CONSIDERATIONS WITH REGARD TO A BRT FOR TSHWANE

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ABSTRACT

The City of Tshwane is faced with a challenge to improve public transport within the city. Although the image of public transport in the City is poor, a number of events/trends are providing a window of opportunity to address the situation. These events and trends include:

- Soccer World Cup 2010
- The decision to go ahead with the construction of Gautrain, with three stations within the Tshwane area
- The taxi recapitalisation programme, which is expected to go ahead soon after years of delays
- Increased congestion
- The city densification and corridor development land use strategy that has been approved by Council.

The City of Tshwane identified bus rapid transit (BRT) as one of the possible methodologies to improve the image, quality and utilisation of public transport within the city.

The purpose of the paper is to report on the aspects which are being considered in the evaluation of the suitability of BRT for Tshwane. These aspects include:

- Critical nodes that should be linked in a fast and effective way, including commercial nodes, the Loftus sport stadium, industrial nodes, dense residential areas and Gautrain stations.
- A possible BRT network, including the phasing of the implementation thereof
- Passenger volumes required to justify such a service
- Appropriate infrastructure measures
- Possible public transport vehicles configurations
- Integration with other public transport modes.

It is hoped that by opening these considerations to wider discussion, that valuable input will be received that will contribute to guide the Tshwane Council on the way to go with regard to BRT as a measure to improve public transport in Tshwane.

1. INTRODUCTION

In the field of public transport the City of Tshwane Metropolitan Municipality (CTMM) is faced with the following:

- Healthy economic growth, resulting in increased vehicle ownership and usage
- Increased congestion on the road network as a result
- At the same time certain elements of the public transport system have deteriorated over the last few years
- However, there are exciting new developments impacting on public transport within the city, and which needs to be accommodated.

1.1 Economic Growth

The South African economy is experiencing unknown growth. So, for example, has a national growth rate of 4,9% per year been recorded in the second quarter of 2006 (Msengana-Ndlela, 2006).

A study done by the CSIR showed that the economies of 13 municipalities grew consistently above national average of 2,5 percent per year over the 8-year period stretching from 1995 to 2003. The strongest growth was encountered in the following municipalities (Msengana-Ndlela, 2006):

- uThungulu District (Empangeni, Richards Bay): 5,8%
- Bojanala Platinum District (Rustenburg, Moretele, Koster, Brits): 4,7%
- Tshwane: 4,6%
- Johannesburg: 4,2%
- Followed by nine other urban centres.

Tshwane as a city is therefore growing consistently at a higher rate than the national average.

The economic growth being experienced contributes to a general increase in household income and increased vehicle ownership and usage. This leads to increased traffic volumes and an alarming rate in the increase in congestion, specifically in Tshwane.

The following pictures show examples of the congestion experienced.


A shortage of urban space, funding, and environmental impacts makes it impossible to continue to address the congestion problem by building more roads only, the focus will have to move to public transport.

1.2 Challenges with regard to Public Transport

Tshwane is faced with the following challenges with regard to establishing an effective and efficient public transport system for the city CTMM, 2005):

- The low population density of the CTMM, making the provision of public transport more expensive
- The relatively high proportion of income that workers pay for their transport, making it necessary to minimise the cost of transport
- The relatively long travel distances between places of work and jobs
- The lack of integration between the different public transport services
- The difficulty to rationalise public transport services due to the amount of change required
- The need to move towards the formalisation of the taxi industry
- The leveling of the playing fields for the operators (bus and taxi)
- Finding sufficient operating funding for the maintenance and security required for public transport services and at the public transport facilities
- Increased congestion being experienced at public transport facilities.

The next pictures show the over-crowded public transport facilities.

The standard of service delivery in the public transport field is poor and needs to be addressed if passengers are to be attracted to public transport.

1.3 Window of opportunity

There are exciting new developments influencing public transport within the city, which includes:

- The City's land use densification strategy which is gaining momentum and which is a high priority to Council (Refer to Section 2 of the paper)
- The construction of Gautrain, a modern, high-speed light rail system between Johannesburg and Tshwane, with three stations within Tshwane. Apart from the direct benefits that will flow from this service, it will assist to break the perception that public transport is only intended for the poor and needy people within our community – pubic transport should become the preferred mode of travel for all our residents.
- The taxi recapitalisation programme of central government, which is gaining momentum.
- World Cup 2010, which requires drastic improvement and renovation of our public transport services, and which is acting as a catalyst to obtain significantly more funding for public transport than was available in the past.
- Options of Bus Rapid Transit (BRT) and Light Rail Transit (LRT) that are successfully being used elsewhere in the world.

2. CTMM COMPACTION AND DENSIFICATION STRATEGY

Public transport planning and land-use planning goes hand-in-hand. A compact city can contribute much towards an efficient public transport system, while such a public transport system is necessary to make a compact city function well.

Tshwane has a compaction and densification strategy (CTMM, 2006) which are briefly discussed here. This strategy should, and does, influence the strategic public transport planning.

2.1 Aim of the Strategy

The aim of the CTMM compaction and densification strategy is:

- To work towards the structural composition of the metro as a whole –not on specific density proposals only
- To act in accordance with national and provincial legislation
- To take principles and guidelines generally accepted, and make them context specific
- To influence planning, implementation and budgeting within the municipality and with other stakeholders.

2.2 Population Density

In comparing Tshwane to international cities the population densities in our urbanised areas are relatively low. Also are there very few people living in our city centre and economic nodes. Many international cities have all achieved highly functional urban environments by means of appropriate higher density housing typologies that add to the image of the city.

2.3 Objectives of Densification

Tshwane's objectives with the densification strategy are as follows:

- Densification as a means to achieve an overall efficient, integrated, stimulating and sustainable environment.
- Minimising the footprint of the city
- Preventing the destruction of agricultural Land
- Improving the use of public transport and facilitating pedestrianisation
- Improving the efficiency of urban areas
- Reducing inequality
- Increasing the marketability of the city
- Ensure a liveable city with high quality environments
- To adhere to legislative directives.

2.4 Smart Growth Principles

The Smart Growth principles adopted by the city consist of the following:

- Functionality must be balanced, focused, strategic and structured
- High density housing at appropriate locations to be provided for all income groups
- Areas of opportunity and restructuring/redevelopment to be identified rather than greenfields development
- Densified areas are to be treated as whole environments
- Development areas should be well served by public transport at that point in time or possibility in future
- Preserve and enhance open space
- Flexible and timeless mixed-use building types.

3. BUS RAPID TRANSIT (BRT)

BRT Concept vehicle as developed by the Fraunhofer Institute, Germany

TransMilenio BRT project in Bogotá, Colombia

3.1 The Broader Context

Tshwane traffic is increasingly being characterised by congestion. This has a negative effect on:

- City growth, as it leads to further sprawl and the associated inefficiencies
- The quality of life of the citizens who have to spend more time on travel
- Road-based public transport vehicle flow.

A BRT system can play the following role within the City:

- Support corridor development, which will lead to a more efficient city
- Improve the quality of life of citizens, as travel time will be significantly reduced
- Promote public transport in such a way that it becomes the preferred mode, even of people who do owe a motor vehicle
- Provide a proper feeding system for Gautrain, and in such a way contribute towards efficient public transport within the Province
- Provide proper access to Loftus Stadium, one of the 2010 World Cup venues
- Provide proper public transport access to growth points such as Menlyn, Brooklyn, Hatfield, Sunnyside, the CBD, Hammanskraal, Denneboom, etc.
- Provide fast and efficient transport to residents living in the northern areas, the declared “area of preference” of the city.

3.2 Passenger volumes

The role of a BRT system would be to provide an efficient backbone to the public transport system of the city. The project closely relates to the ring rail system, which is expected to be upgraded and reformed within the next few years. Table 1 shows the traffic volumes on the various corridors, and the length of the respective BRT lanes.

3.3 Need and Importance

If successfully implemented a BRT system will play a leading role in transforming public transport within the city to a situation where it will become the preferred mode of travel for the majority of residents, and where it will make a major contribution towards the more efficient development of the city as a whole.

The actual capacity of a number of BRT systems world wide is shown in Table 2 (Wright).

Table 1: Passenger volumes

Passengers volumes

Corridor	Morning peak period passengers (3hrs)					Peak hr	Utilisation of BRT	Rail pas. Volume
	1	2	3	4	1+2+4			
	Taxi	Bus	All modes	% of non-PT	Sub-Total			
				10.0%		50.0%	80.0%	
North-South								
Mabopane – Rosslyn	12 560	15 025	43 937	1 635	29 220	14 610	11 688	31 100
Rosslyn - DF Malan – CBD	17 700	9 428	39 700	1 257	28 385	14 193	11 354	
Hammanskraal to Rainbow junction	2 500	3 700	10 100	390	6 590	3 295	2 636	
N1 Freeway north of Magalies	400	5 100	7 600	210	5 710	2 855	2 284	
Rainbow junction to Belle More	8 166	6 710	27 850	1 297	16 173	8 087	6 469	38 200
Laudium Road	4 800	8 050	29 300	1 645	14 495	7 248	5 798	
Centurion: Freeway	4 400	2 600	16 400	940	7 940	3 970	3 176	
Centurion: Old Lyttelton road	6 800	1 300	16 000	790	8 890	4 445	3 556	13 500
Airport freeway at Monument park	1 500	900	10 200	780	3 180	1 590	1 272	
East-West								
Church at Atteridgeville	8 100	2 100	15 000	480	10 680	5 340	4 272	
N4 at Atteridgeville	3 000	-	5 700	270	3 270	1 635	1 308	
Atterbury at N1	1 700	1 700	12 600	920	4 320	2 160	1 728	
Lynnwood at N1	1 000	1 700	10 000	730	3 430	1 715	1 372	
Watermeyer	9 300	2 600	23 600	1 170	13 070	6 535	5 228	
Stormvoel	7 300	2 600	13 700	380	10 280	5 140	4 112	9 400
Kwandebele road	110	17 500	18 900	129	17 739	8 870	7 096	

Table 2: Actual capacity of a number of BRT systems (Wright)

Line	Type	Actual capacity (passengers/hr/direction
São Paulo East Line	Subway	60 000
Santiago La Moneda	Subway	36 000
London Victoria Line	Subway	25 000
São Paulo 9 de Julho	Busway	35 000
Bogotà TransMilenio	Busway	33 000
Porto Alegre, Brazil	Busway	28 000
Curitiba Eixo Sul	Busway	15 100
Bangkok BTS	Rail metro	50 000
Mexico Line B	Rail metro	39 300
Strasbourg	Light rail	18 000

According to Lloyd Wright (presentation in Tshwane, 20 July 2006) BRT is suitable on corridors with volumes ranging from 3 000 to 45 000 passengers per direction per hour.

If compared to Table 1, showing typical passenger volumes during the peak hour in the Tshwane network, there is a possible role for a BRT application.

3.4 Estimated capacity

Vehicles which could be considered for BRT are shown in Table 3.

Table 3: Possilbe BRT vehicles for Tshwane

Description	Capacity (passengers)
Double articulated bus	270
Articulated bus	160
Bus	65
Recap taxi	25

Table 4 shows the passenger volumes that can be transported along a corridor as a function of the various vehicle types. For this analysis the following has been assumed:

- Single lane per direction BRT lane
- Laybyes at stations/stops, as not to influence other vehicles
- Priority treatment of BRT lane at intersections.

3.5 Peak hour characteristics

It is clear from the above that passenger volumes during the morning peak hour (and probably also the afternoon peak hour) are well within the range of a BRT application. It is, however, also necessary to assess volumes during the rest of the day. As a case study DF Malan drive, southern direction only (that is, towards the CBD) was considered. Figure 3 shows the private car volumes on DF Malan Drive in a southern direction, Figure 4 the combi-taxi volumes, Figure 5 the bus volumes and Figure 6 the total traffic.

Table 4: Passenger volume capacity for BRT using different vehicles

			Number of pass/hr			
% Full	Reduction factor	Headway (s)	Double art. Bus	Art. bus	Bus	Recap taxi
80.0%	0.6	5				8 640
80.0%	0.6	10			11 232	4 320
80.0%	0.6	20		13 824	5 616	2 160
80.0%	0.6	30	15 552	9 216	3 744	1 440
80.0%	0.6	60	7 776	4 608	1 872	720
80.0%	0.6	120	3 888	2 304	936	360
80.0%	0.6	180	2 592	1 536	624	240
80.0%	0.6	300	1 555	922	374	144
80.0%	0.6	450	1 037	614	250	96
80.0%	0.6	600	778	461	187	72
80.0%	0.6	750	622	369	150	58
80.0%	0.6	900	518	307	125	48

These values are shown schematically on Figure 2.

Fig 2: Passenger volume capacity for various vehicle types and headways

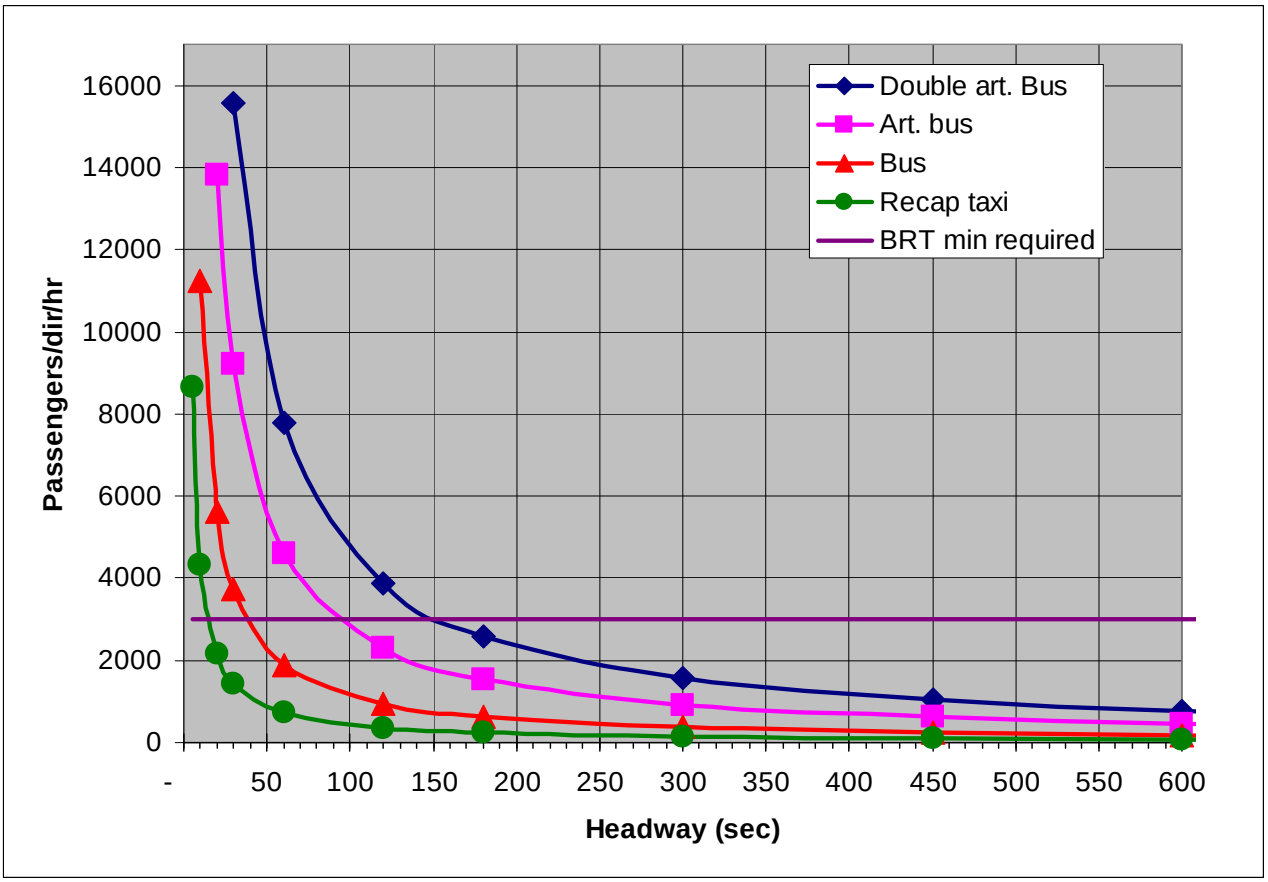

Fig 3: Motor car volumes on DF Malan Drive in a southern direction

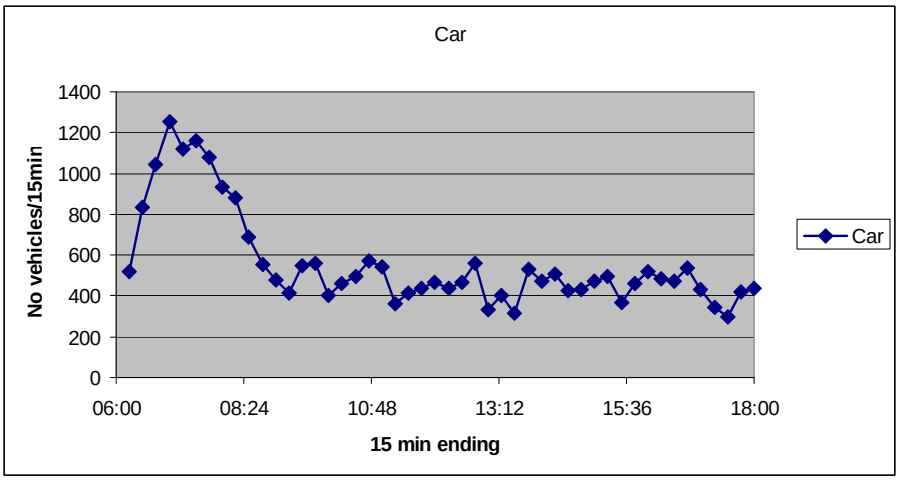

Fig 4: Combi taxi volumes on DF Malan Drive in a southern direction

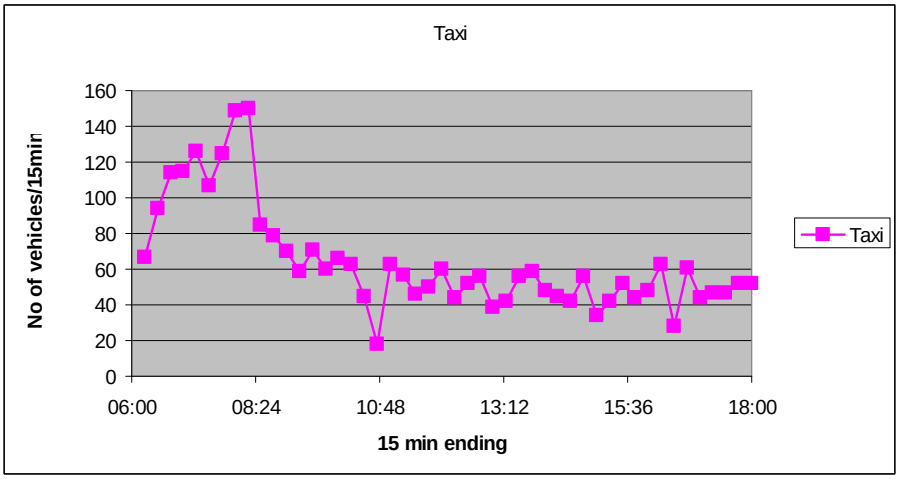

Fig 5: Bus volumes on DF Malan Drive in a southern direction

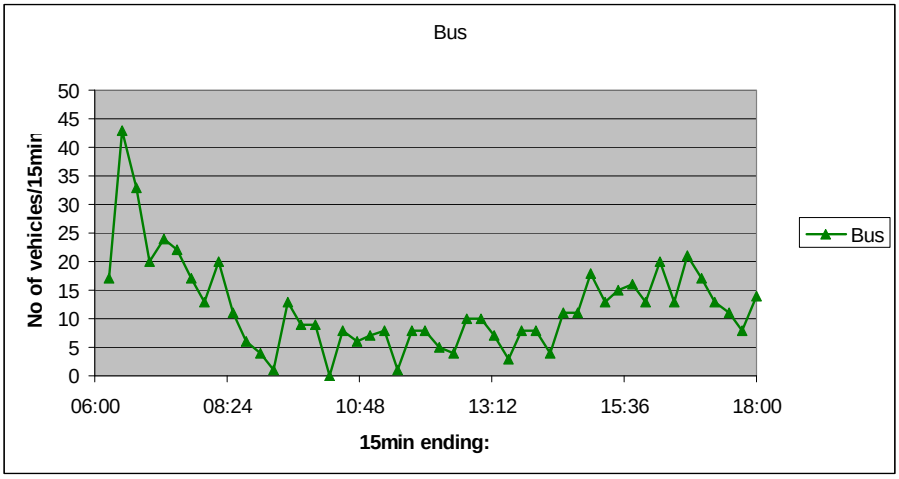

Fig 6: All vehicles volume on DF Malan Drive in a southern direction

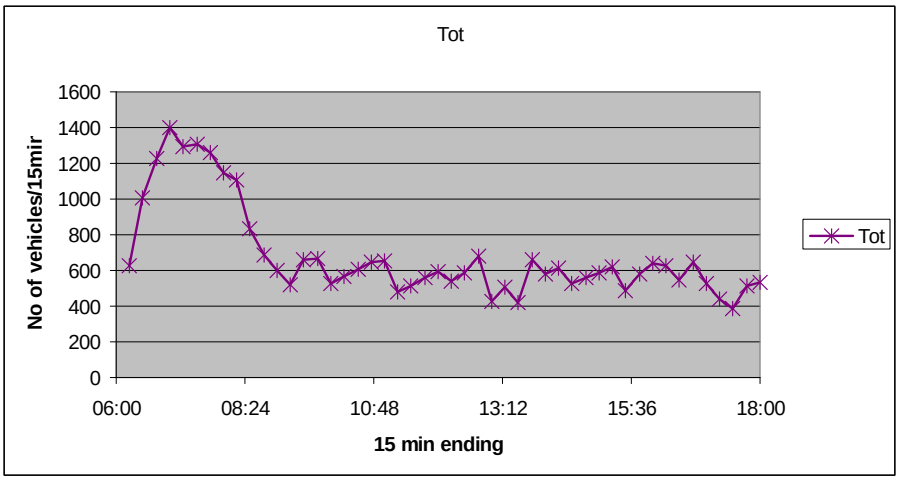

Table 5 shows the off-peak volumes in comparison to the peak volumes. From this table follows that off-peak volumes are still substantial, typically 40% of peak period volumes.

Table 5: Comparison of peak and off-peak volumes

Mode	Vehicle volume		Ratio
	Peak 15 min	Ave 15 min	
Car	1100	500	45.5%
Taxi	120	50	41.7%
Bus	35	10	28.6%
All vehicles	1300	550	42.3%

3.6 Proposed BRT routes

The proposed BRT routes for Tswane are shown in Figure 7.

3.7 Costs and Project Time Frames

Table 6 shows the proposed cost estimate for the various phases. A viability study is recommended in order to improve the preliminary proposals and cost estimates.

3.8 Phased Approach

One of the significant benefits of a BRT, compared to LRT, is that a phased approach towards implementation can be followed. This makes it not only more affordable, but enable the gradual expansion of the system to meet growing needs. In Bogotá, for example, the pre-TransMilenio phase was characterised by small 20 to 25 seater buses. They were typically old, stopped anywhere to pick up or drop off passengers, and provided little indication, if any, of their destinations. Fares were also not standardised or integrated. These small and old buses are gradually phased out as the TransMilenio system is being expanded. The owners and operators of the vehicles being phased out are incorporated in the ownership, management and operation of the TransMilenio system.

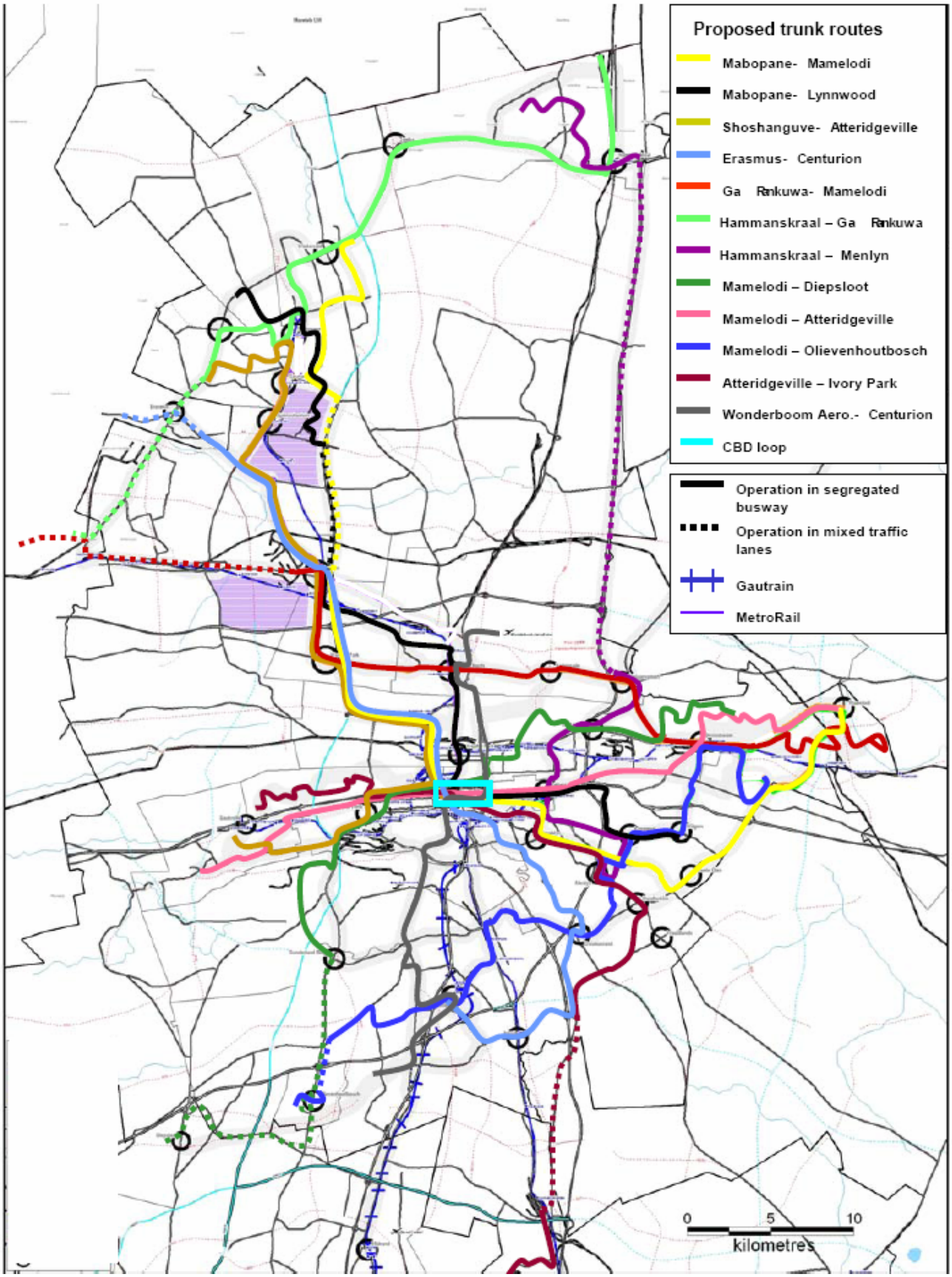

Fig 7: Proposed Rapid Transit network (CTMM, 2007)

4. CONCLUSION

In conclusion it is noted that:

- A more detailed investigation into the merit of BRT is justified by the traffic and passengers volumes referred to
- There appears to be political support for a more detailed investigation, as well as support from the national Department of Transport.
- There may be international support for a BRT system in Tshwane
- There is political appreciation of the role that such a system could play
- The role of minibus-taxis, and possible incorporation into such a system is one of the main challenges
- Institutional demands for a BRT system are very high – centralised planning, implementation, control, fund collection and fund distribution have to be addressed at a central level.

5. RECOMMENDATION

Based on the above initial assessment a more detailed investigation into a BRT system for Tshwane is justified and is recommended.

6. REFERENCES

[1] CTMM. CTMM SPTP Conference, 29 and 30 Nov 2005.

[2] CTMM. Compaction and densification strategy for the City of Tshwane Metropolitan Municipality, City Planning Division, Metropolitan Planning: Urban Research and Strategic Direction, 2006.

[3] CTMM. Tshwane Rapid Transit: Implementation framework. City of Tshwane Metropolitan Municipality, 2007.

[4] Msengana-Ndlela L. Address to the Eastern Cape Local Government Summit, Ms Lindiwe Msengana-Ndlela, DG, DPLG, Port Elizabeth, 23rd August 2006.

[5] Wright, L. Bus Rapid Transit: A global review, Institute for Transportation & Development Policy. New York, USA.

Table 6: Cost Estimates

Description	Phase 1: High and medium			Phase 2: Circular routes			Phase 3: Lower priority radial		
	Distance (km)	Unit cost (R mil/km)	Total (R mil)	Distance (km)	R mil/km	Total (R mil)	Distance (km)	R mil/km	Total (R mil)
Full BRT	49	15	735	104	15	1 560	82	15	1 230
Freeway	25	1	25	-	1	-	-	1	-
			760			1 560			1 230
Contingency		10.0%	76		10.0%	156		10.0%	123
Total			836			1 716			1 353
VAT		14.0%	117		14.0%	240		14.0%	189
Total			953			1 956			1 542