350	Mixed

Source: Primary survey by CDM Smith (2013) & Secondary data from R&B department

Parking facilities are largely limited to the curb side. Both paid and free parking are used. There is a wide acceptance to paid parking. There are ten major intersections of which few are signalized[2].

There exists a large number of road & rail and road & canal crossings as shown in **Figure 3**. They tend to impede the flow of road traffic to channelize traffic creating bottlenecks. Pedestrians are the most neglected group of travellers in the city. Many roads do not have any sidewalks and when they do the pathway is obstructed. Consequently, pedestrians are forced to share the roadway with motorized traffic; a very unsafe situation. As a result, accident levels in the city are quite high at over 300 fatalities a year.

Public Transport System: Public transport is provided by a state transport company (APSRTC). Although the service covers 117 routes; its coverage of the city is incomplete and new routes need to be added.

The main issues facing the city's transport system are:

- Congestion due to a lack of road capacity that does not keep pace with the growth of traffic and numerous road rail and canal crossings that often act as bottlenecks;
- Poor traffic management due to limited usage of signals;
- High accident rates due to poor road conditions, driver discipline, and enforcement and a lack of adequate sidewalks.

2 Few have signals but they are not in use.

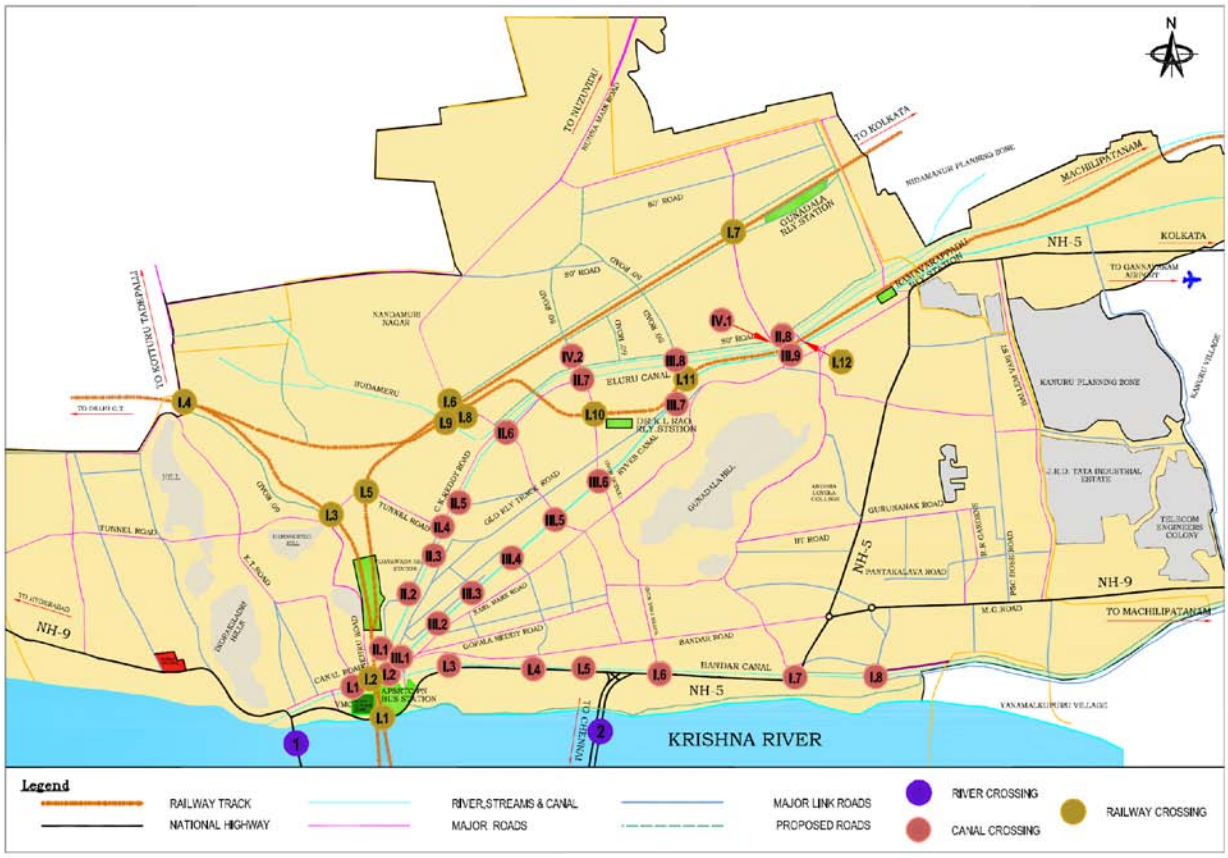

Figure 3 - Locations of Canal Bridges and Railway Level Crossings

2.1.2 Transport Gap Assessment

Using the Service Level Benchmarks set by the Ministry of Urban Development, the city's transport system was evaluated. Of the 10 service level benchmarks, the performance levels indicate that the city needs considerable improvement in road capacity and in facilities for pedestrians, parking and non-motorized transport (cycles) as shown in the **Table 2**. Intelligent Traffic Systems (ITS) are nearly non-existent.

Table 2 - Existing Levels of Service in Vijayawada for the Urban Transport Sector

Service Level Benchmark	Level of Service	
	Present	Target in 5 years
Public Transport facilities	2	1
Pedestrian Infrastructure facilities	3	1
Non-Motorized Transport facilities	3	1
Intelligent Transport System facilities	4	3

Service Level Benchmark	Level of Service	
	Present	Target in 5 years
Travel speed along Major corridors	3	2
Pollution levels	2	1
Road Safety	4	2
Availability of Parking Spaces	4	2
Integrated Land Use Transport System	2	2
Financial Sustainability of Public Transport	3	2

Notes:
Detailed analysis given in the Interim Report
Range: Poor = 4 to Satisfactory = 1
Target is for the end of a 5 year period through an improvement programme.
Source: Consultant

The results of the gap assessment confirmed the Consultant's observations in the field. The main gaps cover the following areas of:

- Traffic management and safety;
- Public transport;
- Road capacity;
- Transport infrastructure serving other modes of transport such as non-motorized transport and pedestrians.

2.1.3 Medium Term Investment Plan (MTIP) and Project Selection for PFS

The gap assessment set the stage for the development of the MTIP and the selection of projects for PFS.

A three step process was used as shown in the following flow chart **Figure 4**. Firstly, all relevant transport projects were identified from previous studies, meetings with key stakeholders, and the Consultant's observations that met the above criteria. Secondly, a short list of projects was selected for the MTIP after having been screened. Thirdly, through a workshop undertaken with the VMC's technical staff, integrated packages of urban transport projects was prioritized and identified for PFS. A final step was the endorsement of the recommendations of the workshop by the Steering Committee.

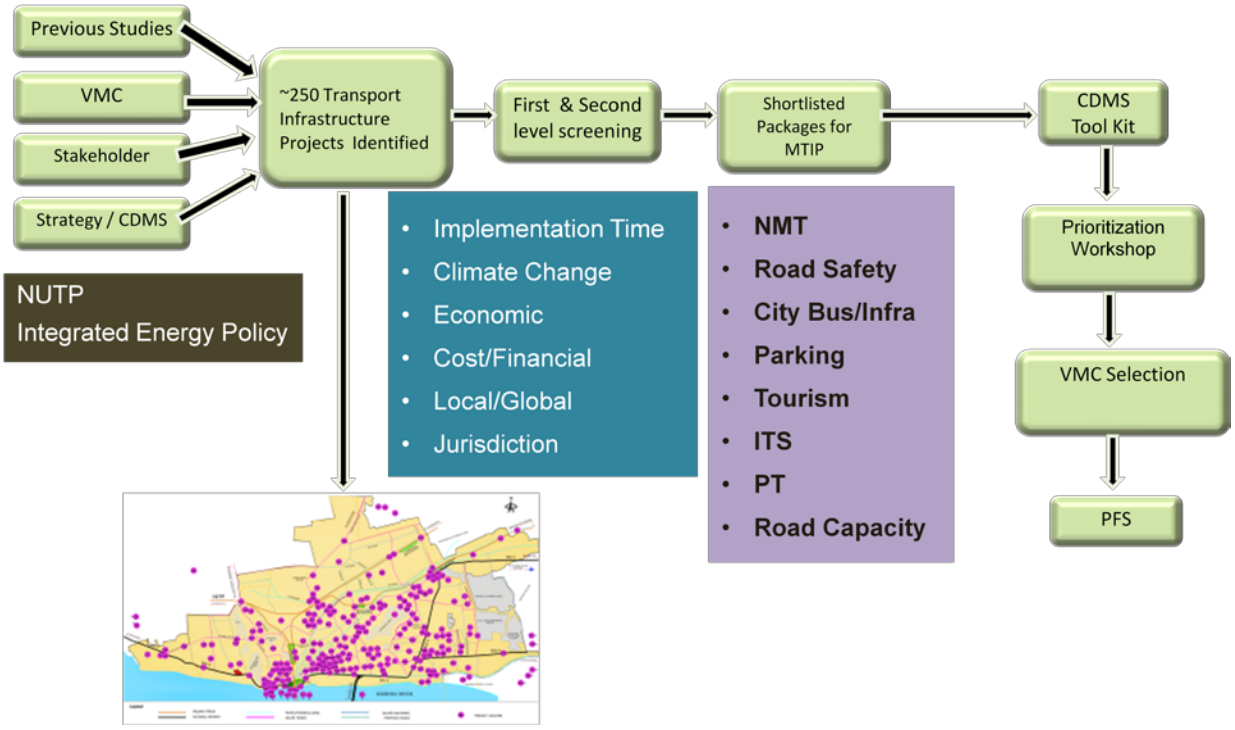

Figure 4 - Project Selection Process for the PFS

The MTIP covers a period of 5 years and requires that the feasibility study, design, financing, tendering and construction be completed within that timeframe. While there are many desirable projects which require a long period gestation, they are not included in the MTIP. As shown in **Table 3**, the MTIP included the following projects in 5 categories: i) non-motorized traffic, ii) road safety, iii) infrastructure for public transport, iv) provision of parking facilities; v) road capacity improvements.

Table 3 - MTIP Projects

S.No	Project Name	Unit	Rate in Lakh Rs	Quantity	Amount in	
					Lakh Rupees	Million USD
1	**NMT program**					
	Pedestrian Crossing Facilities (Half sunken and half elevated)	No	252	20	5040.00	9.2
	Sidewalks	km	74	21.8	1613.20	2.9
	Pedestrian Bridges across Canals (3.0 m wide)	No	518	3	1554.00	2.8
	Pedestrian Precincts	km	0.02	3	0.06	0.0001
	Cycle Track	km	37	22.8	843.60	1.5
2	**Road safety program**					
	Accident Black Spots Identification and Rectification	Lumpsum	31	6	186.00	0.3

S.No	Project Name	Unit	Rate in Lakh Rs	Quantity	Amount in	
					Lakh Rupees	Million USD
	Signages and Markings	Lump sum	7.5	16	120.00	0.22
	Providing central lighting with MV lamps including all fittings	km	10	12.5	125.00	0.2
3	**City bus Infrastructure Improvement**					
	Bus Bays/Bus Shelter	No	16	50	800.00	1.5
	Bus priority lanes	No	3	13.6	40.80	0.1
4	**Parking Provisions**					
	Multilevel Parking	No	1890	1	1890.00	3.4
	Underground and Off Street Parking	ECS	4	1077	4308.00	7.8
	Parking provision along Canal	Lane km	109	1	109.00	0.2
5	**Road capacity improvement program**					
	Flyovers	No	3450	9	31050.00	56.5
	Bridges across canals	No	396	5	1980.00	3.6
	Intersection improvements	No	34	25	850.00	1.5
Total					**50509.66**	**91.84**

Source: Consultant

A workshop was held to prioritize the projects from the MTIP and then to select candidate projects for PFS. The VMC technical staff with the Consultant acting as facilitator selected two packages of projects that would relieve peak hour traffic jams on two of the more congested corridors in the city:

1) The East West Corridor between Police Control Room junction to Auto Naga Gate along Gopal Reddy Road;

2) The North South Corridor between RTO Junction and Kandrika Road Junction along Bhagat Singh Road;

Shortly afterwards, a second Steering Committee Meeting was held to endorse these recommendations. During the meeting, VMC Commissioner suggested an alternative to the North South Corridor, i.e. the development of the BRTS Feeder route for better ridership. This will help to relieve congestion on the existing N-S corridor. Roadway capacity improvements of the N-S corridor (2nd package) would require extensive land acquisition which could delay the project for years. Alternative route would require only limited land acquisition in a low density corridor. As a result, the recommended packages as shown in **Figure 5** for PFS include:

1) The East West Corridor improvements, which included grade separated interchanges, pedestrian facilities, accident black spot rectification, relocation of bus stops, provision of bus bays etc. The East West Corridor package connects Police Control Room Junction to Auto Nagar Gate via Red Circle, Siddhartha College, Executive Club and Panta Kaluva Junctions. This corridor will also provide additional connectivity between the center of the city and the eastern industrial wards of the city.

2) Development of the BRTS Feeder Route focuses on creating new road capacity along a north south axis which includes Road over Bridge (ROB) across railway lines, additional bridge across canal, a flyover at BRTS junction and upgrading a section of earthen road into a 2 lane paved urban road. It begins at the Rhyves Canal Bridge and crosses the BRTS corridor and heads in the northwesterly direction crossing two railway lines and ends at the Kandrika Road. The corridor connects to two bridges crossing two canals which are now under construction. One of its main functions will be to accommodate traffic that is diverted from the congested North South Corridor. The upgraded portion of the road passes through a very poorly served area of the city in which there are no paved roads. It is anticipated that traffic growth might be quite high. Eventually, the road should be upgraded to four lanes as a staged project which would require that additional right of way be acquired now.

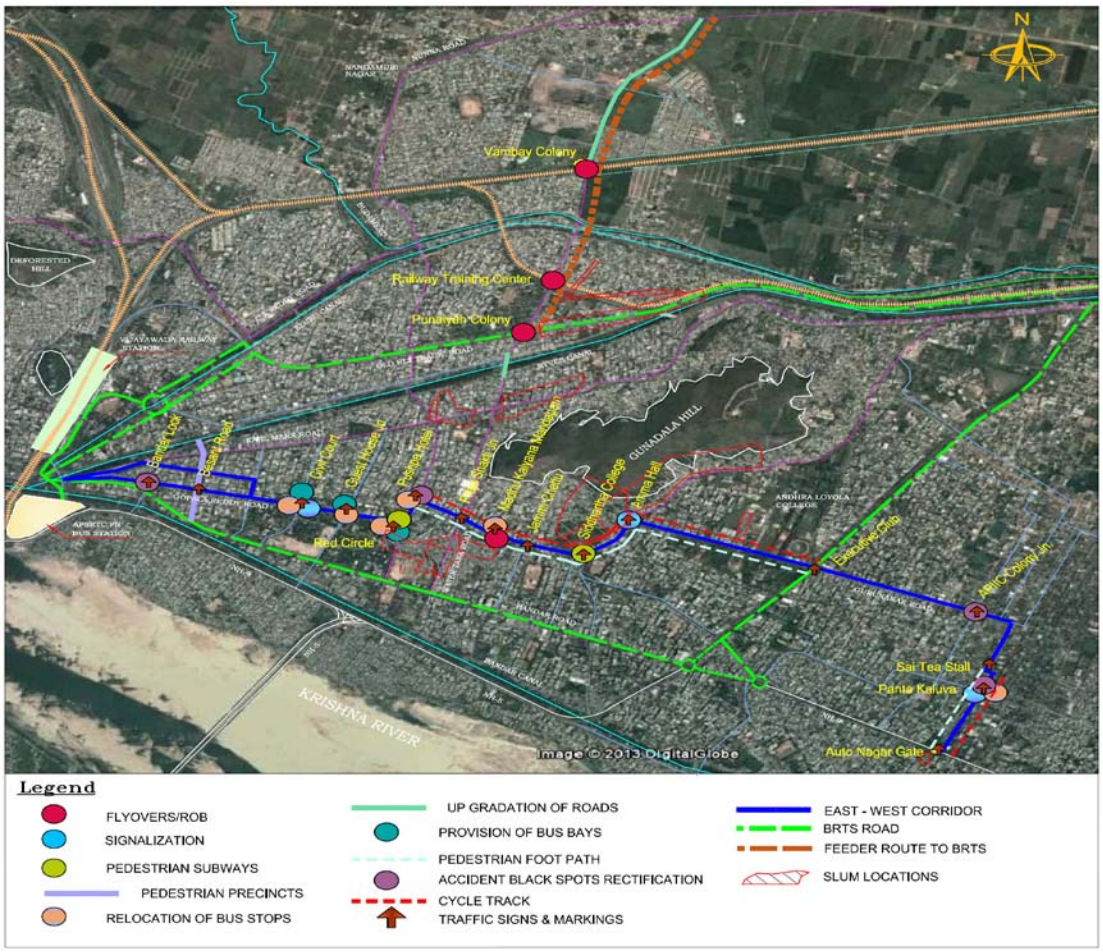

Figure 5 - Proposed project locations

2.2 The Components of the Programme

2.2.1 Descriptive Features

2.2.1.1 Package 1 - East West Corridor Improvements

East West Corridor improvements, which included grade separated interchanges, pedestrian facilities, accident black spot rectification, and upgrading the roads and intersections to an existing road connects Police Control Room Junction to Auto Nagar Gate via Red Circle, Siddhartha College, Executive Club and Panta Kaluva Junction. Besides improving the road capacity and safety in this corridor, this package will improve the connectivity between the center of the city and the eastern industrial area of the city. **Figure 6** shows the location of the major project components and **Table 4** gives their descriptions.

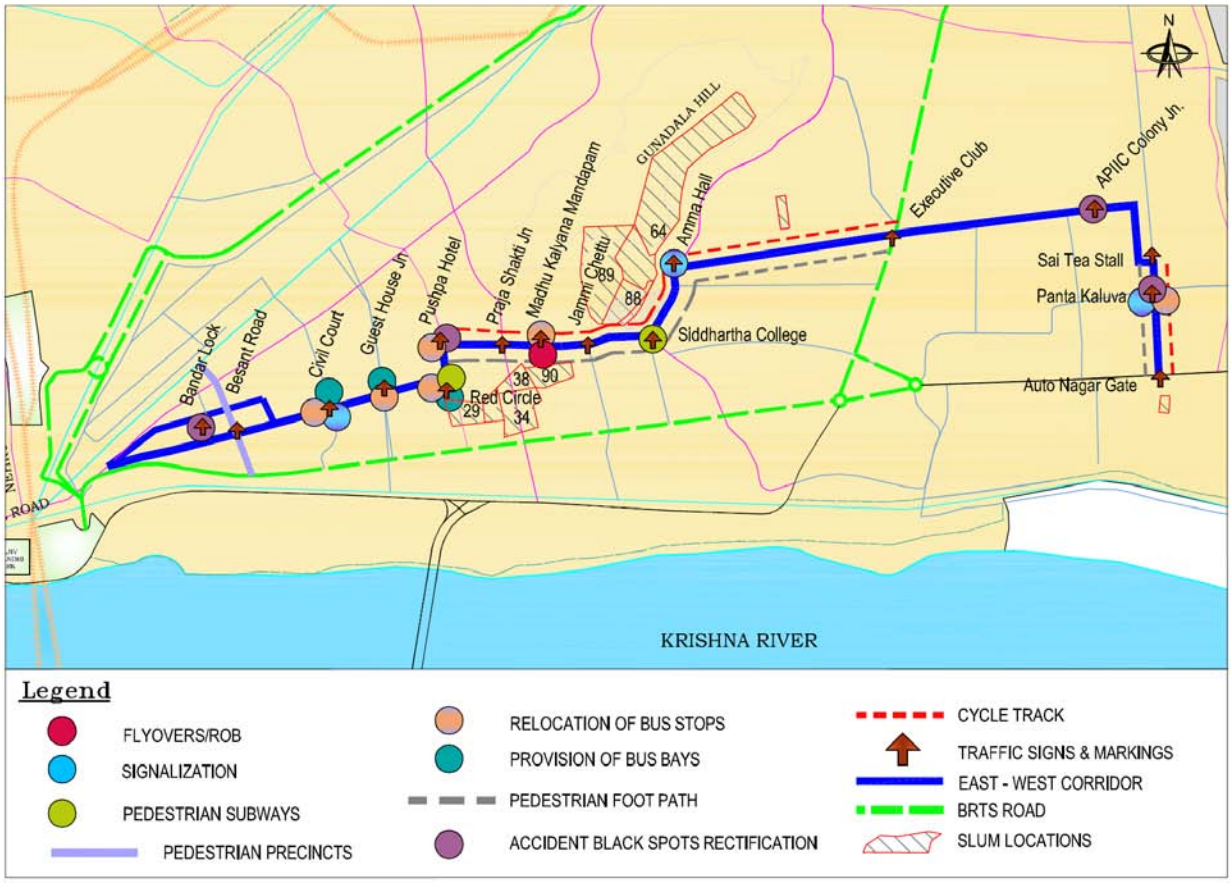

Figure 6 - Package 1: East West Corridor Improvement projects

Table 4 - List of Projects-East West Corridor Improvement (Package 1)

Sl. No.	Proposals	No. of Locations	Name of the Locations
1	Flyover	1	Madhu Kalyana Mandapam
2	a) Signalisation – Installation of New Signals	3	Civil Court
			Amma Hall
			Panta Kalva
	b) Signalisation – Replacement of Existing Signals	2	Praja shakthi jn
			Siddartha College jn
3	a) Pedestrian Underpass or Subway	2	Siddhartha College
			Red Circle
	b) Pedestrian Sidewalks or Footpaths	2	Kasthuribaipet to Executive Club
			Sai Tea Stall to Auto Nagar Gate
	c) Pedestrian Precinct	1	Besant Road
4	a) Relocation of Bus Stops	6	Civil Court
			Guest House Junction
			Red Circle
			Pantakaluva Junction
			Pushpa Hotel
			Madhu Kalyana Mandapam
	b) Provision of Bus Bays	3	Civil Court
			Guest House Junction
			Red Circle
5	Accident Black Spot Rectification	4	Gopal Reddy Road on Bandar Lock Junction
			Kasthuribaipet Junction
			APIIC Colony Junction
			Auto Nagar 100 Feet Road near Panta Kaluva
6	Cycle Lanes or Tracks	2	Kasthuribaipet to Executive Club
			Sai Tea Stall to Auto Nagar Gate
7	Traffic Signs & Markings	16	Bandar lock, Besant Road, Civil Court, Guest House, Red Circle, Pushpa Hotel, Praja Shakthi, Madhu Kalyana Mandapam, Jammi Chettu, Siddhartha College, Amma Hall, Executive Club, APIIC Colony, Sai Tea Stall, Panta Kalva, Auto Nagar Gate

Source: Consultant

Figure 7 shows the present volume to capacity (v/c) ratio which is on a higher side and this corridor will be congested in another five years i.e. by 2018, if no improvements are planned.

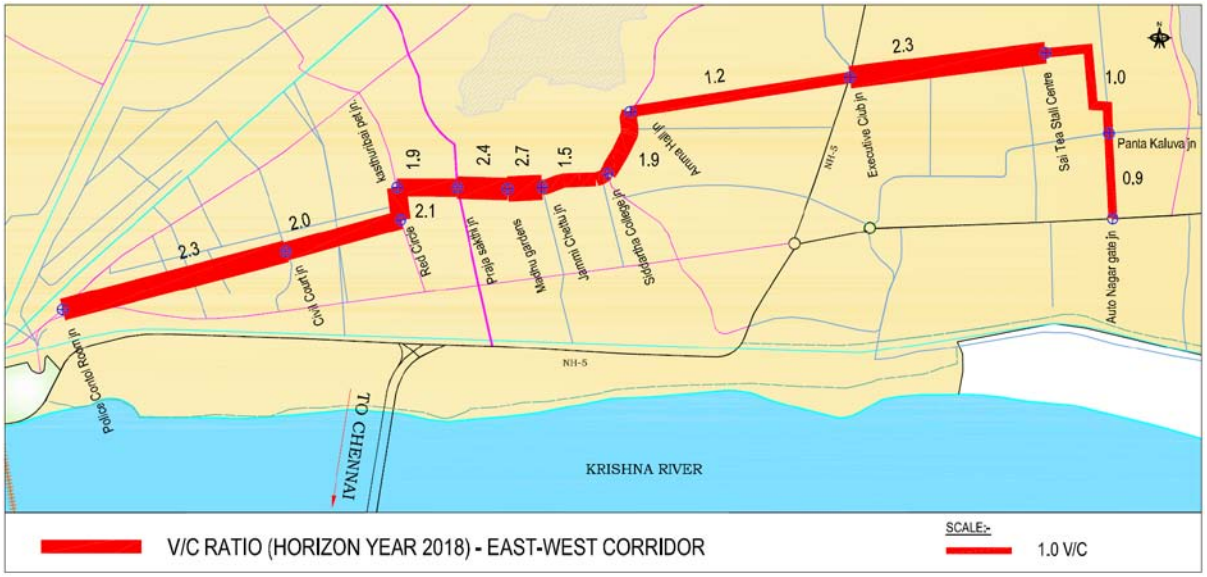

Figure 7 – East West Corridor Projected V/C ratio to the Year 2018

2.2.2 Package 2: Development of the BRTS Feeder Route Project Components

The Bhagat Singh Road through Ajith Singh Nagar to the north is already congested with one railway level crossing, two narrow canal crossings and restricted road width; any additional traffic growth in the northern districts of the city traveling to the center of the city is restricted to this road. The development of the BRTS feeder route aims at providing an alternate route to relieve traffic on Bhagat Singh Road by diverting it to the proposed project road. It offers a direct and alternative link to the city centre for traffic coming from the northern areas of the city; by extending it, it will eventually connect to the Ring Road. It is possible that once the proposed National Highway Bypass is completed, this corridor can act as the connecting link between city and bypass.

The project makes considerable use of existing infrastructure along the route. Since considerable growth potential exists along this corridor, it is proposed to construct 2 lanes initially and make it to four lanes in stages for the missing links, which are at present earthen roads (2.2 km). Whereas the Right of Way should be acquired for four lanes and reserved for future use. The grade separations (i.e. the ROB's and canal crossings) should be four lanes. **Figure 8** shows the location of the project components and described in **Table 5**.

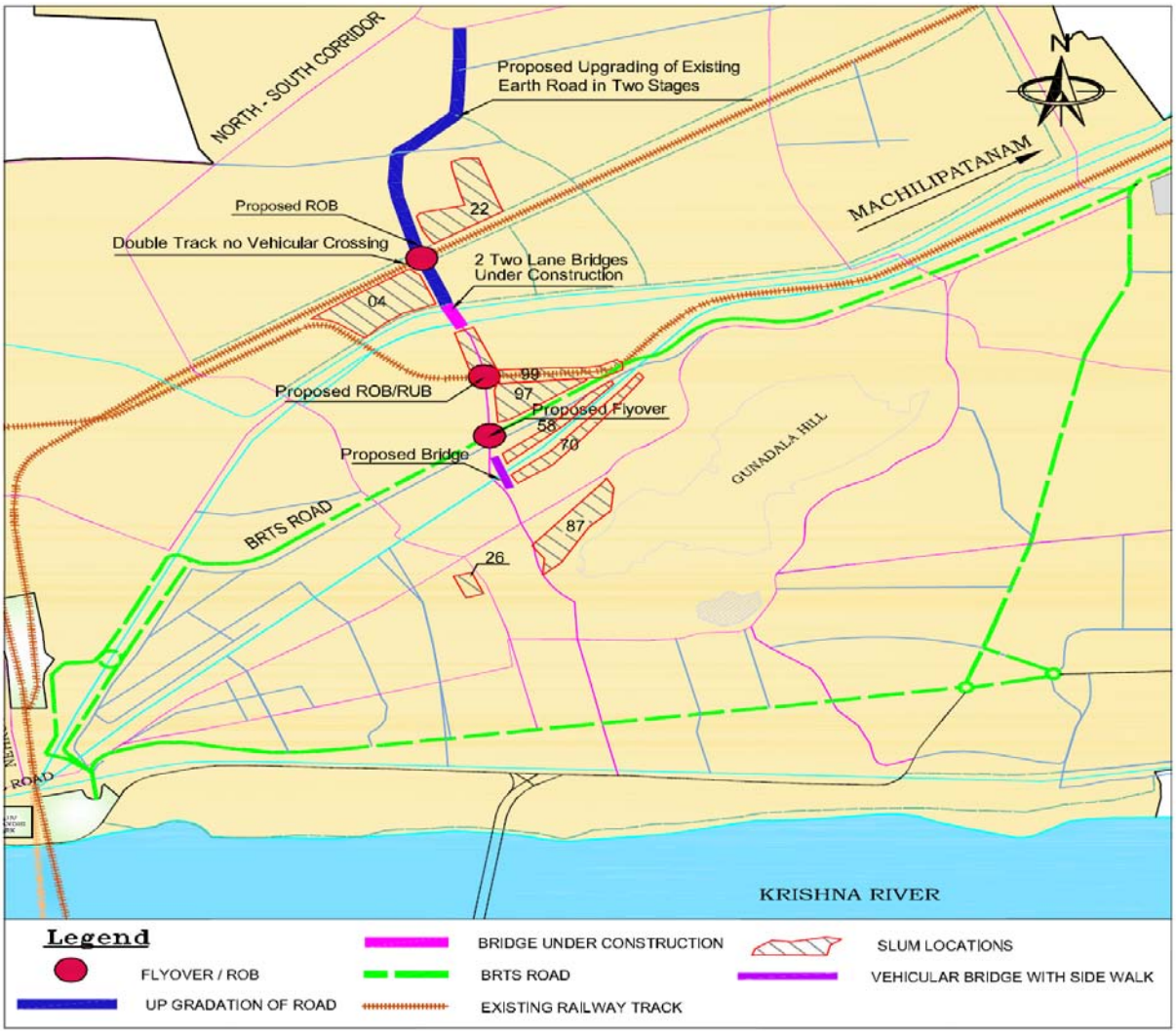

Figure 8 - Package 2 Development of the BRTS Feeder Route – Project Components

Table 5 - Description of Package 2 Project Components

Sl.No	Proposals	No. of Locations	Name of the Locations
1	Flyover/ROB	3	BRTS Road Jn near Punnaiyah Colony
			RuB near Railway training centre
			RoB near Vambay colony
2	Upgrading of an Unpaved Road to a 2 lane Urban Road	2	Unpaved road to 2 lane (Land Acquisition for 4 Lanes)
3	Bridge across canal	1	Bridge across Rhyves canal with sidewalk near Maruthi Nagar
4	Road Furniture & Accessories	1	BRTS Road Jn near Punaiyah Colony to Inner Ring Road

Source: Consultant

2.2.3 Costs

Programme capital costs are based on recently completed projects obtained from VMC. From this data, unit costs for major civil works components are estimated. To these costs cover the following additional items:

- Environmental and climate change mitigation costs not included in the civil works;
- Land acquisition costs using local prices;
- Resettlement;
- Feasibility study (EIA, EMP, and other supporting studies)
- Design and construction supervision;
- Project management including operation of the PIU;
- Capacity building and technical assistance;
- Contingencies.

The programme costs are estimated below in **Table 6**.

Table 6 - Programme Capital Costs

Work Items	Costs in million INR			Costs in million USD		
	Package 1	Package 2	Total	Package 1	Package 2	Total
Civil Works	478.77	1,355.20	1833.97	8.70	24.64	33.34
Environmental & Climate Change Mitigation	4.79	13.55	18.34	0.09	0.25	0.33
Land Acquisition & Resettlement	100.36	92.72	193.08	1.82	1.69	3.51
Total base cost	583.92	1,461.47	2045.39	10.62	26.57	37.19
Feasibility Study	5.84	14.61	20.45	0.11	0.27	0.37
Design & Construction Supervision	29.20	73.07	102.27	0.53	1.33	1.86
Project Management Costs	11.68	29.23	40.91	0.21	0.53	0.74
Capacity building/Technical assistance	5.84	14.61	20.45	0.11	0.27	0.37
Subtotal	636.47	1,593.00	2229.47	11.57	28.96	40.54
Contingencies	127.29	318.60	445.89	2.31	5.79	8.11
Total	763.76	1,911.60	2675.36	13.89	34.76	48.64

Notes:
1. 2013 prices
2. 55 INR = 1 USD

Source: Consultant

3.0 Programme Justification

3.1 Strategic Context

The vision of National Urban Transport Policy – 2008 is to make Indian cities; (i) the most livable in the world; (ii) enable them to become the "engines of economic growth" that power India's development in the 21st century: (iii) allow the cities to evolve into an urban form that is best suited for the unique geography of their locations and (iv) are best placed to support the main social and economic activities that take place in the city.

The gap analysis indicates that there is a considerable room for improving the transport system in VMC to achieve the vision described above. The major roads in the city have received national and state support. Most of the shortcomings in the network are those roads that remain VMC's responsibility due to lack of adequate funds.

There is a shortfall in road capacity on the more heavily travel routes in the city that do not fall under the purview of either the state or national governments highway programme. The proposed packages makes VMC largely responsible for the implementation of the programme except for the Road over Bridges (ROB) projects, which is a shared responsibility with Indian Railways, As a consequence, roads managed entirely by the city have been neglected and have not received adequate capital funding. In addition, the BRTS Feeder Route is targeting less developed areas of the city that have been isolated by the combination of topography, railway infrastructure and the canals.

The proposed investments will benefit all road users in VMC in terms of higher speeds and levels of service quality, reduced travel time, increased fuel efficiency, reduced wear & tear for vehicles and improved safety measures which in turn will reduce accidents. In addition, they will improve public transport and pedestrian and non-motorized transport accessibility and safety reducing the disparities between areas of the city. Consequently, they will improve productivity of the residents of the city and make the city more attractive for investors.

3.2 Economic Viability

The economic benefit cost analysis compares the benefits derived from the project with the capital costs and operating and maintenance costs over the life of the projects. Benefits considered include i) savings in vehicle operating costs and ii) savings in travel time for passengers and cargoes. With the assumption that proposed project interventions will increase the travel speeds in the project corridors, consideration is given to estimating the difference in travel speed under 'with' and 'without' project scenarios to estimate VOC and time savings. They are the quantifiable benefits estimated for the PFS; non-quantifiable benefits comprise reduction in traffic accidents, reduction in emissions, improvements to health and welfare, and improved accessibility for pedestrians and cyclists.

The financial costs are adjusted to reflect import duties, taxes and shadow price of unskilled and skilled labor. The economic opportunity cost of capital (EOCC) is taken as 12%. The analysis period is taken as 24 years.

Two indices of economic viability of the investments are the Economic Internal Rate of Return (EIRR) and Economic Net Present Value (ENPV). They are indicated in **Table 7**.

Table 7 - Economic Cost-Benefit Analysis

Details	Present Value (Rs. million) a/	
	Package 1	Package 2
Costs		
Capital costs	457	1129
O&M costs	97	160
Total costs	554	1289
Benefits		
Savings in Travel Time Cost	440	2266
Savings in VOC	393	1016
Total benefits	832	3282
Indices of Economic Viability		
ENPV (Rs. Million)	278	1993
EIRR (%)	**18.65%**	**29.74%**

a/ In 2013 prices. Discounted to 2013 at 12% real discount rate

Source: Consultant

Sensitive analysis tests the robustness of the results of the economic analysis by varying the main economic parameters (costs and benefits). Except for the combination of all tests, the EIRRs are greater than 12% EOCC, which indicate an economically strong programme. The results of sensitivity analysis are shown in **Table 8**.

Table 8 - Results of Sensitivity Analysis

Details	Package 1		Package 2	
	EIRR	Switching Value a/	EIRR	Switching Value a/
Main Evaluation (Base Case Scenarios)	**18.65%**		**29.74%**	
Capital Costs Increased by 20%	15.89%	60%	25.62%	176%
O&M Cost Overrun Increased by 20%	18.18%	285%	29.44%	1245%
Capital and O&M Cost Overrun Increased by 20%	15.49%		25.36%	
Decrease in Project Benefits by 20%	14.82%	33%	24.46%	60%
One Year Delay in Implementation	18.43%		29.65%	
All Four Tests Combined	11.66%		20.54%	

a/ Calculated as the percentage change in a variable required for EIRR to decrease to 12%.

Source: Consultant

3.3 Financial Viability (with caveats)

Based on either the Financial Internal Rate of Return (FIRR) or Financial Net Present Value (FNPV), a financial rate of return analysis cannot be prepared because there is no revenue generating activity associated with the programme. Consequently, the financial analysis is undertaken from the perspective of the determining how to best finance the project and to what extent VMC can do so from its own resources. The first task was to review the financial accounts of VMC and then to prepare

forecasts. While the financial data for the most recent years is not complete[3] , forecasts of revenues and expenses were made with a number of caveats.

Funding options for the city were reviewed; they include:

PPP: The programme does not lend itself to public private partnership; in part this is due to a lack of an easily identifiable revenue source for the investor.

National and State Government Funding: For VMC, the simplest and most cost effective method is to fund the proposed transport investments by grants from State and Central Governments. VMC is part of Phase I of the JNNURM program. As part of this program the corporation is eligible to receive grants covering 70% (50% - GOI, 20% - GOAP) of the project cost. This requires that VMC finance the balance of 30% by its own resources. In addition, VMC has to bear the cost of land acquisition.

GOI is also implementing a slum improvement program as a subcomponent of the JNNURM called Basic Services for Urban Poor (BSUP) as part. The BSUP program will fund slum improvement projects which provide basic infrastructure for slums and housing facilities for people who fall in Below Poverty Line (BPL) category. The funding pattern for BSUP is 50% GOI grant and balance 50% by State/ULB/Parastatal share, and Beneficiary contribution are encouraged. For VMC tapping the JNNURM program is one of the better options to fund both packages. This requires that (i) the corporation can maintain its status in the Phase II of the JNNURM program, that is, it remains eligible for funding, and (ii) funds are available since VMC must compete with other ULB's for funding.

Financial Institutions: Urban local bodies such as VMC have access to funds from state level development financial institutions. One such institution in the state is Andhra Pradesh Urban Finance Infrastructure Development Corporation Limited (APUFIDC) a public sector financial company. APUFIDC is a state level nodal agency for central and state schemes and can also fund projects from its own resources or from the resources raised from other sources. In general the domestic financial institution will fund infrastructure projects such as transportation, solid waste, water supply schemes, etc. but may not fund purely for slum improvement projects.

International Financial Institutions (IFI): Though the domestic financial institutions are available, there are several advantages to accessing international financial institutions such as (i) lower cost funds, (ii) longer tenor, (iii) access to technical assistance and to institutional capacity building. The disadvantage is that each international organizational has its own administrative system to manage the loan or grant, finding the financing is not straight forward since it must go through the central government administration and therefore it can be time consuming with potential and unaccounted delays.

VMC can follow a mixed approach for better access to funds by combining governmental grants with funds from either a domestic or an international financial institution. In all cases, VMC would have to fund the land acquisition and resettlement costs.

Two program funding options are evaluated based this approach:

- Option 1: GoI/GoAP = 70%; Domestic Financial Institutions = 20% and VMC = 10% plus the land acquisition and

[3] A public accounting firm has been hired to review VMC accounts. Their assignment is still on-going.

- Option 2: GoI/GoAP = 20%; International Financial Institutions = 70% and VMC = 10% plus the land acquisition.

Not too surprisingly, the financial analysis indicates that Option 1 with the large percentage of grant funding by the GoI/GoAP is the preferred alternative. Without external funding, VMC would have great difficulty funding the programme from its own resources.

3.4 Environmental & Climate Change

The proposed project is likely to have several positive impacts by way of improving the existing traffic and transport infrastructure to optimize the road speed (avoid traffic congestions, vehicle idling and consequential reduction in emissions and noise), encouraging the NMT (switching to environmental friendlier transport), and improving the road safety, all of which will essentially contribute positively to the overall city environment. During the construction of the above listed projects, negative environmental impacts will occur. Their severity will depend on the location, design and construction activities involved. Identification of potentially negative impacts and integrating appropriate mitigation measures is essential to enhance net positive impacts on the project.

Regulatory Framework: Indian law and policies of various multilateral and bilateral funding agencies (ADB, GIZ, KfW, World Bank,etc,.) require that the environmental impacts of development projects are identified and assessed as part of the planning and design process and that action is taken to reduce those impacts to acceptable levels. This is done through the environmental assessment process, which has become an integral part of lending operations and project development and implementation worldwide.

From the national perspective, projects are categorised as A or B depending on the scale of the project and the nature of its impacts. Category A projects require an Environmental Clearance(EC) from the national Ministry of Environment and Forests (MoEF). Due to the nature and scale of programme, none of the proposed projects are likely to attract the EIA Notification, 2006 and since all the projects are likely to be classified as Category B, Environmental Clearance from MoEF will not be required B category.

However category B projects require environmental clearance from the State Environment Impact Assessment Authority (SEIAA). The State level Expert Appraisal Committee (EAC) categorises a project as either B1 (requiring EIA study) or B2 (requiring no EIA study), and prepares ToR for B1 projects within 60 days. On completion of the study and review of the report by the EAC, the SEIAA issues the EC based on the EAC recommendation. The investments proposed under the PFS do not attract EIA Notification, 2006, and therefore do not require EIA study and/or Environmental Clearance from MoEF. However, these investments will require, limited environmental assessment study as per the Environmental Safeguard Policies of most of the multilateral funding agencies like ADB, World Bank.

Based on ADB's *Environmental Assessment Guidelines* and with the limited potential environmental impacts, the projects in the proposed programme can be classified as Category B indicating some but limited adverse environmental impacts. This will require preparation of Initial Environmental Examination (IEE) which will determine if an Enviornmental Impact Assessment (EIA) report during feasibility and detailed design phase is required. There will be a need to prepare an Environmental Management Plan to minimize and to monitor the adverse impacts during construction. The IEE/EIA should include an Environmental Management Plan, specifying mitigation measures for each of the

identifed nagative impacts, delegating responsibilities to project authorities, and costs of implementation.

Environmental Impacts: Most of the adverse environmental impacts identified are associated with construction activities that disrupt existing traffic, cause dust, vibration and noise, adversely impact public and worker safety, increase flooding and water logging in surrounding areas during the rainy season, increase structural risk to surrounding buildings or transport infrastructure, and obstruct waterways. These impacts can be mitigated by good design, implementation of the Environmental Management Plan during construction and to incorporate mitigation measures as part of the contract documents.

No long term adverse impacts have been identified. Once completed, the main long term environmental benefit of the programme will be reduced air and noise pollution.

Climate Change: Many aspects of the proposed projects will reduce Green House Gases as shown in **Table 9**. Although there has been no study of risk and vulnerability of Vijayawada City to climate change, **Table 10** attempts to identify the climate vulnerability and the necessary adoption measures.

Table 9 - Reduction in GHG Emissions from the Proposed Projects

Proposed project investment	Likely improvement in traffic & transport scenario	Likely Emissions Savings
Flyovers at four existing traffic junctions	Decongestion of traffic junctions & road safety improvements	The average speed is likely to be increased to 35 kmph. Vehicle driven at ideal speed will use less fuel, and will also emit less air pollutants. Minimization of vehicle acceleration, deceleration and idling will result in both fuel savings and less GHG emissions. Emissions savings: • Emissions savings from improved fuel efficiency due to traffic decongestion • Total emissions saving due to modal shift • The GHG emission savings is estimated to be 12.41 tonnes/day
Signalization of three existing traffic junctions	Decongestion of traffic junctions & road safety improvements	
Vehicular cum Pedestrian Bridge across Ryves Canal near Maruthi Nagar	Decongestion of road	
Pedestrian sub-ways at 2 locations	Decongestion of traffic junctions & road safety improvement	
Sidewalks/Pedestrian footpaths and cycle lanes/tracks on two roads	Encourage NMT, decongestion of traffic junctions, & road safety improvement	
Relocation of bus stops at six locations	Decongestion of road and road safety improvement	
Provision of new bus bays at three locations	Decongestion of road and road safety improvements	
Accident block spot rectification at three locations	Road safety improvements	
Traffic signage's and markings at 15 existing traffic junctions	Decongestion of traffic junctions & road safety improvements	
Upgrading the road – improvement of existing earthen road (Feeder Route of BRTS - from Devi Nagar to Kandrika Road, IRR) to 4-lane bituminous road in 2 stages	Increase public transport share of traffic and reduce private and intermediate share of transport	Lower fuel usage and lower emissions: from reduction in vehicle-km through provision of direct road connectivity and decongestion of existing roads; less emissions from avoiding use of private vehicles through modal shift to public transport. Emissions savings: • Total emissions saving due to

Proposed project investment	Likely improvement in traffic & transport scenario	Likely Emissions Savings
		modal shift • Emissions savings from improved fuel efficiency due to traffic decongestion • Emissions savings from less vehicle-km
Pedestrian precinct – Besant Road	Decongestion of road, separation of pedestrian from motorized traffic, and road safety improvement	Through avoidance of vehicle usage – less fuel usage and less emissions Emissions savings: • Total emissions from improved fuel efficiency of the vehicles in the adjoining roads due to traffic decongestion • The GHG emission savings is estimated to be 47.80 tonnes/day

Source: Consultant

Table 10 - Climate Vulnerability and Adoption Measures

Potential Climate Impacts	Impact on road infrastructure	Impact on transportation mode	Adoption measures
Extreme climate: Hot summers; Heat waves	High degradation of roads and bridges	Pedestrians and Cycle traffic	• Planting of trees along the sides of roads • Increased checking &maintenance of roads and bridges
Extreme climate: Increased frequency of high rainfall and winds, flash floods and cyclones events	High - Damage to roads and other transport structures, markings, signs and traffic signals.	All modes of road transport (damaged or destroyed) Pedestrians Underpasses or Subways (flooded)	• Design drainage facilities for all infrastructure with higher rainfall and revised high flood levels (increase the size of storm, for example, from 50 to 100 year occurrence) • Pedestrian underpass/subway design should consider likely increase in flood/storm including sump pumps; • Design storm water drainage to cater to high floods; • Increase frequency of cleaning and maintenance of drains and pumps; • Increased checking &maintenance of roads and bridges and • Use appropriate construction materials.
Water shortage & drought	Low	NA	-
Sea level rise	NA	NA	-

Potential Climate Impacts	Impact on road infrastructure	Impact on transportation mode	Adoption measures
Higher wind speeds	Low	Pedestrians and Cycle traffic	

NA = Not appropriate
Source: Consultant

3.5 Social, Poverty and Gender Impacts

3.5.1 Beneficiaries

In general, the beneficiaries of this investment proposal are all the citizens of Vijayawada and visitors to the city. In particular for the East West Corridor, the principle beneficiaries are the road users using the road on a daily or occasional basis. Moreover the corridor connects the centre of the city and the industrial area to the east providing easier access between them. The BRTS Feeder Route helps to relieve congestion and to provide access to the poorly served northern areas of the city and to the Inner Ring Road. Both benefit commuters by providing greater economic opportunities through access to future growth areas within the city.

Many of the beneficiaries will be poor and vulnerable and student population since improved safety through the provision of cycle lanes, sidewalks, better located bus stops and better traffic control through signalization largely benefit them. Road accidents disproportionally affect the poor and low income inhabitants of the city because they are forced to walk in trafficked areas mixing with motorized vehicles due to a lack of adequate sidewalks or proper road crossings. Once injured, they have limited capacity to pay for their medical bills, and at the same time, they often loose their employment. Sidewalks and cycle lanes give the poor and low income greater accessibility to public transport and expand their employment opportunities.

Social benefits include improved access for vehicular and pedestrian traffic, reduced road accidents, time savings especially for commuters, and improved safety. As shown in **Table 11**, most social impacts are positive

Table 11 - Beneficial Social Impacts

No.	Proposed Projects Components	Number of Projects	Social Benefits of the Programme			
			Easier Access	Reduced Accidents	Time Savings	Improved Safety
Package 1: East West Corridor						
1	Flyover	1	Yes	Yes	Yes	Yes
2	Signalization		Yes	Yes	Yes	Yes
	New Installations	3	Yes	Yes	Yes	Yes
	Replacement	2	Yes	Yes	Yes	Yes
3	Pedestrian Facilities		Yes	Yes	Yes	Yes
	Pedestrian Underpasses/Subways	2	Yes	Yes	Yes	Yes
	Sidewalks (Pedestrian Footpath)	2	Yes	Yes	Yes	Yes

No.	Proposed Projects Components	Number of Projects	Social Benefits of the Programme			
			Easier Access	Reduced Accidents	Time Savings	Improved Safety
	Pedestrian Precinct	1	Yes	Yes	Yes	Yes
4	Public Transport Facilities		Yes	Yes	Yes	Yes
	Relocation of Bus Stops	6	Yes	Yes	Yes	Yes
	Provision of Bus Bays	3	Yes	Yes	Yes	Yes
5	Accident Black Spot Rectification	4	Yes	Yes		Yes
6	Cycle Lanes/Tracks	2	Yes	Yes	Yes	Yes
7	Traffic Signs & Markings	16	Yes	Yes	Yes	Yes
Package 2: Development of the BRTS Feeder Route						
1	Road Overpasses					
	Flyover	1	Yes	Yes	Yes	Yes
	Road Over Bridge/ Road Under Bridge	2	Yes	Yes	Yes	Yes
2	Upgrading					
	Earthen Road	1	Yes	Yes	Yes	Yes
	Bridge across canal	1	Yes	Yes	Yes	Yes

Source: Consultant

The proposed project components will not create clearly identifiable negative social impacts on the local population with the exception of land acquisition. A limited area of land will need to be acquired to facilitate the design and construction of the proposed infrastructure for both packages. These impacts are summarized in **Table 12**. The proposed private land acquisition envisages displacement of buildings and structures occupied by private individuals and associated loss of livelihood. These impacts have to be mitigated with appropriate Resettlement Policy Frameworks (RPF), which will be prepared in the next stage of the project studies when the designs are at a more advanced stage.

Table 12 - Land Acquisition and Resettlement Adverse Impacts

No.	Proposed Projects Components	Total Number of Projects	Impacted Projects	Anticipated Social Impact		
				Land Acquisition (m^2)	No. Buildings Impacted	Loss of Livelihood (persons)
Package 1: East West Corridor						
1	Flyover	1	Nil	1254	25	150
2	Signalization			-	-	-
	New Installations	3	Nil	-	-	-
	Replacement	2	Nil	-	-	-
3	Pedestrian Facilities					
	Pedestrian Underpasses/Subways	2	1	70	3	9
	Sidewalks/Cycle Tracks – both sides[a]	2	2	3240	100	650
	Pedestrian Precinct	1	Nil	-	-	-

No.	Proposed Projects Components	Total Number of Projects	Impacted Projects	Anticipated Social Impact		
				Land Acquisition (m^2)	No. Buildings Impacted	Loss of Livelihood (persons)
4	Public Transport Facilities					
	Relocation of Bus Stops	6	Nil	-	-	-
	Provision of Bus Bays	3	3	Alienation	3	
5	Accident Black Spot Rectification	4	Nil	-	-	-
6	Traffic Signs & Markings	16	Nil	-	-	-
Package 2: Development of the BRTS Feeder Route						
1	Road Overpasses					
	Flyover	1	Nil	-	-	-
	Road under Bridge (RuB)	1	Nil	2775	22	96
	Road over Bridge (RoB)	1	Nil	600	32	128
2	Upgrading					
	Earthen Road	1	1	Nil	Nil	Nil
3	Bridge across canal	1	1	640	4	8

Note: a. Land acquisition combined two projects – sidewalks and additional lanes for cycles.
Source: Consultant

As to poverty alleviation and gender issues, any improvement to public transport facilities and the urban/pedestrian environment will almost certainly have a positive impact on all members of the communities involved, including those from the poorest households - increasing the accessibility to employment opportunities, markets and other public services (schools, clincs, hospital and etc.) in the city. The development of the BRTS Feeder Route will be able to serve slums with a paved road that will give their residents greater employment opportunities.

The transport sector provides an example of a nontraditional channel to promote social, economic, and gender equity. Access to transportation on safe roads has a direct impact on the economic standing and quality of life in communities living and the well being of each individual. With safe and secure sidewalks, it is possible to travel on foot longer distances to make use of improved, safe and secure transport service especially for school children and women. Similarly, the planned bus stops and bays provide safe refuge for passengers as they mount and descend from a bus.

Community services that depend on good transport infrastructure (ambulance, police and social services) are more able to better serve slum and low income areas.

4.0 Summary and the Way Forward

4.1 Summary

The programme consists of two packages of projects:

- The East West Corridor Improvements which is an integrated programme to improve capacity, safety and accessibility at a cost of 763.76 million INR including Land acquisition or 13.89 million USD and
- The Development of the BRTS Feeder Route which would improve capacity by extending the road network at a cost of 1911.60 million INR including land acquisition or 34.76 million US$.

4.1.1 Strong support by VMC

Consultations with VMC and other key stakeholders indicate strong support for the programme presented above. It achieves the goals of investing in more road capacity for the city to reduce congestion and of improving traffic safety for all modes of urban transport (vehicles, NMT, and pedestrians). Both packages will provide improved connectivity within the city.

Support for the programme comes from:

- Firstly, the programme was developed mainly by the VMC with the Consultant acting as a technical facilitator. Thus, the programme reflects the city's requirements for transport improvements and is not imposed.
- Secondly, the Steering Committee Meeting reviewed and approved the conclusions of the PFS presented by Consultant. All that remains is for the city to begin the long process of implementing the project.

4.1.2 Strong Justification for the Programme

The East West Corridor Improvements upgrades an existing road that will reduce congestion and improve safety and improve access between the central commercial area and the western industrialized area of the city. The Development of the BRTS Feeder Route will be able to relieve congestion on major corridor and provide alternative route between the center of the city and the northern residential areas.

- **Meets the strategic requirements of the city:** The gap analysis indicates that here is a need for more road capacity on the more congested routes in the city. Except for the Road over Bridges (ROB) projects, the VMC is largely responsible for the implementation of the proposed programme. The major roads in the city have received national and state support. As a consequence, roads managed entirely by the city have been neglected and have not received sufficient capital investment to keep pace with the growth of the city.
- **Economic viability:** With an economic cost of capital of 12%, the EIRR's are reasonably robust at 18.65% and 29.74% for Packages 1 and 2, respectively. Only vehicle operating costs

and time savings were quantified. Other benefits such as reduction in accidents and emissions will be considered in the feasibility study.

- **Financial viability:** Since none of the projects generate revenues, the determination of the FIRR and FNPV is not possible. The financial analysis looks at the capacity of the city to fund the projects from its own resources. Two options were reviewed: one with only domestic funding through GoAP and GoI grants and the second with IFI funding. Of the two alternatives, domestic funding is more attractive.

  Environmental and climate change impacts: From the initial review of the programme, the nature and scale of the individual project components will not attract the EIA Notification 2006. The initial environmental analysis indicates that none of the projects require environmental clearances from the GoI. However, at the state level an Environmental Impact Assessment (EIA) may be required by APEIAA. If the programme is partially funded by an IFI, there will probably be a need for an EIA meeting its requirements.

  These outstanding issues will have to be taken up during the feasibility study. Mitigate measures will be recommended to minimize the short term and long term adverse impacts. Once completed, the main environmental benefit of the project will be to reduce air and noise pollution.

  Similarly, the main advantage of the programme from the perspective of climate change is the reduction in GHG emissions or emission savings to the tune of 60.21 tonnes/day. Most of the climate change risks can be mitigated through the design of the different components of each project.

- **Social, Poverty and Gender Impacts:** Once implemented, most social impacts are positive for the programme; they include easier access, reduced accidents, time savings and improved safety benefiting the poor and women. The main adverse social impact involves land acquisition for both packages. While the land take for Package 2 (5.26 ha) is much larger than Package 1 (2.44 ha) the number of affected persons is much greater for Package 1 (1007 versus 399). A Resettlement Policy Framework (RPF) will be prepared in the next stage of the project.

  The proposed improvements envisioned under the programme will have a positive impact upon the poor by providing improved public transport facilities, sidewalks and other safety measures. These benefits from the projects include a more welcoming environment for woman.

4.2 Way Forward

With the completed PFS, VMC will be facing the challenge of implementing the programme over the next 5 years. VMC will need to do the following in order to expedite the implementation of the programme:

1. It is imperative that VMC has capital account statements for the last three fiscal years. Due to the delays in obtaining them, it is equally important that these results are endorsed by an

accredited national accounting firm[4]. They are needed if VMC is to receive funding from national programmes such as Phase II JNNURM and Basic Services for Urban Poor (BSUP). Both programmes are competitive and in this context VMC must present a mature image. Likewise, International Financial Institutions (IFI) do their own financial due diligence of the organizations which they fund and require that the urban institutions they deal with are financially robust.

2. A consultant needs to be recruited and employed to prepare the feasibility study, compliance documentation (social and environmental studies to support the implementation of the projects), the detailed designs and contract documents. It is recommended that a single consultant be selected for both packages. The terms of reference (TOR) for these consulting services are found in Section -7 of Volume -1. Tendering for these services is expected to take 6 months.

3. The first steps to begin the land acquisition should be taken as early as possible. Only as the detailed design progresses are the precise requirements known, and in some cases the designs may need to be modified to avoid some areas. Land acquisition is a long lead time item and will require public participation, and meetings with affected persons.

   Land acquisition raises concerns among various sectors of society causing long delays. A good public relations programme in support of the programme by VMC will help to make these challenges less formidable.

4. Financing the programme will require considerable effort on the part of VMC; it will need to identify the funding sources and then satisfy the regulatory and other requirements to achieve positive outcomes. In the case of JNNURM, VMC will have to present a strong case in support of the programme since Phase 2 is reported to have stringent requirements.

   To begin, VMC may have to fund the initial program activities to ensure a rapid start and maintain the momentum created with the preparation of the PFS. This will require:

   - Initial budget allotments for consulting services and other startup costs and
   - This will have to be followed by budget allotments for land acquisition and resettlement.

   Besides considering state and central government grants, the VMC should identify potential International Financial Institutions (IFI) or bilateral donors who may be interested in funding the programme. This will not be an easy task since it falls outside the corporation's normal practices and experiences. CDIA and other institutions might help to facilitate this process.

   If an IFI becomes involved, its compliance requirements are quite rigorous and considerable management time will be absorbed in the process of satisfying them. In technical areas, the design consultant could facilitate this process.

5. Depending upon the conditions of the loan agreement and the practices of the IFI, a Project Implementation (PIU) will need to be established in order to oversee the management of the

[4] VMC has hired an accounting firm to do this.

programme including its design and construction, its procurement and contract administration and its accounting and finances. See **Figure 9**.

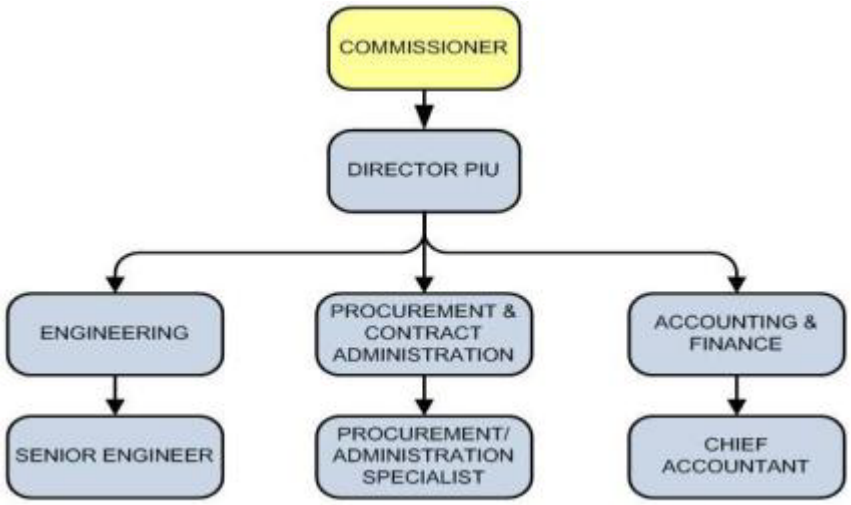

Figure 9 - Proposed Structure of the PIU

Because of the IFI compliance requirements, the PIU will function to a large degree independently of VMC management structure. However, even without IFI financing, a PIU is also very useful modality for the implementation of a large and many faceted programme.

6. With the designs nearly completed and the funding assured, the procurement of a construction supervision consultant should begin.

   The construction supervision consultant should be ready to begin work either before or during the tendering of the construction contracts for both packages. This allows some overlap between the design and construction supervision consultants.

7. The procurement of the construction contractors' services can begin when the land acquisition is near complete. Ideally, construction should not commence until all the land required for the project components is free and clear. Many construction projects have had considerable delays and cost overruns because they began prior to having the land free of all encumbrances. Thus, the tendering should be timed when the land acquisition activities are nearly finished.

8. Once the construction contracts are awarded the day to day management of these contracts will be done by the PIU with the assistance of the construction supervision consultants.

The above steps are summarized in **Figure 10**. It shows that construction activities should be completed by the second quarter of 2017 assuming that it will take 2 years to complete the construction of each package. The estimated duration from start to completion is around 4.5 years. Key to achieving this schedule is completing the land acquisition and resettlement over a period of slightly more than 2 years.

S.No	Task Name	Duration (Months)
1	**Programme Implementation**	**51**
2	Completion of PFS	
3	**FS and Design Services**	**21**
4	Procurement	9
5	FS and Other Services	12
6	Design Services	12
7	Land Acquisition	26
8	**Financing the Programme**	**29**
9	**VMC**	**26**
10	Land Acquisation	24
11	Other	24
12	State and Central Governments	24
13	International Funding Agency	24
14	**Procurement**	**12**
15	Construction Supervision Services	6
16	Package 1	9
17	Package 2	9
18	**Construction**	**30**
19	Construction Supervision	30
20	Package 1	24
21	Package 2	24

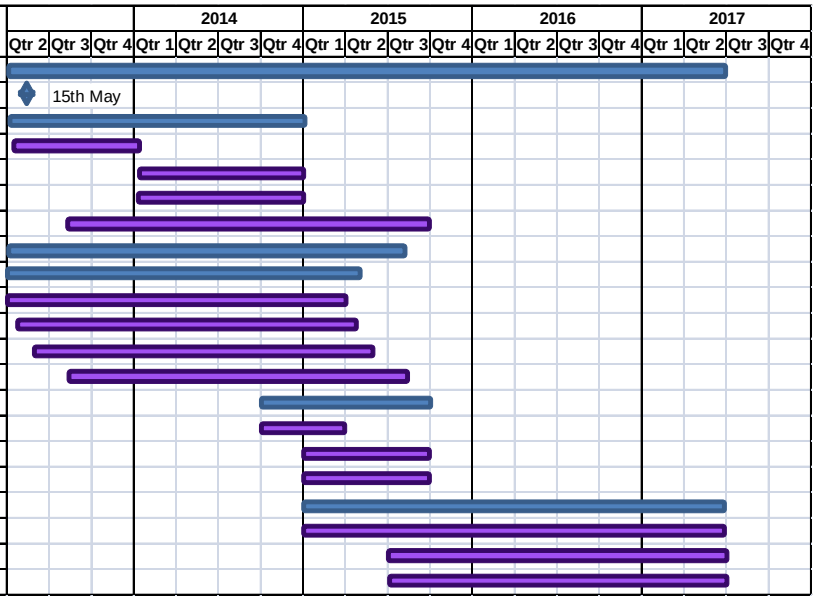

Figure 10 - Programme Schedule