Ministry of Transport and Public Works

Malawi National Transport Master Plan

Urban Transport Sub-Sectoral Plan

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Acronyms

ADMARC	Agricultural Development and Marketing Corporation
BCA	Blantyre City Assembly
BCC	Blantyre City Council
BRT	Bus Rapid Transit
BWB	Blantyre Water Board
CBD	Central Business District
CCODE	Centre for Community Organisation and Development
CDCs	Community Development Committees
ESCOM	Electricity Supply Corporation of Malawi
GoM	Government of Malawi
HDR	High Density Residential
HfHM	Habitat for Humanity Malawi
HHI	Henry Henderson Institute
LCC	Lilongwe City Council
LDA	Lilongwe District Assembly
LDF	Local Development Fund
LDR	Low Density Residential
LGFC	Local Government Finance Committee
LIA	Low Income Areas
MARDEF	Malawi Rural Development Fund
MCC	Mzuzu City Council
MDR	Medium Density Residential
MHC	Malawi Housing Corporation
MoLGRD	Ministry of Local Government and Rural Development
MoLHUD	Ministry of Lands, Housing and Urban Development
MPC	Malawi Posts Corporation
MPs	Members of Parliament
NRWB	Northern Region Water Board
NSO	National Statistical Office
PAC	Plot Allocation Committee
RA	Roads Authority
SWRB	Southern Region Water Board
TAs	Traditional Authorities
THAs	Traditional Housing Areas
TPC	Town Planning Committee
ZCC	Zomba City Council

Heavy truck running through Lilongwe

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Malawi National Transport Master Plan

1 Introduction

Urban Transport Sub-Sectoral Plan

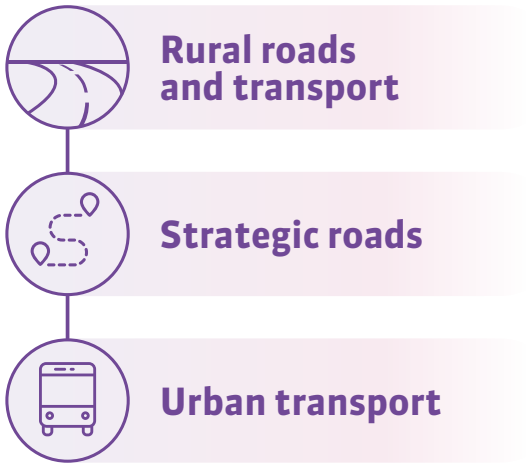
1 Introduction, aims and objectives

1.1 Introduction to the National Transport Master Plan

The Government of Malawi commissioned WS Atkins in February 2016 to prepare a National Transport Master Plan (NTMP). The primary objective of the study is the development of a plan to guide the sustainable development of an integrated multi modal transport sector over the period 2017 to 2037.

The study has identified the requirements of the sector in terms of the transport provision required for freight and passenger services under each mode of transport and potential inter-modal transfer facilities. The NTMP includes a prioritized time bound plan for institutional (organizational, policy and regulatory) reform and capacity building in all sub-sectors. This urban transport sub-sector plan has been developed working with the concerned agencies and organisations, in both the public and private sector.

Figure 1.1 Transport linkages



1.2 Introduction to the urban transport sub-sector

The Malawi National Transport Master Plan (NTMP) contains a specific sub-sectoral plan for urban transport. In the context of this report the term 'urban' is used to refer to the four main cities of Malawi: Blantyre, Lilongwe, Mzuzu and Zomba. As other towns in Malawi grow, the principles of urban transport strategy and development identified in this report will become equally applicable.

Currently, the four urban areas of Malawi make up 12.5% of the country's population, but contribute a much higher proportion of gross domestic product (GDP). Indeed, the contribution of Blantyre and Lilongwe is estimated to be around 31% of the national GDP[1].

The urban areas do not exist in isolation from the rest of the Malawian economy, and the primary links within the agricultural sector are transport links – mainly roads (Figure 1-1). Urban transport therefore forms part of a chain of movement for raw and processed produce, for both the domestic and international markets. In the context of the NTMP, therefore, urban transport is a significant sub-sector, and is addressed under the over-riding objective of attempting to reduce transport costs.

However, the consideration of urban transport is not limited to the above. Urban areas, unlike the rest of Malawi, are experiencing traffic congestion owing to the increase in the ownership and use of private vehicles. This affects the efficiency of the urban centres, hampers efficient public transport operations, and causes environmental damage. At the same time, urban public transport is poorly regulated and fares are high. This report addresses these transport costs as well.

1 Estimates for other African cities: Lagos (36%), Johannesburg (30%), Nairobi (25%), World Economic Forum

In this report, we present a review of the current land use and demographics of the four cities in question, along with proposals for land use change, and proposals for improved transport where such exist. It presents reviews of the transport sector in the urban areas, and identifies major issues and proposes strategies to improve functioning. This review covers the main modes of transport in the urban areas, ridership levels by type of service, and safety and environmental issues.

For Blantyre and Lilongwe the review takes in the existing Master Plans and identifies such limitations that might impact on proposals being made under the NTMP. The review also covers the organisational structure of public transport in the major urban areas. This report then goes on to identify measures that modify and enhance the existing plans in the light of demand data.

Proposed strategies for improving urban transport have been the subject of consultation with all the city councils, covering traffic management, provision of public transport, and other changes. This report contains an action plan, setting out timetables, responsibilities and mechanisms. The action plan for reforms provides for legal changes necessary to affect the reforms. The action plan has identified support activities which could be financed by the World Bank and other development partners.

1.3 Aims and objectives of the urban transport plan

The primary objective of the overall study is the development of a National Transport Master Plan (NTMP) to guide the sustainable development of an integrated multi modal transport sector for Malawi over the period 2016 to 2037. Three strategic objectives have been developed to support to guide the development of the overall NTMP:

1. 1. Reduce transport costs and prices across all modes;
2. 2. Improve the safety of transport infrastructure and services; and
3. 3. Enhanced and sustainable passenger and freight transport systems.

The achievement of these long-term goals will be guided by the pursuit of the following operational objectives, listed below:

1. To facilitate a modal shift from road to rail and inland water transport;
2. To mainstream safety and security considerations into transport projects, policies and related processes;
3. To increase citizens' access to all-weather roads;
4. To improve intermodal integration;
5. To enhance the connectivity of rural areas, including to support continued growth of the agricultural sector;
6. To foster transport systems to support the development of oil and mining sectors;
7. To improve the resilience of transport infrastructure and services;
8. To develop the domestic freight industry; and
9. To reduce dependence on Mozambique for access to international markets.

The aim of this urban transport plan is to propose a strategy that will result in the development of sustainable (public) urban transport systems served by a strong mass transit network supplemented by other modes including walking, cycling, buses and taxis. The measures proposed will underpin the realisation of more integrated, safer, accessible and urban areas with improved air quality.

In addition, the objectives of this Urban Transport Sub-Sectoral Plan include:

- The identification of options for improving extent, quality, efficiency, and adequacy of urban transport services and infrastructure in cities; and
- The preparation of a time-bound costed action plan for interventions in the cities of Malawi.

Wide uncovered draingage system along the main roads in Lilongwe

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Malawi National Transport Master Plan

2 Urban governance

Urban Transport Sub-Sectoral Plan

2 **Urban governance**

All cities in Malawi are managed by city councils in accordance with the Local Government Act, 1998. The Act also mandates elected representatives of the various city wards and other ex-officio and non-voting members headed by a Mayor to manage each city.

The Act outlines the functions of the cities and regulates their operations and those of the Secretariat, which is headed by the Chief Executive Officer. The cities are managed through departments which vary between cities, but which cover the following responsibilities:

- Administration;
- Finance;
- Town Planning;
- Health and Social Services;
- Engineering Services;
- Leisure, Culture and Recreation;
- Commerce;
- Education, Youth, Sport; and
- Environment.

Citizens elect councillors directly who form part of the City Assembly. The elected councillors then elect a mayor amongst themselves. Traditional Authorities (TAs) and Members of Parliament (MPs) within the council's jurisdiction are also members of the local council. The council has various committees including the consultative forum that includes MPs, TAs and representatives of interest groups that meet quarterly.

Table 2.1 Institutional responsibilities

Institution	Role
Ministry of Local Government and Rural Development (MoLGRD)	Oversees governance projects in the country
Local Government Finance Committee (LGFC)	Control budgetary matters
City Council	Oversees governance projects and all budgetary matters at the local level
Community Development Committees	Assist in mobilising funds for development initiatives
Other stakeholders including: ▪ Development organisations ▪ Civil society organisations ▪ Financial institutions	Assist with improving governance

Grade seperated pedestrian facility in Blantyre

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Malawi National Transport Master Plan

3 Blantyre

Urban Transport Sub-Sectoral Plan

3 **Blantyre**

3.1 **Background**

Founded in 1876 through the missionary work of the Church of Scotland, it has many historic and cultural heritage resources, which constitute a vital part of the city and are crucial to its identity, cultural and social well-being and attractiveness to business and tourism.

It became a British consular in 1883 and attained municipality status in 1895, making it Malawi's oldest municipality and one of the oldest urban centres in east, central and southern Africa.

3.2 **Land**

Blantyre city located in Blantyre district covers an area of 220km^2 and is situated in the Shire Highlands at an altitude of approximately 1,150m above sea level. The topography of the city is varied, comprising relatively flat areas, rolling terrain, several small hills and streams. The city is divided into 26 administrative wards as indicated in Figure 3.1 with land use proposals shown in Figure 3.2.

Figure 3.1 Administrative wards of Blantyre City

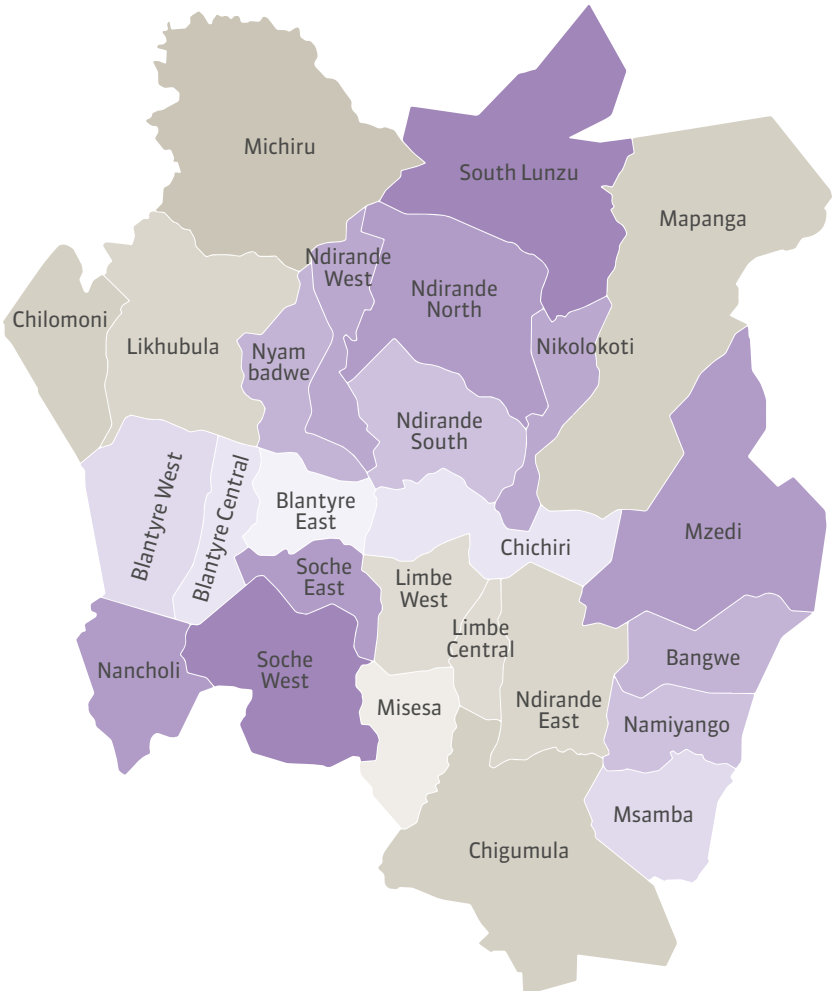
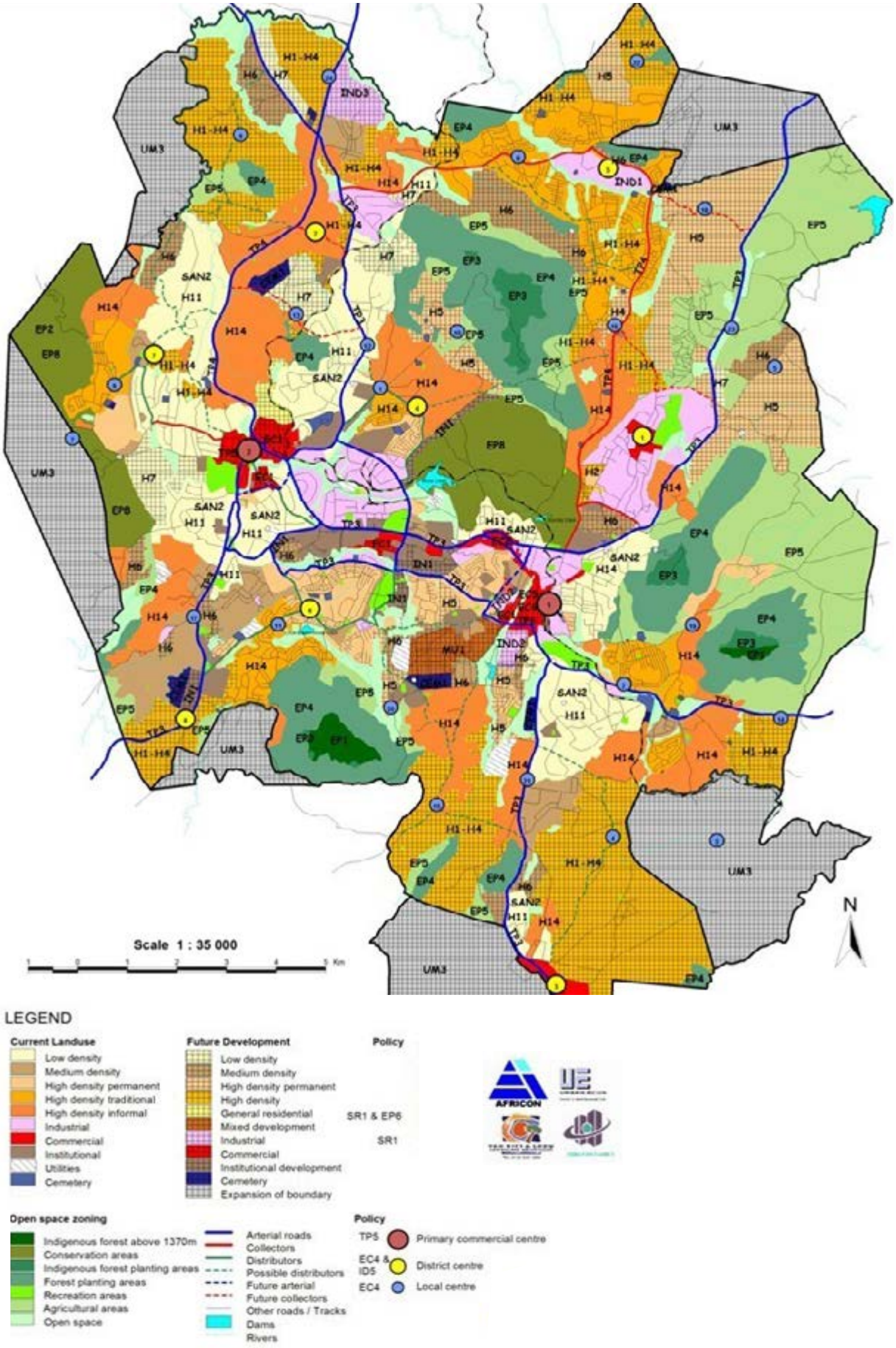


Figure 3.2 BCA Urban Structure Plan



Source: BCA, Strategic Planning and Social Inclusion Agenda

3.3 **Population**

The city has experienced high population growth as indicated in Figure 3 3. It is not Malawi's largest city in terms of population, but it has the largest population density in the country. High population growth is expected because of high fertility rates and in-migration.

However, there are concerns as to whether the existing infrastructure can sustain the rapid population growth.

In 2007, it was estimated that about 72% of the urban population in the city lived in the unplanned areas which are Low Income Areas (LIA), occupying up to 23% of the land in the city.

Figure 3.3 Blantyre City population growth

Source: National Statistics Office November 2010 Population Projections Volume 7

3.4 **Economy**

Blantyre City is the commercial and industrial capital, the city has a strong solid economic base for sustained economic growth and a diversified modern economy offering a wide range of employment opportunities. The city has reasonably developed physical and social infrastructure and enjoys a locational advantage. It is well connected by road to all major areas within Malawi; with the majority of international freight being routed via the city. Blantyre City is also very well connected to Malawi's main international ports, Beira and Nacala in Mozambique as shown by Figure 3.4.

Figure 3.4 Blantyre City's access to international ports

3.5 Existing transport plan for Blantyre

A Blantyre Urban Structure Plan was commissioned in 1999, and reported some years later. The plan found that the roads system within the formally developed areas of Blantyre currently had adequate capacity to accommodate the traffic volumes. However, poor surface condition, high levels of pedestrian-vehicle conflict and poor enforcement of traffic regulations tended to negate this. There was a need to provide adequate facilities for pedestrians and bicycles, both in the interest of traffic mobility and safety. Most people walked to their destinations or made use of minibuses. Local public transport provision needed be focused on minibuses but there was a need to regulate the industry effectively, to provide suitable facilities and to improve enforcement, the lack of which had a significant impact on traffic mobility and safety. The available parking areas in the city centres was insufficient to accommodate the observed demand. This had significant impact on mobility in the city centres.

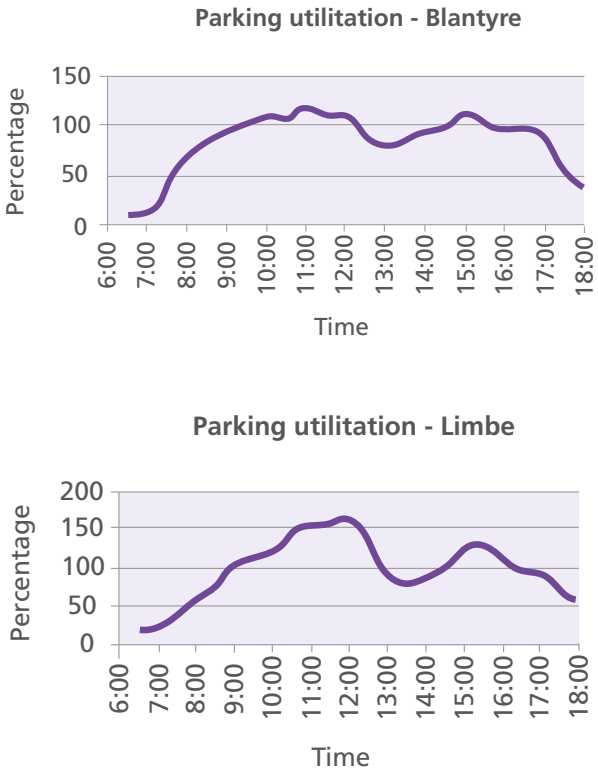
Road maintenance in the city was the responsibility of the City Assembly. Some maintenance tasks were contracted out, but the City Assembly also performed some maintenance tasks with its own maintenance personnel. The condition of the roads indicated a lack of resources to adequately maintain the paved roads in the city. The situation in the informal areas was even worse.

Community representatives indicated the current condition of the roads was a major problem, especially so in the informal areas. Public transport refused to use these roads resulting in long walking distances to the nearest public transport ranks. The lack of pedestrian and cycle ways also featured high on their list of problems. The cost and reliability of the minibuses were also cited as important problems.

Table 3.1 Estimated mode shares in Blantyre

Mode	2010	2016
Private vehicle	8	7
Public transport	30	26
Bicycle	4	1
Walking	58	66

Figure 3.5 Parking demand vs supply in Blantyre



Source: Blantyre Structure Plan

The key issues identified were:

1. A road hierarchy, which included the main roads within the city limits, needed to be established.
2. The road network within Blantyre City, in terms of number of lanes, had adequate spare capacity, although the poor surface condition negated that.
3. There was a need to provide adequate facilities for pedestrians and bicycles, both in the interest of traffic mobility and safety.
4. Local public transport provision needed to be focused on minibuses. There was a need to regulate the industry, make provision for suitable facilities and to improve enforcement.
5. The available parking in the city centres was insufficient to accommodate the demand. This had a significant impact on mobility in the city centres.
6. The lack of adequate enforcement had significant impact on traffic mobility and safety.
7. The City Assembly was insufficiently equipped to carry out comprehensive transport plan.

The specific projects identified are listed in Table 3.2. Most of these have not been implemented, although the implementation of street lighting on the Chipembere Highway (not listed) was completed in early 2017. The main reason for non-implementation appears to be lack of resources. However, the low capacity within the Blantyre City Council (BCC) in the fields of transport planning, and traffic management and engineering is probably a more important factor.

No. 1.1 to 1.10 in the table are road projects, most of which are widening or dualling proposals. Without complimentary junction improvement proposals, these may be a bit premature. Access management plans, designed to maximise the through-capacity of key roads (nos. 1.12 to 1.15) are to be supported, although clearly details need to be worked out.

The construction of the by-passes (nos. 1.9, 1.10) have merit and require economic evaluation.

Proposals for improved pedestrian facilities (nos. 1.21 to 1.25, 2.5 and 2.6) are supported, and over the plan period should be extended to other parts of the city.

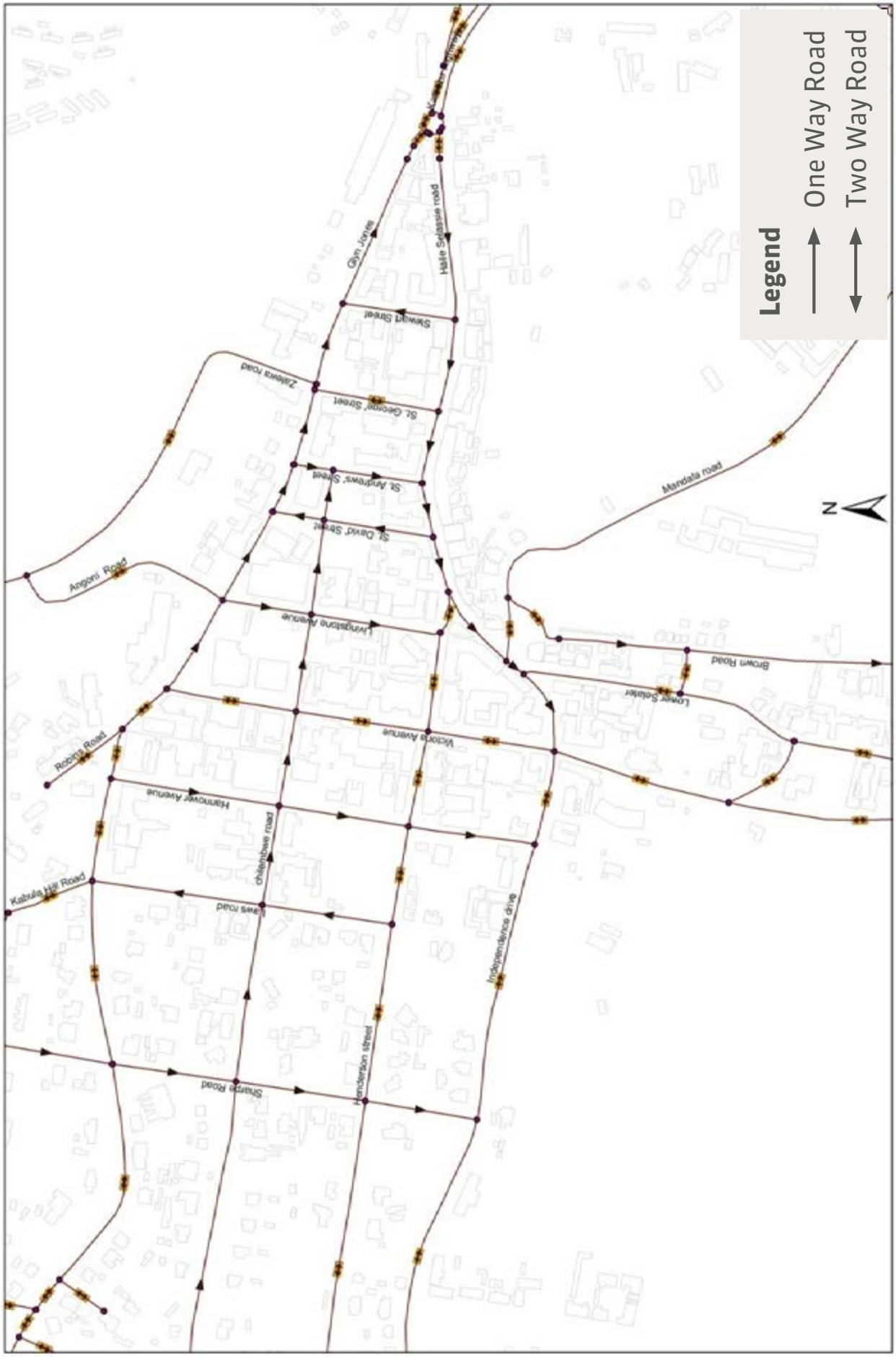
Proposals for public transport are generally weak, and although there is a reference to regulating the public transport industry (no. 2.8), it is not detailed.

A traffic management plan for Blantyre CBD (Figure 3.6) is not listed. This should be implemented urgently, at least on a trial basis.

Table 3.2 Transport projects and proposals, Blantyre

Objective	No.	List of projects	Estimated cost (US$)
To provide and maintain an integrated, effective and safe transport system through effective planning, maximising the potential of existing facilities and alleviating problem areas	1.1	Upgrade Chipembere Highway, between Moi/Makata Roads and Old Chileka Road to a dual carriageway	2 266
	1.2	Upgrade Kenyatta/Moi/Kwacha intersection	85
	1.3	Upgrade Kenyatta/Kapeni intersection	85
	1.4	Upgrade Blantyre-Limbe corridor	4 000
	1.5	Upgrade Blantyre-Nancholi corridor	1 333
	1.6	Upgrade Blantyre-Chirimba corridor	2 600
	1.7	Upgrade Limbe-Bangwe corridor	330
	1.8	Upgrade Limbe-Nkolokothi corridor	670
	1.9	Construct Limbe bypass	580
	1.10	Construct Blantyre bypass	800
	1.11	Rehabilitate the strategic road network	4 160
	1.12	Access management plan for Chipembere Highway + initial implementation measures	430
	1.13	Access management plan for Zalewa Road + initial implementation measures	185
	1.14	Access management plan for Nkolokothi/Ntawira Parkway + initial implementation measures	185
	1.15	Access management plan for Kenyatta Drive + initial implementation measures	350
	1.16	Demolish the James-Churchill-Bank-Livingstone Roads block and develop a public transport, street vending and parking facility.	
	1.17	Upgrade Blantyre taxi rank	
	1.18	Upgrade Chinseu taxi rank	
	1.19	Upgrade Ndirande taxi rank	
	1.20	Conduct a feasibility study of a rail commuter service	85
	1.21	Develop a pedestrian walkway in Limbe CBD	
	1.22	Relocate and control vendors in Limbe CDB	
	1.23	Relocate and control vendors in Blantyre CDB	
	1.24	Construct pedestrian facilities on Zalewa Road and Chikwawa Road	200
	1.25	Construct pedestrian facilities along Zomba Road, Thyolo Road and Midima Road.	300
	1.26	Demarcate parking bays in Blantyre and Limbe CBD	
	1.27	Construct a parking area in Blantyre CBD	85
To ensure that the transportation department has sufficient capacity and capability to effectively plan, manage and control the City's transportation network	2.1	Develop a road upgrading program and strategy	50
	2.2	Develop a road maintenance program and strategy	
	2.3	Manage and control access to the major road network	
	2.4	Develop a public transport facility provision and maintenance strategy and program	
	2.5	Develop a pedestrian walkway construction strategy and program	
	2.6	Develop a pedestrian walkway maintenance strategy and program	
	2.7	Develop a parking provision and maintenance strategy	
	2.8	Regulate the minibus public transport industry	
	2.9	Develop a strategy to implement access management plans on the remainder of the road network	
	2.10	Integrate the computerised road management system with the GIS	
	2.11	Carry out a study of the inter town regional bus terminals, their adequacy and how they should be controlled and managed.	
Source: Blantyre Structure Plan			**18 779**

Figure 3.6 Blantyre CBD Traffic Management Plan



Minibus pick up point right next to pedestrian crossing in Lilongwe

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4 Lilongwe

Urban Transport Sub-Sectoral Plan

4 Lilongwe

4.1 **Background**

Lilongwe City, named after the Lilongwe River which runs through the city, became the official capital of the Malawi in 1975. The city's central position in the country played an instrumental role in it being designated Malawi's capital city.

The emergence of a major tobacco industry in the surrounding areas increased Lilongwe's importance as an agricultural market centre. The city consists of two contrasting parts, Old Town and New Town. Old Town is the area where the original fishing village was located and today it continues to have the appearance of a traditional African settlement with open air markets and numerous small shops and other businesses. New Town came into existence after Lilongwe became the capital and has modern buildings including the national legislative building, government ministries, embassies and commercial offices.

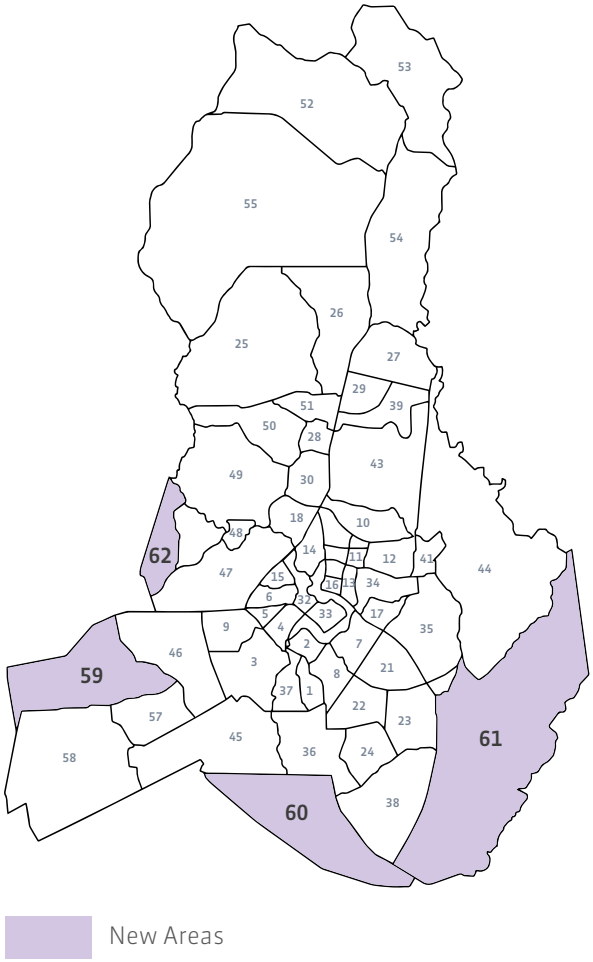
4.2 **Land**

Lilongwe City has a total area of 456 km^2 of which 60% is public, 30% is private and 10% is customary land. The following are the main land owners in the city.

- Ministry of Lands, Housing and Urban Development (MoLHUD);
- Lilongwe City Council (LCC);
- Lilongwe District Assembly (LDA); and
- Chiefs who claim administration as de facto landlords and managers of public land.

The current land use for the city is shown in Figure 4.1 below and Figure 4.2 overleaf shows a map of land use across the city. Agricultural land use occupies more than half of the land in the city and accounts for 21,646 ha followed by residential land use which occupies 23.7%.

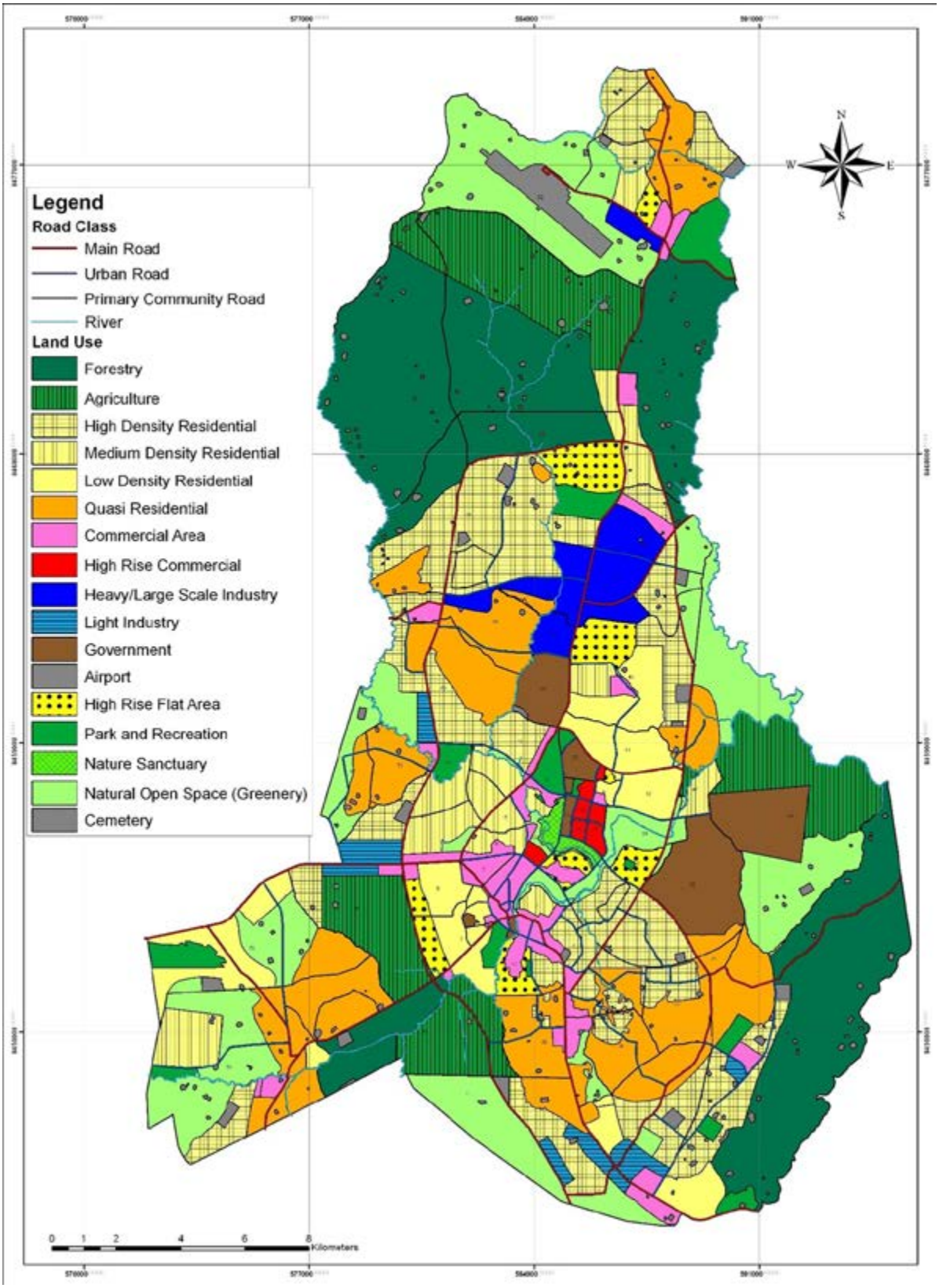
Figure 4.1 New areas to be converted from LDA to LCC



4.2.14 Future land use plan

Figure 4.2 presents the future land use plan for Lilongwe. The plan presented here is for 2030 planning horizon.

Figure 4.2 Future land use plan for Lilongwe City

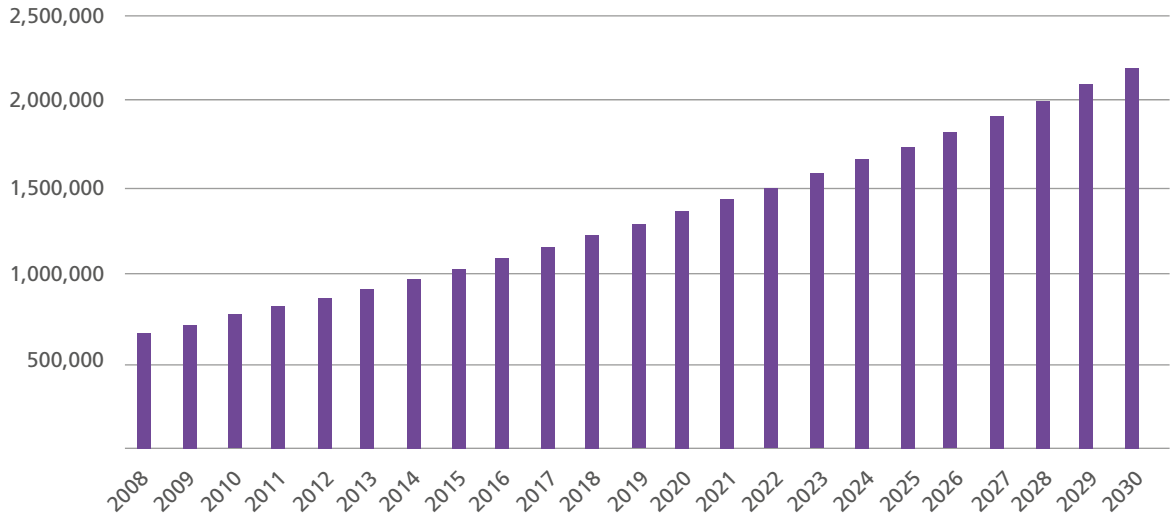


Source: The Study on Urban Development Master Plan for Lilongwe, JICA, September 2010

4.3 **Population**

The city has witnessed rapid population growth since 1975 and about 76% of the population lives in informal settlements that take up about 12.2% of the total city land area. The population growth figures and projections are shown below (Figure 4.3).

Figure 4.3 Population growth of Lilongwe City



Source: NSO

The growing population of the city will increase demand on urban utilities including water supply, sanitation and solid waste management.

4.4 **Existing transport plan for Lilongwe**

In 2010 the Urban Development Master Plan for Lilongwe was developed, which included a comprehensive urban development master plan and the development programs for urban transport development, water supply and sewerage development, enhancement of living environment and environmental management.

The introduction to the plan noted the rapid increase in the number of vehicles causing traffic congestion along the M1, particularly in the Old Town area, since that also serves as an international arterial road passing through the centre of the urban area. This merging of international and intra-city transportation, created a traffic problem that needed to be addressed. Other traffic-related issues that needed to be dealt with included the improvement of public transport facilities, improvement of access to unpaved areas, and widening of the main trunk roads.

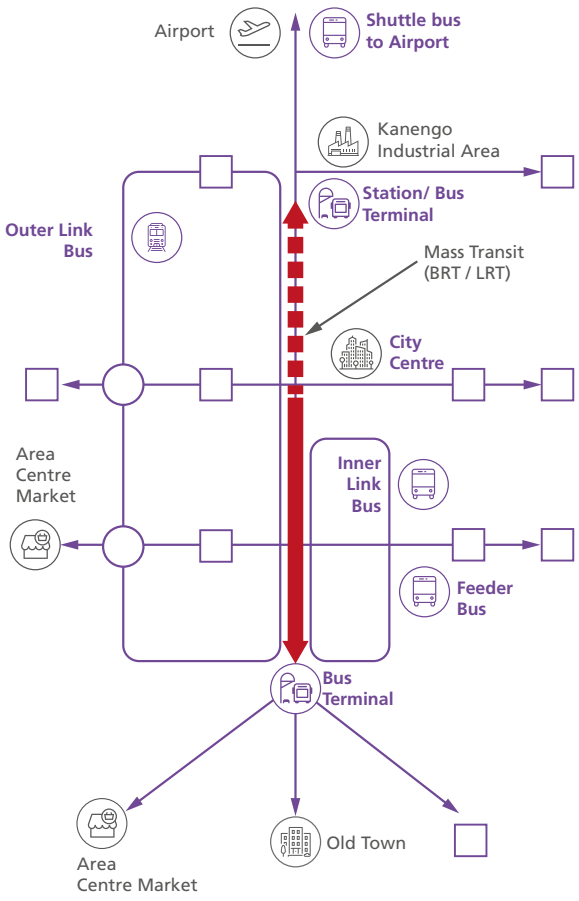
The transport development plan was formulated in conjunction with the cluster shape development (urban structure). A road network plan was proposed that included the missing links for smooth road transport in the city by means of improvement and construction of roads and related facilities:

- Improvement of M1 road traversing from south to north in the city, expanded from two to four lanes. Because of severe traffic congestion observed in the central area, priority to be given to the M1 road in the central area;
- Construction of an inner ring road around the central area of the two poles of the Old Town and the City Centre;
- Construction of an outer ring road bypassing cargo traffic from the Kanengo industrial zone to the south area (Mchinji Road to the M1 at Kanengo);
- Construction of seven radial roads connecting the inner/outer ring roads to the suburban area (five main roads and two arterial roads); and
- Construction of the Western Bypass as part of the Nacala Corridor.

The plans for public transport included recommended services by BRT or Light Rail Transit (LRT) between the City Centre and Old Town areas, and ring route services by large bus services linking the Old Town - City Centre - Kanengo industrial area and western residential areas. (Figure 4.4). Bus terminal construction at both ends of the BRT/LRT would be necessary at the City Centre and Old Town areas.

Figure 4.4 shows the schematic representation of public transport proposals for Lilongwe. The main components are a mass transit link between Kanengo and Old Town, broadly following the alignment of the M1, and two high capacity bus loops, one linking the City Centre sector with Old Town, and one linking Areas 25, 49, 47 and 18 with Old Town.

Figure 4.4 Schematic public transport plan for Lilongwe



Source: Proposed by the JICA study team

In addition, public transport development proposals included a review of minibus operation routes, the institutional reform of bus operation, expansion of the existing minibus depot, construction and improvement of bus stops, and the construction of a new bus terminal. The priority was to be given to the extension of the existing minibus depot and review of minibus operation routes.

Traffic management projects were recommended such as improvement of intersections from roundabouts to traffic signals to increase handling traffic capacity, installation of a central signal control system and a parking management system.

Traffic safety recommendations included the development of a road safety master plan, and construction of safe pedestrian and bicycle network.

Specific projects identified for implementation were:

1. Widening of M1 Kanengo;
2. Widening of M1 Area18 RA North;
3. Widening of M1 Area 18 Roundabout - Mchinji Roundabout;
4. Widening of M1 Old Town Area;
5. Mchinji RA - Community Centre;
6. Widening of M1 Community Centre - Chidzanja Road;
7. Widening of M1 South;
8. Widening & Extension of Chayamba Road for Inner & Outer Ring Roads;
9. Extension of Chidzanjya Road for Inner Ring Road;
10. Widening of Chidzanjya Road for Inner Ring Road Improvement of Northern Outer Ring Road;
11. Improvement of Northern Outer Ring Road II;
12. Construction of North Western Arch of Outer Ring Road;
13. Construction of South Western Arch of Outer Ring Road;
14. Improvement of Western Bypass Access Road for Outer Ring Road;
15. Widening of Salima Road (M14);

16. Widening of S123 in Area 50 & 51 16 improvement of S123 in Area 50;
17. Widening of Mchinji Road (M12);
18. Widening of Likuni Road (S124) in Area 3;
19. Improvement of T361in Area 53 & 54;
20. Improvement of T363 in Area 61;
21. Capacity development for LCA's road related services;
22. Road maintenance program, road rehabilitation program;
23. Development of road inventory database;
24. Construction of new bus terminals expansion of minibus depot in Old Town;
25. Construction and improvement of bus stops and review of minibus operation and routes;
26. Institutional reform of bus operation;
27. Introduction program for the establishment of a new bus company (third sector company);
28. Improvement of intersections;
29. Introduction of central control system;
30. Improvement of car parking system;
31. Development of safety traffic environment (Road Safety Master Plan);
32. Development of safe pedestrian network;
33. Development of cycle road network; and
34. Modernisation of navigation system.

Progress on the implementation of the plan has been slow. The Lilongwe Western Bypass from the M1 (Bunda turn off) to the Mchinji Road was completed as part of the Nacala Corridor project. By and large, very little else has been done.

The primary reason for the lack of implementation of the plan appears to be the lack of capacity within the city council, to plan, design and attract funding for schemes. At the same time donors, have made it known that they are unwilling to fund projects unless capacity is built.

Also, the proposals themselves are not founded within a coherent vision, which has led to a long list of disjointed projects with no prioritisation or idea of where to start. This in itself, makes the first steps for the implementing agency, difficult.

Turning to the list of projects (above), numbers 1 to 20 are road projects. They are mainly road widening schemes (Nos.1 to 10, and 15 to 18. However, these should not be implemented without first improving the capacity of intermediate junctions, mainly through conversion to high capacity signals with sufficient approach and storage lanes and carefully designed signal stages for both vehicles and pedestrians. The proposals for ring road components appear sensible, subject to economic evaluation, as they are designed to remove through traffic from the city.

The remaining proposals are worthy, if somewhat vague. The introduction of a central control system (No.29) relates to signal control and would make a useful contribution, once a number of intersections have been signalised and there is a need to control these on an area-wide basis.

The public transport proposals suggest a move in the right direction, and need to be articulated further in terms of the legal and regulatory requirements. The proposed expansion of the minibus depot in the Old Town suggests a consolidation of the status quo in terms of minibus operations and does not sit well within a modern mass transit system. At the same time, a bus terminus/depot in the centre of a city is not supported; an interchange for through buses is preferred with terminals and depots[2] on the city outskirts.

As noted above, capacity development for the Lilongwe City Assembly (no. 21) is vital. This is fully supported.

2 A terminal is generally a place where bus route(s) start and end. A depot can be a terminal but would include maintenance facilities

The central bus terminal in Mzuzu can accommodate large number of buses

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Malawi National Transport Master Plan

5 Mzuzu

Urban Transport Sub-Sectoral Plan

5 Mzuzu

5.1 Background

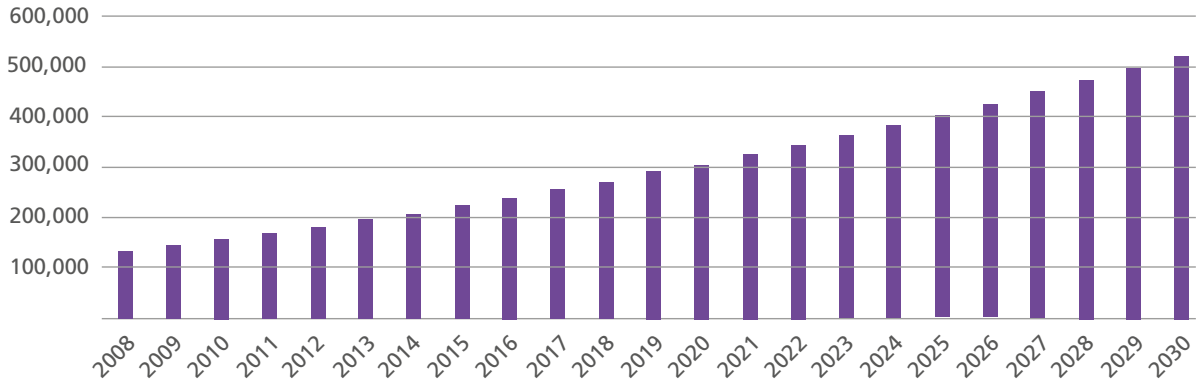
Mzuzu City is a fast-growing city which owes its origin to the Commonwealth Development Corporation's Tung Oil Estates established in 1947. The city became a municipality in 1980 and a city in 1985. The city is a strategic industrial location for agriculture, livestock and forestry based activities. It serves a hinterland with a population of 1,708,930 inhabitants.

5.2 Population

The population of the city was 168,928 inhabitants as of 2011, with a population density of 2,791/km^2 and a growth rate of 4.4%. The population of the city represents 1% share of the national population. Projected population growth up to 2030 is indicated in Figure 5.1.

Mzuzu has the highest urbanisation rate at 7.6%, and in addition around 20,000 commuters use commercial and social services and the public infrastructure in the city. This massive urbanisation is putting pressure on the growth rate of the city and will require a lot of coping mechanisms for the council to contain the booming population.

Figure 5.1 Mzuzu City population projection



Source: NSO

Informal taxi services provided in Zomba

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Malawi National Transport Master Plan

6 Zomba

Urban Transport Sub-Sectoral Plan

6 **Zomba**

6.1 **Background**

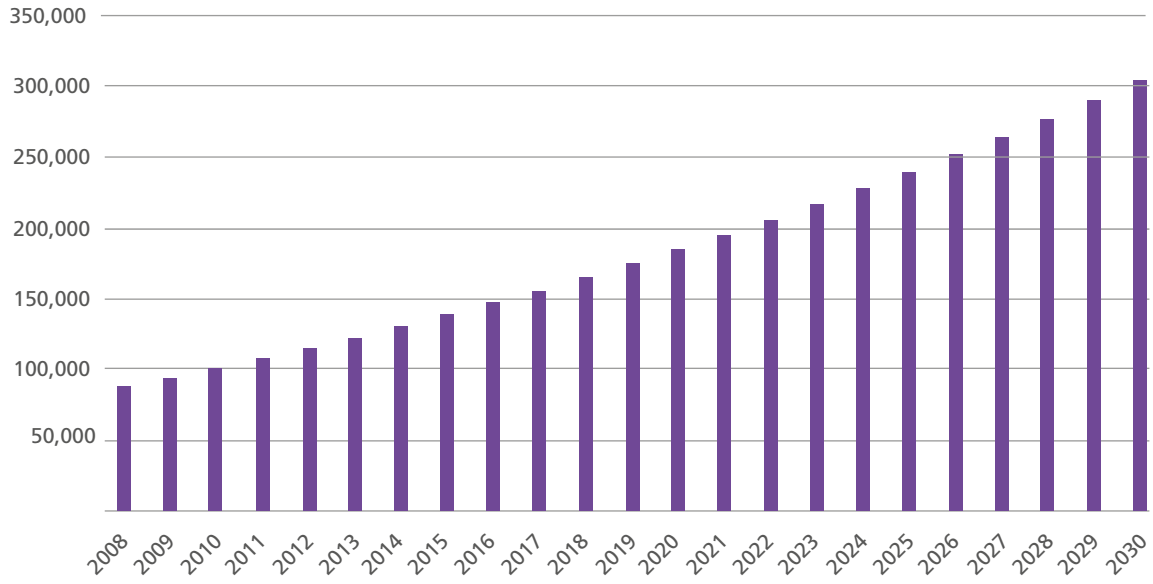
Zomba City was the first capital city of Malawi until 1975 when the capital was relocated to Lilongwe. The city became the university town, housing the University of Malawi central administration and Chancellor College (a constituent college).

In 1979, Zomba assumed municipal status and was granted city status in March 2008. The city is located at the foot of Zomba Plateau, which is the fourth highest plateau in the country. The plateau is one of the renowned tourist attractions in the country due to its diverse natural resources and scenic beauty.

6.2 **Population**

The city is experiencing rapid population growth and has a population density of 2,264 per km^2 with an annual growth rate of 3.0%. About 65% of the population lives in unplanned areas. Zomba's population swells during academic terms owing to the presence of Chancellor College. No minibuses service the route between student quarters and the university campus. The ZCC has a major task in accommodating the growing population in a well-planned manner.

Figure 6.1 Population and Housing Census 2008



Source: NSO

The M1 through Mzuzu: very high motorised and non-motorised vehicle conflict at the market place

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Malawi National Transport Master Plan

7 Demographic forecasts

Urban Transport Sub-Sectoral Plan

7 Demographic forecasts

7.1 Overview

The area of Lilongwe City, including Area 58 (Chinsapo) is 393 km^2, and the population in 2016 is estimated to be 1,022,000. The population density of Lilongwe is currently around 2,700 persons per sq. km., lower than the capital cities of neighbouring countries as shown in Table 7.1. Chinsapo is physically separated from the remainder of the city and is entirely surrounded by Lilongwe District.

Table 7.1 Population densities, selected African cities, 2016

City	Population density (persons per sq. km.)
Lilongwe	2,600
Harare	2,700
Maputo	6,400
Dar-es-Salaam	7,500
Lusaka	8,500
Kinshasa	19,500

The relatively low population density of Lilongwe indicates a dispersed residential arrangement with little high density housing. Whist there are a large number of informal settlements, it is not characterised by high density slum areas like Nairobi and Abidjan. The dispersed nature of the population means that distances to economic activities are relatively long, which adds to transport costs.

The population and population densities of the four cities in Malawi are compared in Table 7.2.

Table 7.2 Urban population densities, Malawi, 2016

City	Population	Area (sq.km)	Population density
Lilongwe	1,021,948	393	2,600
Blantyre	962,992	228	4,224
Mzuzu	237,428	144	1,649
Zomba	145,148	39	3,721

7.2 Population

The forecast population growth and annual growth rates for each of the four cities in Malawi are compared in Table 7.3.

Table 7.3 Forecast population growth, Malawi urban areas

Year	Lilongwe	Blantyre	Mzuzu	Zomba	Total urban	Annual % growth rate
2016	1,022,000	963,000	237,000	145,000	2,367,000	
2021	1,339,000	1,165,000	323,000	192,000	3,019,000	4.99
2026	1,706,000	1,395,000	424,000	248,000	3,773,000	4,56
2031	2,151,000	1664,000	547,000	316,000	4,678,000	4.39
2036	2,725,000	1,996,000	709,000	403,000	5,833,000	4.51

7.3 Employment

In 2008, the Japan International Cooperation Agency (JICA) estimated the employment in Lilongwe to be 210,000 comprising jobs in the sectors set out in Table 7.4. Employment in 2008 represented 0.31 jobs per head of population. JICA forecast that this figure would rise by 1% per year to 0.33 by 2015.

Table 7.4 Estimated employment in Lilongwe, 2008

Employment category	Jobs
Agriculture, mining	3,200
Manufacturing	18,300
Commercial	38,500
Government	40,000
Informal	110,000
Total	**210,000**

Source: The Study on Urban Development Master Plan for Lilongwe, JICA, September 2010

To estimate employment in Lilongwe and other urban areas for 2016, we have used the data from the 2013 Labour Force Survey, which disaggregates rural and urban employment rates as shown in Table 7.5.

Table 7.5 Labour force and employment

Parameter	Urban	Rural
Working Age Population	1,050,000	6,746,000
Labour Force	896,000	6,072,000
Employment Participation Rate	0.613	0.727
Employment Rate	0.26	0.33

Using the rate shown in Table 7.5, employment estimates for the four cities were made as shown in Table 7.6.

Table 7.6 Urban employment estimates

Urban area	Employment
Lilongwe	270,000
Blantyre	254,000
Mzuzu	63,000
Zomba	38,000
Total	**625,000**

As GDP per head grows, we expect the employment rate per head of population to grow, and the figure of 1% per year, proposed by JICA has been adopted, leading to forecast employment rates as set out in Table 7.7.

Table 7.7 Forecast urban employment rates

Year	Jobs per head of population
2016	0.26
2021	0.28
2026	0.29
2031	0.31
2036	0.32

Using the employment rates in Table 7.7, forecast jobs in the four cities are presented in Table 7.8.

Table 7.8 Forecast urban employment

Year	Lilongwe	Blantyre	Mzuzu	Zomba	Total urban
2016	270,000	254,000	63,000	38,000	625,000
2021	372,000	323,000	90,000	53,000	838,000
2026	498,000	407,000	124,000	72,000	1,101,000
2031	660,000	510,000	168,000	97,000	1,435,000
2036	878,000	643,000	229,000	130,000	1,880,000

Minibus stand along the road in Lilongwe

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Malawi National Transport Master Plan

8 Transport demand

Urban Transport Sub-Sectoral Plan

8 Transport demand

8.1 Public transport use in Lilongwe

A survey of minibuses and minibus passengers was carried out in Lilongwe in September 2016. The survey intended to capture all minibuses entering and leaving a central cordon defined by the following roads:

- M1, Area 18;
- Capital Hill Road;
- Chidzanja Road;
- Falls Estate Road;
- Likuni Road;
- M12, Mchinji Road, Crossroads Depot;
- Mzimba Drive;
- Petroda, Area 47; and
- Youth Drive.

Every minibus crossing the cordon was counted, along with its origin/destination, registration plate, and estimated number of passengers. By analysing registration plates we could remove minibuses counted more than once during the survey period (06.00 to 18.00 hours), and deduce that, on that day, there were 3,761 vehicles operating to/from, and within Lilongwe. Table 8.1 lists the inbound passengers and Table 8.2 the outbound passengers Figure 8.1 shows the daily profile of inbound passengers, and Figure 8.2 the profile of outbound passengers.

Table 8.1 Inbound daily minibus passengers, Lilongwe cordon

	Hour beginning											
	06:00	**07:00**	**08:00**	**09:00**	**10:00**	**11:00**	**12:00**	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**
Area 18	612	491	378	955	663	672	588	647	554	399	933	528
Capital Hill Road	90	498	354	280	208	191	61	280	117	178	101	137
Chidanzja Road	410	998	349	906	1816	688	516	323	373	377	738	938
Falls Estate Road	644	4358	2158	2008	1794	759	416	72	1228	1370	1005	1176
Likuni	279	290	126	268	213	505	401	817	548	1212	45	269
Mchinji Road	512	932	407	452	260	283	380	329	531	614	286	548
Mzimba Drive	579	1669	739	192	942	569	543	609	716	523	787	454
Petroda Area 47	101	460	1137	833	518	406	521	327	420	459	420	177
Youth Drive	13	60	120	29	103	218	194	236	139	184	335	196
Total Inbound	**3240**	**9756**	**5768**	**5923**	**6517**	**4291**	**3620**	**3640**	**4626**	**5316**	**4650**	**4423**

Table 8.2 Outbound daily minibus passengers, Lilongwe cordon

	Hour beginning											
	06:00	**07:00**	**08:00**	**09:00**	**10:00**	**11:00**	**12:00**	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**
Area 18	259	403	705	650	407	946	1485	842	910	2000	1937	771
Capital Hill Road	145	238	455	265	414	223	193	70	276	507	418	161
Chidzanja Road	222	521	682	1214	433	975	448	549	128	594	503	578
Falls Estate Road	310	129	261	453	593	282	1196	410	741	854	734	1313
Likuni	148	191	196	192	226	533	412	862	577	1444	1045	583
Mchinji Road	216	639	497	391	78	408	294	477	590	560	631	205
Mzimba Drive	239	466	535	452	1304	442	558	655	951	1124	416	250
Petroda Area 47	102	406	529	713	61	490	686	675	636	902	663	201
Youth Drive	132	766	711	152	132	334	542	397	413	586	431	131
Total Outbound	**1773**	**3759**	**4571**	**4482**	**3648**	**4633**	**5814**	**4937**	**5222**	**8571**	**6778**	**4193**

Figure 8.1 Total daily inbound minibus passengers, Lilongwe cordon

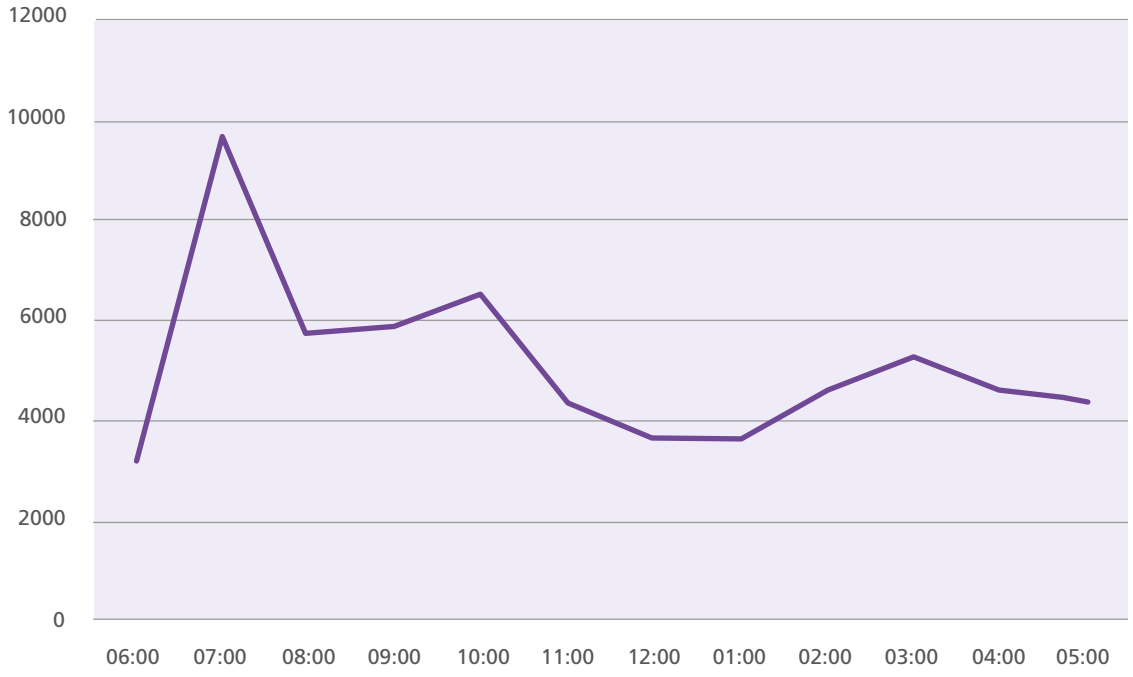
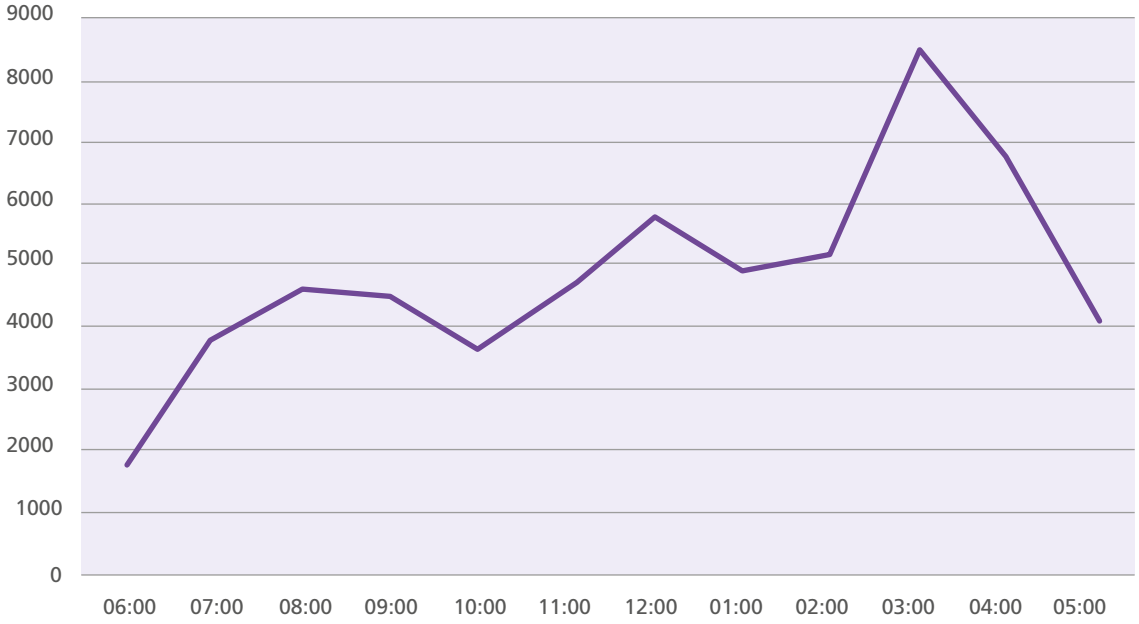


Figure 8.2 Total daily outbound minibus passengers, Lilongwe cordon



The total number of 120,150 passengers were counted crossing the cordon on the survey day. The number of trips (origin to destination, one way) per minibus per day within the city varied between 4 and 10, with an average of 6 trips. 3,761 minibuses were observed to be operating in the city, with an average passenger daily load per vehicle per day of 59.4. The total daily passengers carried by minibuses in Lilongwe is on average 223,403.

8.2 **Minibus patronage in other cities**

The Minibus Owners Association of Malawi (MOAM) estimate that there are 12,300 minibuses operating as public service vehicles in Malawi, dispersed as shown in Table 8.3.

Table 8.3 Minibuses per region

Region	No. of minibuses
Central	5,400
Southern	6,100
Northern	800
Total	**12,300**

Source: MOAM

An estimate of minibuses operating in each city was made using the population figures in Table 7.2 with a view to respecting the regional totals in Table 8.3. The results are shown in Table 8.4.

Table 8.4 Estimated number of minibuses operating in the four cities

City	Number of minibuses	Minibuses per head of population	Source
Lilongwe	3,761	0.0037	NTMP Surveys
Blantyre	3,544	0.0037	Ratio as per Lilongwe
Mzuzu	250	0.0011	Pro rata Northern Region
Zomba	170	0.0012	Ratio as per Mzuzu
Non City (Rural)	4,575	0.0003	
Total	**12,300**	**0.0007**	

The daily person trip rate per minibus of 59.4 from Lilongwe was applied to all four cities to provide daily estimates of minibus trips, as shown in Table 8.5.

Table 8.5 Estimated daily minibus person trips

City	Person trips by minibus
Lilongwe	223,403
Blantyre	210,515
Mzuzu	14,850
Zomba	10,098

8.3 Private transport use in the cities

We estimate that at the end of 2016 there were around 248,000 vehicles registered in Malawi, including government vehicles. There is no data to establish the distribution of vehicle ownership around the country, so the following approach was adopted. Taking the assumption that vehicle ownership is directly related to income, we reviewed the salary differentials of a major bank for the same position across the cities in Malawi. This revealed the factors shown in Table 8.6.

Table 8.6 Income differentials across cities

City	Factor above national average
Lilongwe	1.20
Blantyre	1.12
Mzuzu	1.0
Zomba	1.0

Using the factors in Table 8.6 estimates of vehicle ownership across the four cities were made, as shown in Table 8.7.

Table 8.7 Vehicle ownership estimates

City	Population	Vehicles per head	Vehicles
Lilongwe	1,021,948	0.0178	18,181
Blantyre	962,992	0.0167	16,081
Mzuzu	237.428	0.0145	3,454
Zomba	145,148	0.0145	2,112
Malawi Average	**16,702,279**	**0.0149**	**248,393**

The Lilongwe vehicle fleet survey revealed that 89% of the vehicle fleet was private cars. The road side interviews revealed a trip rate of 2.33 per private vehicle, and an average occupancy of 1.5 persons. Applying these factors gives the daily private vehicle person-trips in the four cities, which are shown in Table 8.8 below.

Table 8.8 Urban daily private person trip estimates

City	Person trips
Lilongwe	56,576
Blantyre	50,042
Mzuzu	10,750
Zomba	6,572

8.4 **Walk trips in Lilongwe**

Casual observation and consultations with city council officials suggested that walking was the most important mode of transport in all four cities. In order to assess the number of daily trips made by walking an assumption of the mode share of walk trips in Lilongwe was made by reference to data from other African cities. These are shown in Table 8.9.

Table 8.9 Walk mode share, selected African cities

City	Year(s)	Walk mode share (%)
Addis Ababa	1992-2002	70
Morogoro	1992-2002	67
Lusaka	2007	65
Harare	1992-2002	63
Dar-es-Salaam	2005	50
Eldoret	1992-2002	48
Nairobi	2001	48
Nairobi	1992-2002	47
Dar-es-Salaam	2010	46
Dar-es-Salaam	1992-2002	45
Harare	2010	42
Nairobi	2010	41
Dar-es-Salaam	2010	34
Ibadan	2010	30
Cape Town	2004	13

As shown, the share by walking decreases over time as motorisation, both private and public, increases. We believe the share by walking should be significantly higher than recent estimates (2010) for Dar, Harare and Nairobi, but perhaps slightly less than the estimate made for Lusaka in 2007. We therefore proposed a figure of 61%.

8.5 Other urban transport modes

8.5.1 Cycling

Own account cycling in Lilongwe and the other three cities represents a small share of daily transport trips. Private cycling seems more popular in Lilongwe, and this may be in the of the order of 1,000 cycles used regularly for private transport.

However, cycles as a public transport mode are becoming increasingly important in Lilongwe. Their primary function is to provide a service from minibus stops and terminating points, penetrating residential areas usually on unpaved roads. We carried out a sample survey of this operation, known as kabazas which indicated that in February 2017, there were of the order of 3,000 cycles operating in Lilongwe. Each cycle has an average daily passenger rate of 5.2, with fares varying between MWK 173 to 180 per km. Using the above, we estimate 15,600 daily trips are made by cycle in Lilongwe.

Blantyre does not have kabazas to any great extent, and own-account cycling is much less than in Lilongwe. There are kabazas and own account cycling in both Mzuzu and Zomba.

8.5.2 Sedan taxis

There are a few unregistered saloon cars acting as taxis in Lilongwe, either booked by telephone, or located near centres of attraction, such as hotels, bars and shops. It is not possible to estimate their number, but it is assumed that their overall contribution to transport is negligible.

In contrast, there are a large number of taxis operating in Blantyre, usually recognisable by their red/white registration plates (registered as hire or public service vehicles). They often operate from self-organised ranks (particularly in Blantyre city, Ndirande, and Chinseu) operating on a cab-rank principle. Fares are generally consistent between drivers, up to MWK 1,000 per km.

Sedan taxis operate in Zomba. These tend not be registered as public service vehicles, and are often of questionable fitness.

8.5.3 Three-wheeler taxis

A vehicle fleet survey carried out in Lilongwe revealed the existence of around 100 three-wheeler vehicles operating as taxis. These are generally located in the Old Town areas, but are found plying for hire on most of the city's roads. Their fares average MWK 1,500 per trip, (MWK 237 per km), and on average they carry around 10-20 passengers each per day. Three-wheelers do not currently ply in the other cities.

8.5.4 Motorcycle taxis

Motor-cycle taxis are a recent phenomenon in Malawi, and operate in a limited fashion in a purely informal way in Blantyre and Mzuzu.

8.5.5 Other

Passenger carrying trucks are observed in Lilongwe, as well as other urban areas. These matolas are not so common as in rural areas, and tend to be hired for special occasions such as funerals, as opposed to acting as public transport services.

8.6 **Education trips in Lilongwe**

The mode share of schoolchildren's trips to school varies significantly by type of school: government (public); and private.

At private schools, trips to school are dominated by private transport (85%), with children being dropped off and picked up by parents or drivers, or using private buses owned by the school for bringing students to school. Less than 2% walk with the remainder (13%) using minibuses.

At public schools, the dominant mode is walking (66%), with 15% using kabazas, 13% private cars (including begging for lifts), and only 6% minibuses. The relatively low use of minibuses (Table 8.10) reflects the high public transport fares. Most public schools do not operate private bus services.

Table 8.10 Public transport mode share for education trips

City	Year	Share by public transport
Dar-es-Salaam	2010	49
Nairobi	2010	29
LIlongwe	2017	10

Lilongwe range 6% to 14%

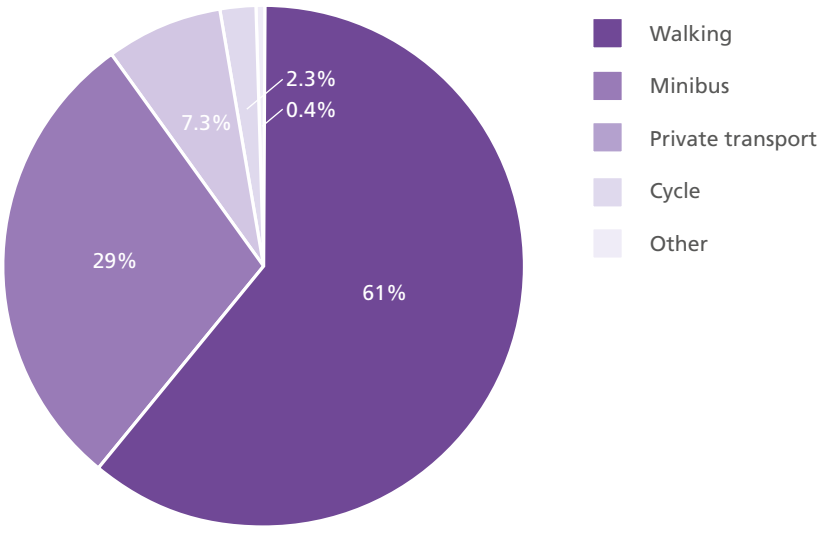
8.7 **Overall mode shares in Lilongwe**

Table 8.11 shows the trips and mode shares estimated for Lilongwe City in 2016, that result from the analyses and assumptions above. These are shown graphically in Figure 8.3.

Table 8.11 Mode shares, Lilongwe City, 2016

Mode	Daily trips	Share (%)
Walk	470,000	61.0
Public Transport (minibus)	223,400	29.0
Private Car	56,600	7.3
Cycle	17,600	2.3
Other (motor cycles, taxis etc.)	2,800	0.4
Total	**770,400**	**100.0**

Figure 8.3 Mode shares, Lilongwe City, 2016



8.8 **Walking in the cities**

Walking is the dominant mode of transport in Lilongwe, and likely to be so in the other cities. Walking, as a derived demand, is a function of income and population density – the relative proximity of transport generators and attractors. Whilst people in developed cities are choosing to walk for health reasons, despite their ability to pay for motorised transport, commentators in Malawi argue that *"...people walk because they are poor"*.

Given that poverty is even spread across the cities, the determinant for walk trip making will be population density, which makes opportunities closer together (the further away opportunities are, the less trip making in total). Table 8.12 shows the estimated walk trip rates based on population density in each city.

Table 8.12 Walk trip rates

City	Population	Area (sq.km)	Density (per sq.km)	Walk trip rate per head
Lilongwe	1,021,948	393	2,600	0.46
Blantyre	962,992	228	4,224	0.56
Mzuzu	237,428	144	1,649	0.36
Zomba	145,148	39	3,721	0.49

8.9 **Mode shares in the four cities**

Using the estimates for walking (Table 8.12), minibus use (Table 8.5), and private car trips (Table 8.8), overall modal shares for the four cities has been estimated. There are differences between the cities with respect to the minor modes of transport, as summarised below:

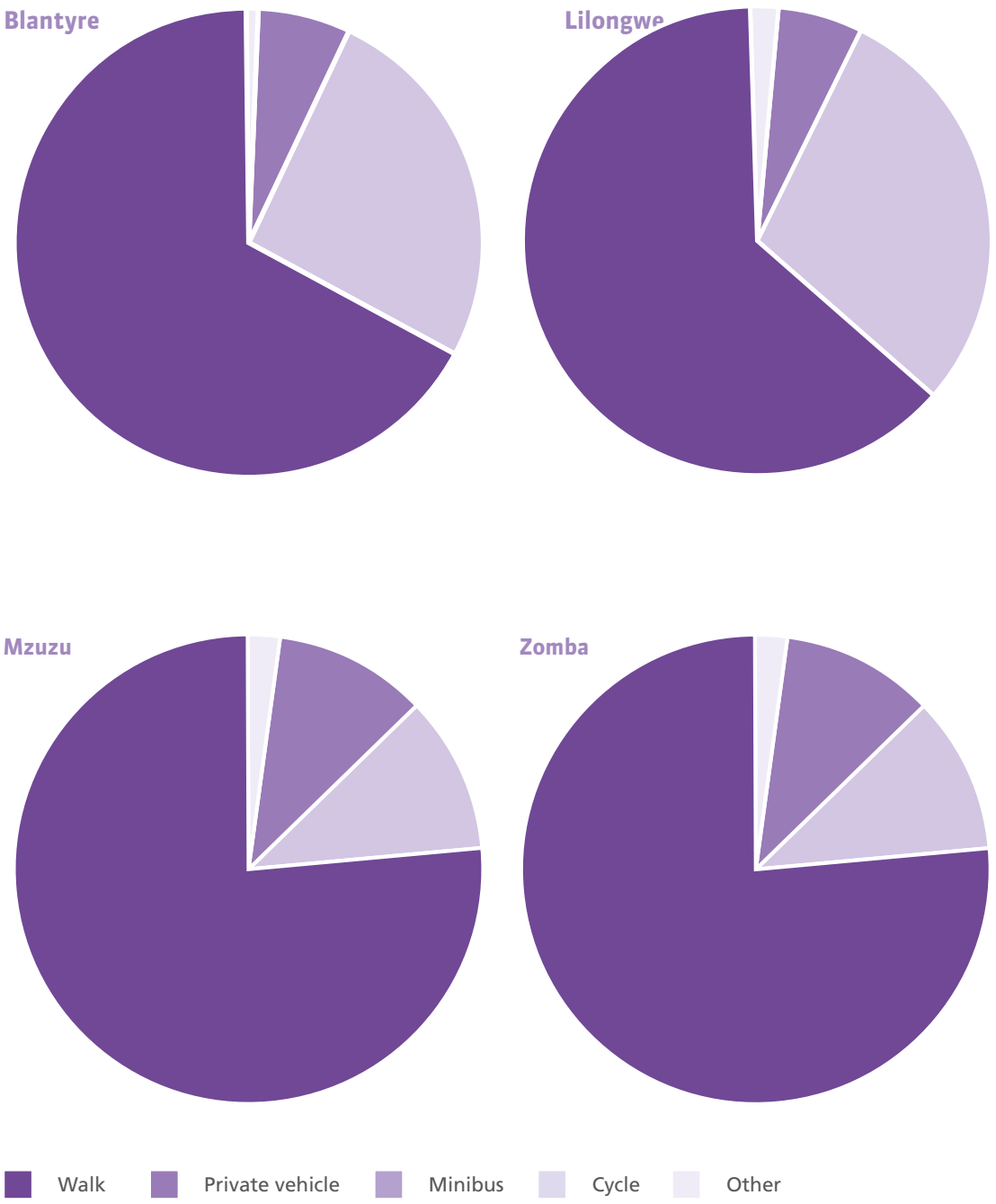
- Blantyre does not have a kabaza market, with limited own account cycling, and some motor cycle taxis are beginning to penetrate the city;
- Mzuzu has both small but growing kabaza and motor cycle taxi services; and
- Zomba has kabaza services, mainly operating in the suburbs and it has a few sedan taxi services.

Figure 8.4 shows the other transport modes operating in the four cities. Figure 8.5 compares modal shares in the four cities. The data and assumptions that underlie these figures should not be taken as absolute in all cases; rather they are provided in order to understand the similarities between the four cities, and the differences.

Figure 8.4 Other transport modes

Top to bottom: Hybrid bus-truck operating in Lilongwe; Motor cycle taxis in Mzuzu; Motor cycle taxis in Zomba

Figure 8.5 Urban transport modal shares, 2016



8.10 **Comparisons with other African cities**

Table 8.13, Table 8.14 and Table 8.15 show the comparisons of Lilongwe with other African cities in terms of mode shares[4]. The comparisons suggest that the assumptions and analyses made for Lilongwe above, are reasonable in regard to its stage of development.

Table 8.13 Private transport mode share in selected African cities

City	Year	Private transport (%)
Kampala	2009	35
Abidjan	2009	18
Harare	2007	17
Nairobi	2006	15
Accra	2009	13
Dar-es-Salaam	2009	10
Addis Ababa	2009	7
Dar-es-Salaam	2007	6
Lilongwe	**2016**	**7**

Table 8.14 Public transport mode share in selected African cities

City	Year	%
Dar es Salaam	2010	58
Nairobi	2010	52
Nairobi	2002	45
Dar es Salaam	2002	44
Dar es Salaam	2005	43
Nairobi	2001	42
Cape town	2004	39
Nairobi	2007	38
Harare	2002	38
Addis Ababa	2009	35
Nairobi	2002	32
Ibadan	2010	30
Lilongwe	**2016**	**29**
Lusaka	2007	21

Table 8.15 Public transport share of motorised trips in selected African cities

City	Year	%
Dar-es-Salaam	2010	89
Nairobi	2010	88
Lilongwe	**2016**	**80**
Lagos	2008	77
Lusaka	2007	68

4 *Travel behaviour in Cape Town, Dar-es-Salaam and Nairobi Cities, Estomihi Masaoe, Romano Del Mistro and George Makajuma, 2011*
Sustainable Urban Mobility in 'Anglophone' Sub-Saharan Africa, Gordon Pirie, Global Report on Human Settlements, 2013
Urban Transport Policy for Greater Maputo, Nathan Associates Inc. for review by the United States Agency for International Development, December 2006
Cities on the Move, World Bank Urban Transport Strategy Review, 2002

Segregated pedestrian facilities in Zomba

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9 Urban transport costs

Urban Transport Sub-Sectoral Plan

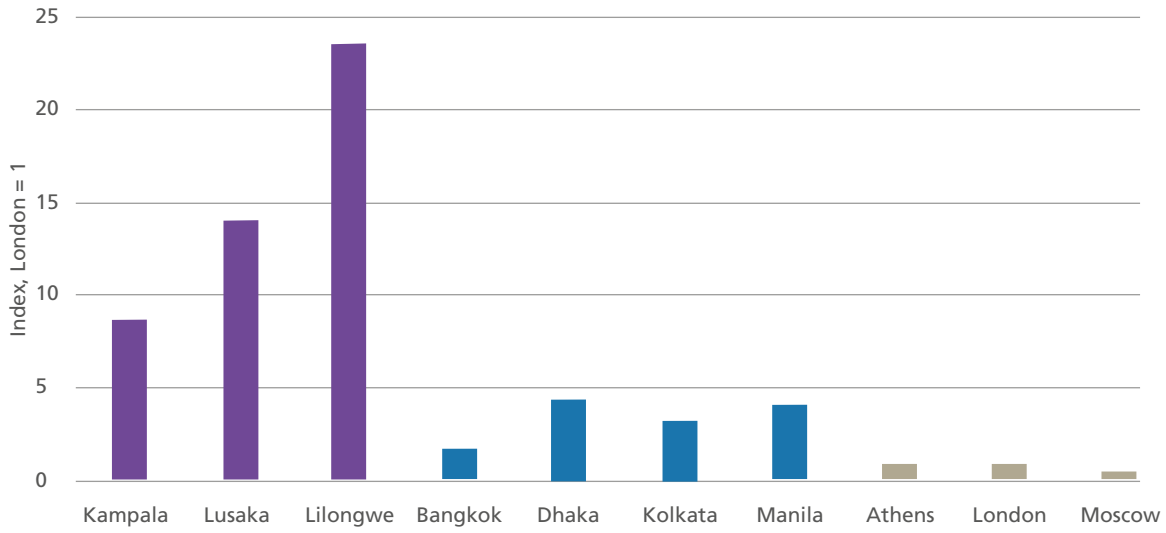
9 Urban transport costs

9.1 Minibus fares

Minibus fares average around MWK40-50 per kilometre, and are largely driven by fuel costs which are constant across the country. Minibus fares in Lilongwe are around MWK 50 per km.

Such a fare level, relative to ability to pay, is high in international comparison. Figure 9.1 shows public transport fares in selected African, Asian and European cities, the observed fares have been normalised against GDP per capita for the respective country and indexed, with London set at 1.0.

Figure 9.1 Public transport fares relative to affordability in selected cities

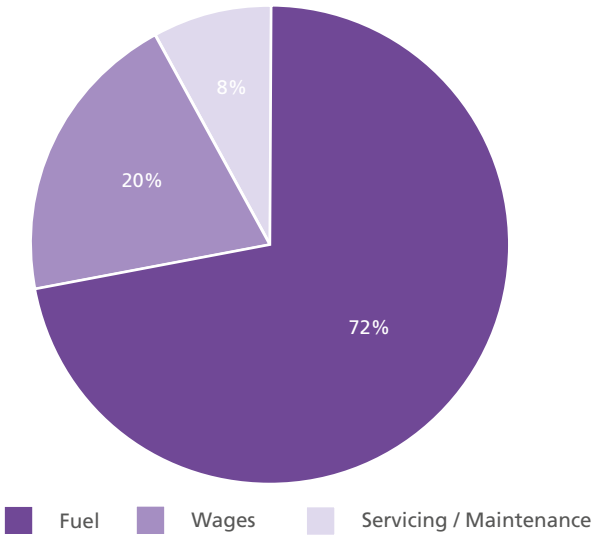


Source: Consultant

Relative to affordability minibus fares in Lilongwe are 23 times more expensive than bus fares in London. Whilst all the African examples exhibit high fares compared to other regions, Lilongwe's minibus fares are almost three times higher than those of Kampala, and 50% more than in the neighbouring capital of Lusaka.

Operating costs (excluding rental) of minibuses in Lilongwe are dominated by fuel costs as shown in Figure 9.2. Fuel accounts for 72% of operating costs, with wages (and limited benefits) at 20%, and servicing and maintenance costs around 8%. Although in Lilongwe, the total annual turnover of minibuses[3] is of the order of $20 million, the business is not highly profitable and the poor quality of vehicles bears testament to this. Consultations revealed that high minibus fares in all four cities are a cause for concern for the authorities.

Figure 9.2 Operating cost breakdown of minibus operations in Lilongwe



Source: NTMP

3 Minibuses operating within the city and accessing the city from other towns

9.2 **Ability to pay**

A survey of urban employees in occupations in Lilongwe and Blantyre earning up to MWK100,000 per month was carried out to determine the amount that was being spent on transport (minibus fares). Table 9.1 lists the results. Employees are spending between 6% and 40% of their gross income on public transport to access work, with transport costs tending to be slightly higher in Lilongwe where travel to work distances are on average longer.

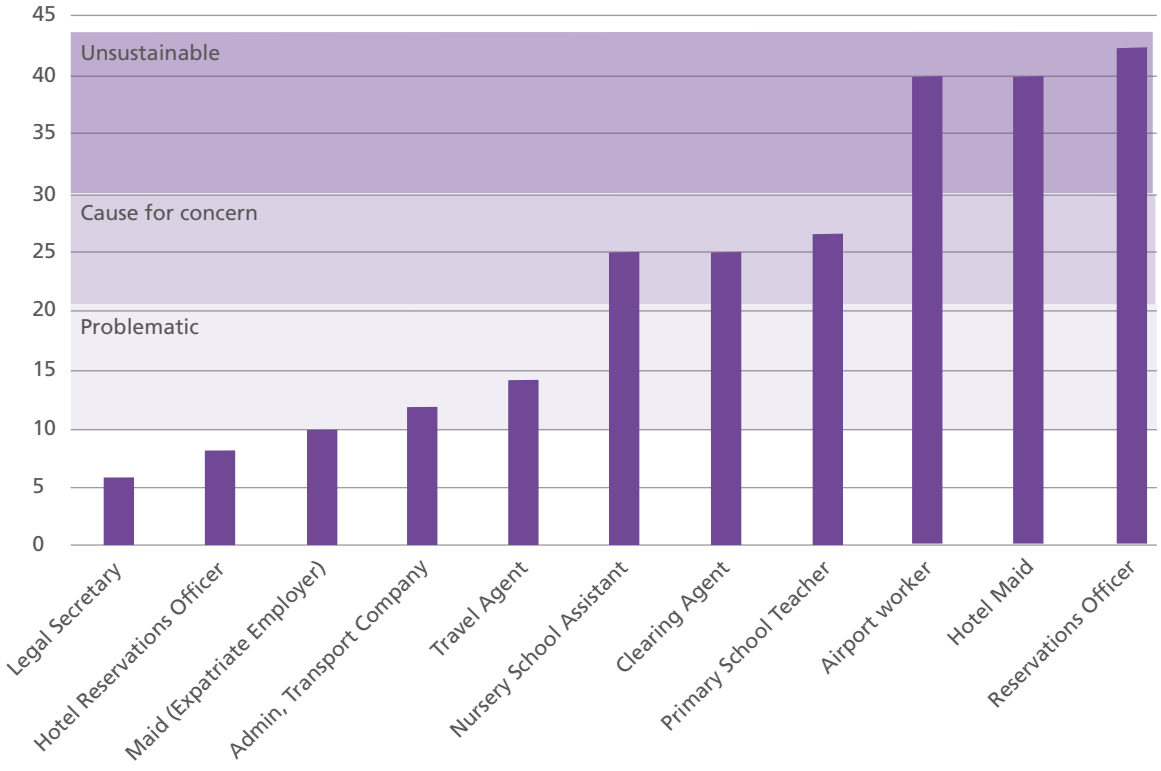
Table 9.1 Urban employee wages and transport costs

Occupation	Wages (MWK)	Wage (US$)	Transport per month (MWK)	% income spent on transport	Net income (MWK)
Hotel Maid	30,000	42	12,000	40	18,000
Nursery School Assistant	40,000	56	10,000	25	30,000
Reservations Officer	40,000	56	17,000	43	23,000
Clearing Agent	40,000	56	10,000	25	30,000
Maid (Expatriate Employer)	50,000	69	5,000	10	45,000
Admin, Transport Company	50,000	69	6,000	12	44,000
Primary School Teacher	60,000	83	16,000	27	44,000
Airport worker	70,000	97	28,000	40	42,000
Travel Agent	70,000	97	10,000	14	60,000
Legal Secretary	100,000	139	6,000	6	94,000

Source: NTMP

Figure 9.3 shows the proportions of wages spent on transport. Where the percentage is greater than 10% the proportion can be considered 'problematic', and between 20% and 30%, the proportion is a 'cause for concern'. Above the 30%, the proportion is 'unsustainable' and means that individuals constantly consider whether the cost of the journey to work is worth the outcome in terms of wages. At this level of cost, workers often drop out of that occupation in that location.

Figure 9.3 Transport costs as a proportion of income



A recent study in Zambia[4] found that around two-thirds of public transport users had an average salary in the same range (in US Dollar terms) as a sample in Table 9.1 above. Of these, it is possible that around 13% were in the 'unsustainable' category of ratio of transport expenditure to income, with the remainder in the 'problematic' zone. Virtually all these passengers were in households that spent more on transport annually than they did on education.

Table 9.2 shows sample minibus fares in Blantyre at February 2017. Table 9.3 shows the resultant transport cost proportions of wages for various fare and wage levels in Blantyre. The highlighted cells can be considered 'problematic'.

4 Trip Modelling and Cost Analysis for Public Road Transport System for the City of Lusaka, Zambia Institute for Policy Analysis and Research, 2013.

Table 9.2 Minibus fares in Blantyre

Origin	Destination	Fare (MWK)
Blantyre CBD	Limbe	200
Ndirande	Limbe	150
Ndirande	Limbe	150
Bangwe	Limbe	150
Chirimba	Blantyre CBD	200
Chilomoni	Limbe	250
Chilomoni	Blantyre CBD	200
Chirimba	Limbe	200
Zingwangwa	Blantyre CBD	250
Chilobwe	Blantyre CBD	250
Chigamula	Limbe	250
Chimwankhunda	Blantyre CBD	300

Table 9.3 Monthly transport costs as percentage of income, for fare and income, Blantyre

	Monthly income (MWK)			
One way minibus fare (MWK)	**30,000**	**50,000**	**70,000**	**90,000**
150	10	6	4	3
200	13	8	6	4
250	17	10	7	6
300	20	12	9	7

Other studies reviewed[5] showed that in Lagos (Nigeria), 15% to 20% of household expenditure in 1997 was spent on transport (public and personal), while in Doula (Cameroon) in 2000 the equivalent figure was 14% of household expenditure, while in Yaounde it was 15% on average, but only 11% for the highest income quintile. In Dakar in 1998, 8% of household expenditures are spent on transport in average, and households of the highest income quintile spend 4.5%. In these cities, it was concluded that most of the poor simply walk, because they cannot afford public transport fares.

A Poverty Impact Assessment was commissioned by the World Bank as part of the preparation of an Urban Transport Project for Lagos, Nigeria in 2002. Although this assessment did not provide a direct measure of affordability, it did provide data on which it could be estimated for 1992. Taking the assessment's definition of poor as having one third the average income for the city, and the then average fare, the proportion of a poor working person's income spent on transport would have been over 54% and the expenditure of someone on an average income, more than 17%. These are both very high and reflect the high fares charged on buses in Lagos. Like Malawi, (see para. 10.7) fare regulations are not strictly enforced and operators effectively bargain the fare with passengers according to the length of the queue.

5 *Affordability of Public Transport in Developing Countries Robin Carruthers, Malise Dick and Anuja Saurkar, World Bank, 2005.*

Small car parking facility beside the central bus terminal in Mzuzu

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Malawi National Transport Master Plan

10 Challenges in urban transport

Urban Transport Sub-Sectoral Plan

10 Challenges in urban transport

10.1 Traffic speed

10.1.1 Speeds in Blantyre and Lilongwe

Surveys of traffic speeds were carried out in Lilongwe and Blantyre in March 2017. The surveys used a moving observer technique in which the survey vehicle was driven within the general traffic flow, only overtaking a vehicle if overtaken by another. The surveys were carried out between 07.00 hours and 09.00 hours in both cities on weekdays.

The survey in Lilongwe covered a circular route (in both directions), starting at Area 18 roundabout and travelling via Parliament roundabout, Kenyatta Drive, Youth Drive signals, Kamuzu Central Hospital roundabout, Mzimba Street, Kavale Junction, Lubani, M1 through Old Town, Golf Course roundabout, Kamuzu Procession, CrossRoads roundabout, M1 to Area 18 roundabout.

The surveys in Blantyre covered:

1. Blantyre to/from Limbe from Clock Tower roundabout to Ilovo roundabout via Kamuzu Highway; and
2. Blantyre CBD – Victoria Avenue, Halie Selasse, Glyn Jones Road circuit.

Table 10.1 shows average peak hour traffic speeds in Lilongwe and Blantyre.

Table 10.1 Average morning peak hour traffic speeds

City	Route	Average speed (km/hour)
Lilongwe		29.2
Blantyre	CBD	17.8
Blantyre	Blantyre-Limbe	23.6

Source: RA

10.1.2 International comparisons

Table 10.2 shows traffic speeds recorded in a number of selected cities over the past 17 years. In Lusaka in 2008 the average speed was relatively high, but the average speed in Lilongwe is already well below that. The average speed in Blantyre CBD is low in international comparison, worse than the averages for both Accra and Nairobi recorded recently.

Table 10.2 Traffic speeds in selected cities

City	Year	Average morning peak hour traffic speed (km/hour)
Bangalore	2005	35
Bangalore	2014	9.0 – 12.9
Singapore	2005	26.7
Singapore	2014	28.9
Brisbane	2016	17.2 – 20.1
Sydney	2006	32
Sydney	2010	31
Accra	2017	20
Nairobi	2016	20
Dar-es-Salaam	2016	10-12
Lusaka	2008	34.8
Maputo	2000	30.6

10.2 **Mix of through traffic and local traffic**

Through-traffic in Lilongwe contributes to congestion on roads serving activities within the city itself. The Lilongwe western by-pass, constructed after the JICA report, as part of the Nacala Corridor links the M1 (south at Bunda turn off) with the M12 at Gateway Mall. Thereafter, through traffic has the choice of using the M12 and M1 through Lilongwe or skirting around Area 47 and Area 49 to the M1 near Kanengo, in both cases via 2-lane roads. Through traffic is often found on Mzimba Street and Paul Kagame Road within the city, as well as on the M1 through Old Town.

Traffic congestion on the M1 sections north and south of the Area 18 roundabout, and between Paul Kagame Road and Kawale Road and on the Mzimba Street approaches to Kamuzu Central Hospital. Traffic volumes on the M1 of 15,000 vehicles per day were observed.

Blantyre is the confluence of four main roads, the M1, M2, M3 and M4. The designated M1 passes directly through the Blantyre CBD via the Larji Kulji roundabout. The M3 and M4 join the M2 at the north and south ends of Limbe's one way system, ensuring that all main road traffic is forced through the busy and congested commercial section of Limbe.

Mzuzu lies on the junction of the M1 and M5 (to Nkhata Bay). The city is centred on the M1, with the recent major developments of the Reserve Bank of Malawi and the Shoprite-anchored shopping mall both having direct access to the M1. Plans for a bypass are being developed which could relieve the city centre from through traffic, whilst at the same time attracting development to the city fringe.

Zomba is dominated by the M3, although the old commercial centre lies a little to its east. Nevertheless, through traffic on the M3 serves to divide the east and west sides of the city.

10.3 **Poor quality infrastructure**

43% of the urban road network (Table 10.3) are unpaved. Table 10.4 lists the road total road lengths in each of the four cities.

Table 10.3 Urban road types, 2008

Type	Km	%
Paved	770	57
Unpaved	578	43
Total	**1,348**	**100**

Table 10.4 Classified road network in the four cities

City	Road length (km)
Blantyre	282
Lilongwe	253
Mzuzu	170
Zomba	156
Total	**861**

Paved roads are not well maintained, and there is a lack of safe pedestrian infrastructure on most roads. Facilities for public transport, such as shelters at designated stops are few. Where roads are unpaved, particularly within residential areas, they inhibit minibus operations, and passengers are forced to walk or use bicycles. Where minibuses do penetrate unpaved roads, they generally hike fares to compensate for higher operating costs. There is recent evidence from Mzuzu that the upgraded road financed by National Oil Company of Malawi (NOCMA) to reach the strategic fuel reserve resulted in lower minibus fares.

Table 10.5 lists road classes in Blantyre by pavement type, and includes all roads, beyond the classified roads shown in Table 10.4.

Table 10.5 All roads in Blantyre by type

Category	Earth (km)	Paved (km)	Unpaved (km)	Total (km)
Main Roads	0.00	84.00	0.00	84.00
Access roads	21.94	33.51	53.9	109.35
Distributor roads	0	4.19	32.04	36.23
Collector roads	0	3.84	30.88	34.72
Industrial roads	0	1.4	18.73	20.13
Sub-Total (Classified)	21.94	126.94	135.55	284.43
Residential roads	103.75	69.92	95.73	269.4
Totals	**125.69**	**196.86**	**231.28**	**553.83**

Source: BCC

Table 10.6 shows the proportions of paved and unpaved roads in Blantyre, derived from Table 10.5. Less than half the classified roads (48%) are paved, and even fewer (36%) of the residential roads are paved.

Table 10.6 Road surface, Blantyre

Category	Unpaved	Paved	Total
Classified	55.4	44.6	100
Residential	74.0	26.0	100
Total	**64.5**	**35.5**	**100**

10.4 Lack of pedestrian facilities

Given that walking is the most important mode in all the cities, the attention given to facilities for pedestrians has historically been poor, with an accent on the moving vehicle. There is a general widespread lack of guardrails and street lights to reduce risks of traffic accidents, and insufficient facilities for pedestrian safety – footways, zebra crossing, and pedestrian signal protected crossings.

10.4.1 Poorly located pedestrian facilities

Where attempts have been made to provide (safe) pedestrian crossing facilities these have often been badly designed or executed. Figure 10.1 shows a pedestrian crossing painted on Paul Kagame Road at the junction with Kamuzu Procession in Lilongwe. The junction is signal controlled but with no 'all red' stage. This means that there is always one stream of traffic provided with a green light traversing the crossing, meaning that pedestrians are unprotected from moving vehicles.

At the same time, the crossing is located too close to the junction, meaning that turning vehicles see the crossing late, and may be unable to stop in time if a pedestrian is on the crossing. Pedestrians are therefore provided with a false measure of security, in a dangerous environment.

Figure 10.2 shows (top) a pedestrian crossing in Blantyre. It allows access from a minibus stop on the north side of Kamuzu Highway to Shoprite on the south side. However, the crossing is located away from the minibus stop which tempts pedestrians into crossing the dual carriageway without using the pedestrian crossing (bottom), because it is a more direct route. In such cases the use of guard rails may be considered in order to guide pedestrians to the safe facility.

Figure 10.1 Pedestrian crossing on Paul Kagame Road, Lilongwe

Figure 10.2 Pedestrian crossing, Chipembere Highway, Chichiri, Blantyre

Figure 10.4 shows example of inadequate pedestrian facilities in Lilongwe and Blantyre.

Figure 10.4 Inadequate pedestrian facilities

Clockwise from top left: Temporary obstruction in the footway forcing pedestrians into the carriageway (Blantyre); Poor footway maintenance (Blantyre); No footway (Area 1, Lilongwe); Permanent obstruction in the footway (Blantyre)

10.5 **Car parking**

Car parking is limited to private off-street facilities in commercial developments, and on-street parking in all the cities. Parking on main roads is generally prohibited, and this is reasonably well adhered to.

Figure 10.3 On-street parking

On street parking warden, Haile Selasse, Blantyre (left) and Marked on-street parking bays, Zomba (right)

On-street parking is regulated and charged for in most urban centres by city authorities – Victoria Avenue and Haile Selasse in Blantyre, Old Market in Zomba and in the City Centre and Old Town, Lilongwe. Charges are currently around MWK 100 per hour in the urban centres, and MWK 100 unlimited outside. Parking fees are collected manually by the city councils. There is sparse data on the contribution that parking makes to cities' revenues.

Elsewhere parking is provided within the curtilage of private buildings. There are no regulations to determine the appropriate amount of parking relative to the size or type of the development. This has both short and long term implications. In the short term, with increased private car use, many buildings are experiencing shortages of car parking (Amina House, Lilongwe and National Bank, Blantyre), and vehicles are forced to use access and other roads to park, contributing to congestion. In the longer term, if congestion becomes much greater, authorities may want to restrict parking with a view to encouraging public transport use, but such private off-street spaces cannot be regulated.

10.6 **Cycling**

As noted earlier in this report, cycling is growing in importance in urban areas. However, there are no facilities for cyclists in the form of lanes or priorities, so they mix with general traffic with the attendant safety hazards. The importance of cycling in the four cities is shown in Table 10.7. On the main roads surveyed, bicycles constituted 20% of the total vehicles counted, but this rose to 43% on the secondary roads. Women cycling alone is common; the essential barrier to transport by cycle being cost rather than cultural considerations.

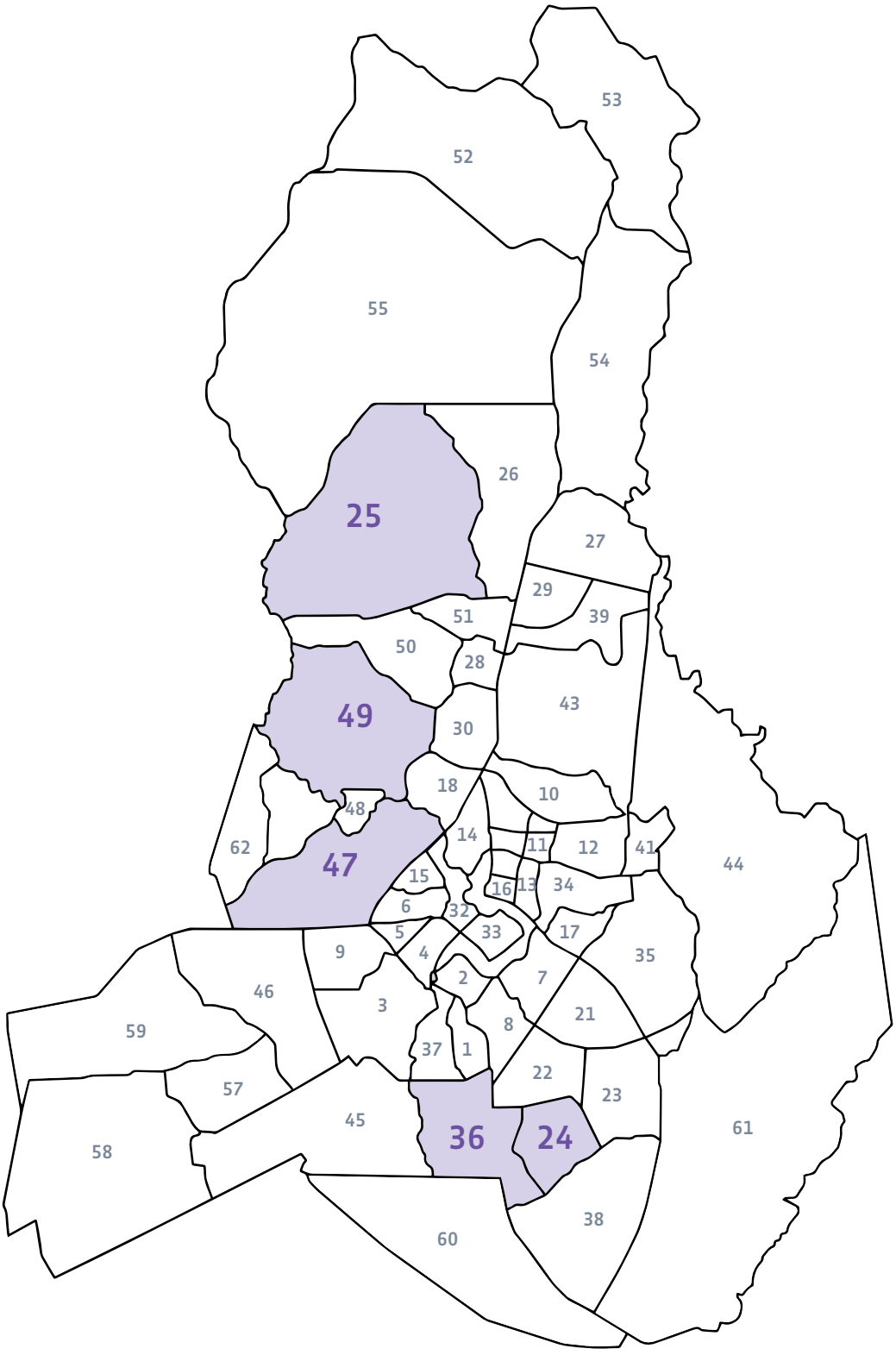
Table 10.7 Motorised and bicycle daily (16 hour) traffic volumes on selected urban roads

City	Road	No. of bicycles	Motorised vehicles	Bicycle share of all vehicles (%)
Lilongwe	M1, Area 38	802	3639	18%
	S124, Likuni Road, Area 46	4130	11410	27%
Blantyre	M2, Kanjedza	254	2249	10%
	M1, Mbayani	768	2846	21%
Zomba	M3, Domasi	1419	3878	27%
	S143, Matawale	5233	1970	73%
Mzuzu	S108	1091	689	61%
	M1, ADMARC Depot	247	1734	12%

Source: NTMP

Surveys of cycles as public transport were carried out in Lilongwe at 5 locations as shown in Figure 10.5.

Figure 10.5 Kabaza survey locations



The surveys revealed that just over one-third of kabaza passengers are women (37%) compared to men (63%) as shown in Figure 10.6. Most kabaza passengers used bicycles in conjunction with a walk trip (66%), with 19% using kazabas to access minibus services, which do not penetrate residential areas, usually where roads are unpaved. Kabaza drivers earn around MWK 40,000 (gross of cycle maintenance etc.) per month on average in Lilongwe.

Figure 10.6 Kabaza usage by area and gender

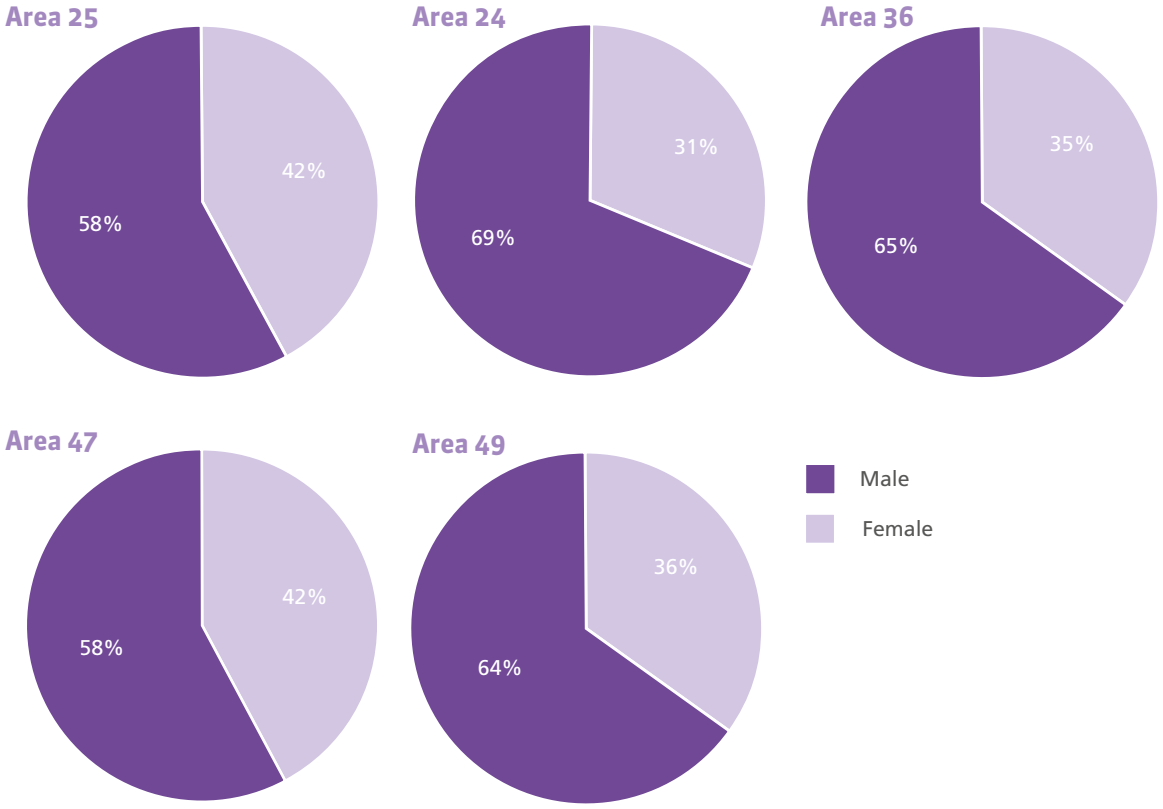


Figure 10.7 Kabaza operations

Kabaza operating on unpaved road, Lilongwe (left), bicycle modified for public transport use (right)

Kabaza operators in Lilongwe reported that they were supposed to register with the LCC at a charge of MWK 2,000, in return for safety training. However, it appears that no safety training has been carried out, and that there is no record of any income received by the LCC. As a result of this, the majority of operators (56%) have not registered. In addition, 46% of kabaza drivers use some form of high visibility vest.

10.7 **Public transport**

Motorised public transport within urban areas is mainly provided by 17-seater minibuses, usually a Toyota Hiace or Nissan. These are operator by a driver, and a conductor who controls the opening of the rear near-side (sliding) passenger door, and who also collects fares. Most minibuses are rented to the driver/conductor team by an owner who seeks a fixed rent. Thereafter, the income risk is taken by the operating team. Their common objective, in the unregulated environment, is to maximise bo fares and occupancy, whilst operating at maximum speed in order to optimise loads. Operating costs are kept to a minimum by minimising fuel in the tank, and a relatively cavalier approach to basic and routine maintenance, particularly of tyres, lights and brakes.

Minibuses operate between semi-formal terminals, and more informal 'depots' in the residential areas. Minibuses fill up with passengers before starting a journey from a depot, meaning that passengers en-route from the depot are unlikely to able to board as the minibus is full. Many passengers have, therefore, to walk back to depots away from their intended destination to be sure of being able to board. All minibus terminals are congested with little or nothing by way of passenger information.

In all the cities, minibuses do not fully penetrate those residential areas where roads are unpaved. Where they do, premium fares are often charged.

Figure 10.8 Evening commute

Top: People waiting at the City Centre, Lilongwe for a lift to Landscape Area 44 (bottom) where no minibuses ply on this unpaved road

Most urban minibus routes are radial in nature. Trips which require more than a simple leg into the central area, require a change of vehicle and consequent additional cost and time. This often involves travelling into the central area, and then travelling out again.

Many minibuses do not have fully functioning lights. They frequently run out of fuel and have to re-fuel on the road, adding to passenger time. Drivers are not formally trained and behaviour varies between erratic and downright unsafe. They often operate on shoulders or footways and pose a hazard to cyclists and pedestrians.

Minibus fares can rise at times of peak demand, for example when it is raining. However, fares are also routinely hiked when operators detect a demand in excess of supply. From the Area 12 depot in Lilongwe a regular fare at around 06.00 hours to town is MWK250. By 06.30, if there is an over-supply of late-comers and operators raise the fare to MWK300.

All of the above means that the public transport service is acting in the interests of the operator, rather than the passenger. The passenger suffers from a service that is costly, uncomfortable, time consuming, not suited to passenger needs, and unsafe. The lack of regulation of the industry has led to this situation; it has not resulted in fair competition, but rather a cartel of individual driver/operators.

Figure 10.9 Minibus terminals

Clockwise from top: Lilongwe (Old Town), Blantyre (Mibawa), Mzuzu and Zomba

Minibus patronage in Lilongwe is summarised in Table 8.1 and 8.2. The highest peak hour flow was recorded on the Falls Estate Road, with 4,358 passengers in 287 minibuses. These minibuses could be replaced by 50 big buses per hour, offering passengers greater capacity, comfort and safety. Minibuses could be re-deployed elsewhere to act as feeder services.

Figure 10.10 Minibus penetration in residential area

Minibuses operating on an unpaved road in Area 12, Lilongwe

Figure 10.11 Roundabout safety

Pedestrians crossing roundabout entry/exits without protection in (top to bottom): Mzuzu, Blantyre and Lilongwe

10.8 **Roundabouts and signal junctions**

Most large junctions in urban areas are formed as roundabouts. These tend to be inefficient in managing traffic largely due to poor design and diver behaviour. They are inappropriate where there are many pedestrians as they are unsafe, as all junction entries and exits are free flow affording pedestrians no protection.

Figure 10.12 Roundabout safety

Signal controlled junctions are more appropriate in urban areas but these are limited to:

- Presidential Way/Convention Drive, Lilongwe;
- Kenyatta/Youth Drive, Lilongwe;
- Paul Kagame/Kamuzu Procession, Lilongwe;
- M1/Lubani, Lilongwe;
- Old Town M1, east of Lilongwe River, Lilongwe;
- Kamuzu Procession/Sharrar, Lilongwe;
- Sharrar/Murry Road, Lilongwe
- M1/Chilambula (Area 47), Lilongwe;
- M1/Chayamba Drive, Lilongwe;
- M1/Msokela (Area 47), Lilongwe;
- Haile Selasse/Victoria Avenue, Blantyre;
- Mahatma Ghandi/Kapeni, Blantyre;
- Kapeni/Kenyatta Drive, Blantyre;
- Chileka Road/Makata Road, Blantyre;
- Standard Bank, Limbe; and
- Kenyatta Drive/M2, Limbe.

With the exception of the first junction in the list, most are relatively old installations and all have poorly located primary and secondary signal heads. Most operate on fixed plans, and are not demand responsive. Traffic signal design has not located signal heads and stop lines correctly. Very few provide any signal protection for pedestrians, and where this is the case, the bulbs appear to be broken (Figure 10.13).

Figure 10.12 Urban traffic signals

Pedestrian control bulbs in Blantyre (left) and Lilongwe (right) not working

10.9 **Duties on buses and bus parts**

Taxes and duties on buses of different sizes are listed in Table 10.8. The range of duties is clearly intended at encouraging the import of larger, newer buses. The effective tax and duty on a new (less than five years old) bus of more than 45 passengers is zero, compared to that on a minibus, which is a minimum of 15% plus 5% plus 16.5%.

Table 10.8 Customs duties and taxes on buses

	%							
Item	**Customs Duty in respect of the goods classified under the corresponding Customs Procedure Code for ASYCUDA ++**	**Customs Duty in respect of the goods classified under the corresponding Customs Procedure Code for ASYCUDA ++**	**COMESA rates of customs duty**	**SADC rates of customs duty from member states other than South Africa**	**SADC rates of customs duty from South Africa Only**	**Excise duty**	**Value Added TAX**	**Withholding Tax**
Vehicle of a seating capacity of 45 persons or more including the driver								
Manufactured within a period not exceeding 5 years	Free	Free	Free	Free	Free		Zero	3
Manufactured in a period exceeding 5 years but not exceeding 8 years	30	25	1	Free	Free	5	16.5	3
Manufactured in a period exceeding 8 years but not exceeding 12 years	30	25	1	Free	Free	30	16.5	3
Vehicle with more than 12 years from the year of manufacture	30	25	1	Free	15	60	16.5	3
Vehicle of a seating capacity exceeding 31 but not more than 44 persons including the driver								
Manufactured within a period not exceeding 8 years	20	15	1	Free	Free		16.5	3
Manufactured within a period exceeding 8 years but not exceeding 12 years	20	15	1	Free	Free	10	16.5	3
Vehicles with more than 12 years from the year of manufacture	20	15	1	Free	Free	25	16.5	3
Vehicle of a seating capacity exceeding 11 but not more than 31 persons including the driver								
Manufactured within a period not exceeding 8 years	20	15	1	Free	Free	5	16.5	3
Manufactured in a period exceeding 8 years but nor more than 12 years	20	15	1	Free	Free	30	16.5	3
Vehicles with more than 12 years from the year of manufacture	20	15	1	Free	Free	60	16.5	3
Tyres used on buses								
New pneumatic tyres of rubber	30	25	2	Free	25	-	16.5	3
Re-treaded or used pneumatic tyres of rubber; solid or cushion tyres, tyre treads and tyre flaps of rubber	30	25	2	Free	Free	25	16.5	3
Inner tubes	30	25	2	Free	Free	-	16.5	3

Source: MRA, Customs and Excise Act, Customs and Excise (Tariffs) (No.3) Order, 2013

10.10 **Mobility impairment**

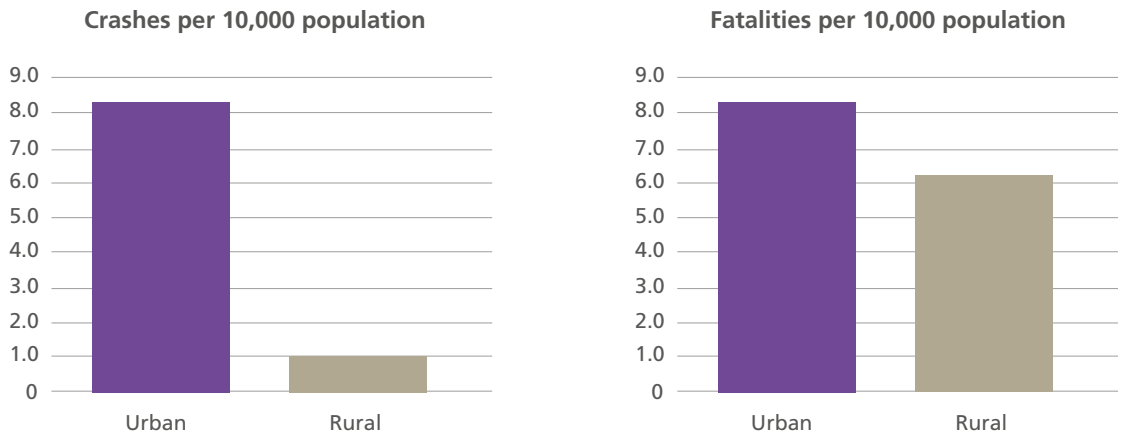
A range of mobility impairments are evident in the cities. Representatives of city authorities emphasised the need for these to be treated as a priority. The improvement of pedestrian facilities is the most basic and important means of improving mobility, and additional measures as recommended where appropriate are persented in Chapter 14.

10.11 **Road safety**

There are no specific data on road accidents in the four cities. However the limited data suggests that accident rates in urban areas may well be higher than elsewhere. In 2015, the road accident rate per 10,000 people across Malawi was 5.1[6], whereas for the combined area of Lilongwe city and Lilongwe district it was 9.7[7].

Within urban areas the impacts of road accidents tend to be less severe, since speeds are lower than on Main roads.

Figure 10.13 Crashes and fatalities, urban and rural areas



Urban comprises cities of Lilongwe, Blantyre, Mzuzu and Zomba, and Lilongwe, Blantyre and Zomba Districts

6 DRTSS and consultant
7 Lilongwe Police and consultant

10.12 **Strategic challenges**

There are a number of strategic transport challenges faced by urban authorities, as follows:

- Lack of coordination between the city councils and other national bodies, e.g. the Roads Authority, Directorate of Road Traffic and Safety Services (DRTSS) and the road traffic police;
- Limited human resources in terms of the number of staff members and their skills;
- Lack of vehicles and equipment for operation and maintenance;
- Lack of budget for road improvement and maintenance;
- Insufficient information systems, including traffic and information signs for traffic safety;
- Minibuses in all cities acting in a highly unregulated environment; and
- Lack of clear urban transport policy direction.

Bus terminal in Blantyre

Malawi National Transport Master Plan

11 Future transport demands

Urban Transport Sub-Sectoral Plan

11 Future transport demands

11.1 Assumptions and forecasts

Future transport demand is expected to be a function of increased population and employment, and increased motorisation. Because trip rates by private car are higher than by other transport modes, with increased car ownership there will be greater overall trip rates in the cities in the future.

Walking is expected to decrease as a share of transport trip making. In each city, it has been assumed that the share by walk will decrease by 2 percentage points per 5 years over the 20-year forecast period, as shown in Table 11.1. This suggests that the walk share in 20 years' time for Lilongwe would be similar to that of Nairobi at the turn of the century. In Zomba, the share would be similar to that observed in Addis Ababa in the 1990's.

Table 11.1 Assumed future % walk shares for cities

Year	Blantyre	Lilongwe	Mzuzu	Zomba
2016	66.4	61.0	74.9	79.7
2021	64.4	59.0	72.9	77.7
2026	62.4	57.0	70.9	75.7
2031	60.4	55.0	68.9	73.7
2036	58.4	53.0	66.9	71.7

Car use is assumed to grow in line with overall vehicle growth, leading to both a higher share of trip making as well as an absolute growth in trips (Table 11.2).

Table 11.2 Forecast % private car shares for cities

Year	Blantyre	Lilongwe	Mzuzu	Zomba
2016	6.9	7.4	10.4	8.2
2021	8.2	8.7	14.2	11.1
2026	9.3	9.9	16.2	12.7
2031	9.9	10.6	17.3	13.4
2036	10.4	11.0	18.0	14.0

Public transport (minibus) trips per job are assumed to rise as result of an increased ability to pay resulting from real GDP growth. Minibus shares are also forecast to grow (Table 11.3). Other mode shares are expected to remain broadly similar.

Table 11.3 Forecast % public transport shares for cities

Year	Blantyre	Lilongwe	Mzuzu	Zomba
2016	25.9	29.1	12.8	11.2
2021	26.6	29.8	11.3	10.3
2026	27.5	30.6	11.3	10.8
2031	28.9	32.0	12.2	12.0
2036	30.5	33.5	13.5	13.4

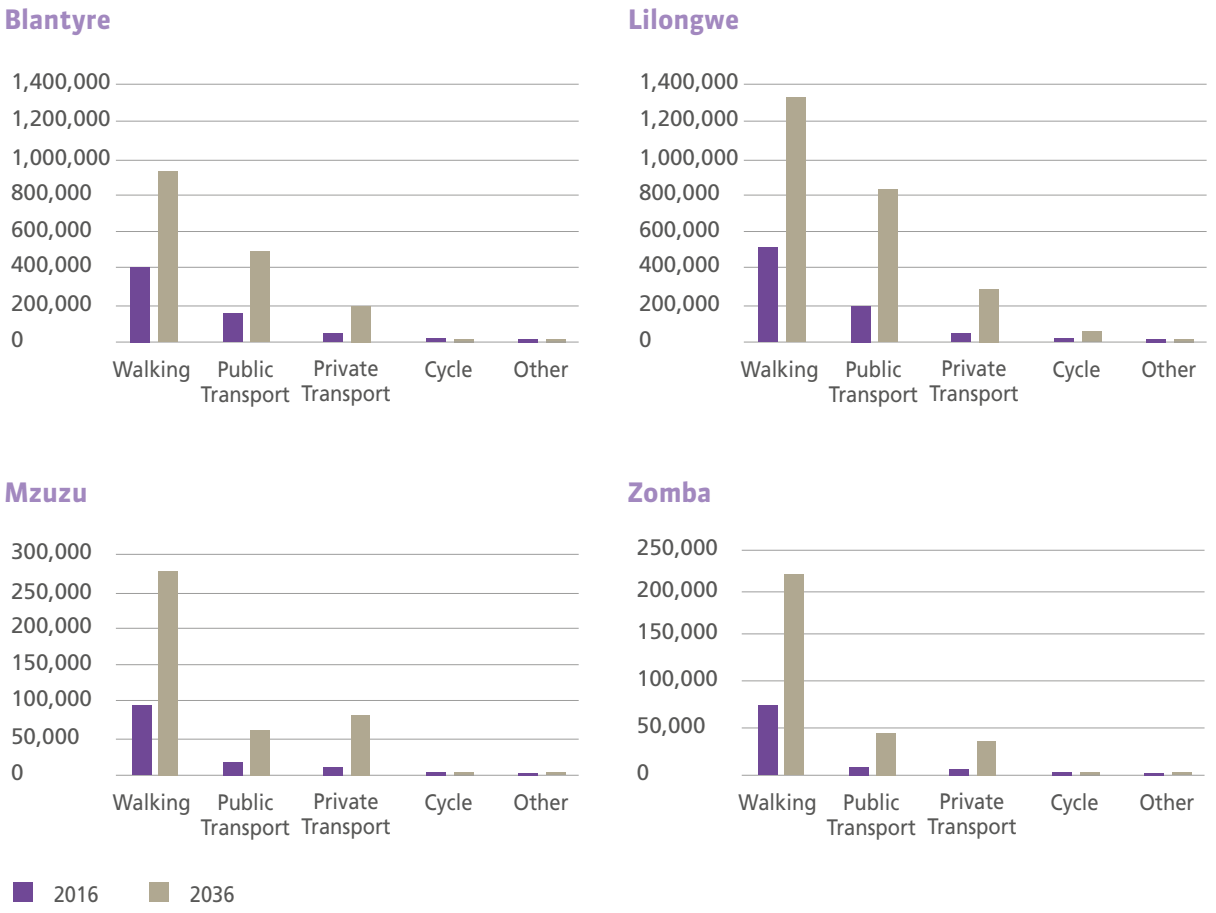
The shares of motorised and non-motorised trips are listed in Table 11.4.

Table 11.4 Forecast share of motorised and non-motorised trips

	2016		2036	
City	**Motorised**	**Non-Motorised**	**Motorised**	**Non-Motorised**
Blantyre	33	67	41	59
Lilongwe	37	63	44	56
Mzuzu	24	76	32	68
Zomba	20	80	28	72

Forecast trips in 2036 are shown for the four cities in Figure 11.1.

Figure 11.1 Forecast transport demand by mode



The JICA study for the Lilongwe Master Plan predicted that the number of person trips using public transport in 2030 would be approximately 830,000, of which those between the City Centre and Old Town areas would be approximately 100,000 per day. Public transport demand from the western residential area to the centre area was also expected to increase. It is forecasted 838,000 public transport trips in Lilongwe in 2036. This can be considered very close to the JICA forecast, given the slight depressive effect on transport demand caused by the recent economic downturn.

11.2 **Implications for urban transport policy**

In 20 years' time the demand for transport in the urban areas of Malawi will still be dominated by non-motorised transport modes, particularly walking. Key points for crafting urban transport policy for the next 20 years are:

- Private car use will not exceed 12% of all daily trips in any urban area;
- In all urban areas, the share of trip making by non-motorised and public transport modes will exceed 88%;
- The modal share of public transport in Lilongwe and Blantyre is expected to be 34% and 31% respectively, similar to the share observed in Nairobi in 2002;
- The daily demand for public transport in Lilongwe and Blantyre will grow by 3.8 times and 3.0 times respectively;
- Overall, motorised trips will increase from 33% to 41% of total trips;
- Car trips are expected to grow by 4.6 times; and
- The public transport share of motorised trips is expected to be around 75%, similar to Lagos in 2008.

On-street parking available in Blantyre, impacting the road capacity

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Malawi National Transport Master Plan

12 Responsive urban transport policy

Urban Transport Sub-Sectoral Plan

12 Responsive urban transport policy

12.1 National transport policy

The National Transport Policy (NTP) states that urban transport services are dominated by minibus and tricycle taxi with shorter journeys undertaken by bicycle taxi and there are high levels of traffic congestion and high pedestrian traffic in most urban roads.

Traffic congestion results in slower speeds, longer trip times, and increased vehicular queuing. Vehicular movement is also hampered by poor traffic management and enforcement of traffic regulations.

The NTP will:

i. Explore options for improved service provision including both road and rail based options in the major conurbations;
ii. Increase awareness of road safety issues for all road users;
iii. Ensure that the urban transport needs and priorities of women and other vulnerable groups are met;
iv. Improve the quality of private sector service provision to meet demand;
v. Ensure appropriate traffic management; and
vi. Ensure suitable urban planning and designs that would prevent future traffic congestion.

With these themes in mind, this section addresses enhancing the policy in order to create a more detailed basis for the development of urban transport.

12.2 Need for policy enhancement

There is a need for an Urban Transport Policy for Malawi to set the direction for the re-organisation and improvement of public transport in the urban areas. A clear policy will assist the political leadership to see the above initiatives within the context of a coherent set of objectives.

It should be recognised that policy is the distillation of current social, political, economic and technological perspectives in a country. Such perspectives are always changing, and therefore, policy should also be regarded as dynamic and flexible. This is not to suggest that transport policy should be continuously changing which would result in uncertainty and would constrain economic development. Such a situation would be as bad as a policy which was rigid and did not take changing realities into account. Policy should therefore be flexible whilst providing a firm basis for planning and development.

Also, policy on its own does not constitute development. The process needs to lead on to planning and implementation. The policy should provide a framework for planning and the integration of planning in the transport sector with planning in other sectors.

Although policy requires technical and economical expertise to develop, it requires political and top management will to implement. Policy, ultimately, is a political statement of how a certain sector is to be regulated and how public funds are going to be spent. Political endorsement and support is therefore a central element of policy development.

12.3 **Approach**

The development of an Urban Transport Policy for Malawi, addresses six key concerns or issues facing the urban areas today:

1. What are the principles for a transport system that can address the divergent transport needs of different stakeholders?
2. How should the most efficient mode(s) of transport be defined and how should different modes of transport be integrated, particularly in relation to minibus, kabaza, bus, and future rail services?
3. Should current low volume carriers best be phased out in favour of high volume or mass transport delivery systems?
4. How should the legal, policy and administrative / delivery arrangements in the city be structured to support effective, integrated public transport services that meet the needs of today and help to reach future development visions?
5. What are the immediate steps that can be taken to improve public transport service delivery and related integration in urban areas?
6. How should the public transport systems for cities be organised?

The approach adopted, is to:

- Propose a meaningful and succinct public transport vision;
- Prepare a comprehensive analysis of the six issues listed above;

12.4 **Vision**

It is imperative that a shift in mindset of travellers, policy makers and politicians is achieved. This needs to be based on a number of guiding transport principles fundamental to the development of a sustainable transport system. The key message is that a car dominated urban transport system is not sustainable and will not reduce traffic congestion in cities or support the needs of transport users.

There are two main choices: maintain the status quo or recognise that sweeping and affirmative changes are needed. This can be succinctly enunciated by the following Urban Transport Vision.

How does the country want to see the urban transport system of cities in malawi in the future?

A car dominated system with high transport costs?

or

A sustainable (public) transport system with a strong mass transit network supplemented by other modes (pedestrian, cycling, taxi, bus)?

12.5 Guiding principles for a sustainable transport system

A number of guiding principles for progressing sustainable transport are outlined below. These principles need to form the basis of Malawi's sustainable urban transport policy and be used to give a clear direction on how the relevant authorities will make decisions that balance competing demands on streets. Without the adoption of the measures flowing from these principles, it will be difficult to reduce traffic congestion in urban areas and quality of life will likely deteriorate. These guiding principles have been designed to address the divergent transport needs of different users.

Currently in cities, motorised vehicles, particularly private vehicles and minibuses, predominate by taking precedence for road space and priority. Instead, authorities need to develop a road user hierarchy that prioritises walking, bike riding and public transport, consistent with a view to moving people and doing so sustainably and safely rather than a focus on moving motor vehicles. Authorities need to address the long-term issues associated with car use and will need to change the way decisions are made and the budget is spent to best reflect the road user hierarchy. The guiding principles can be encapsulated as follows:

Principle I - Ensure priority

Preference will be given to, and right of way to sustainable transport modes in terms of allocating time, space and facilities, guided by the proposed new Road User Hierarchy.

In order to achieve a safe and well connected transport network, it is imperative that authorities give priority to sustainable transport modes, through:

- Ensuring that agencies' development budgets focus on projects that support pedestrians as the most important road user;
- Planning and implementing projects that are following consideration of how to provide for the accessibility and safety of walkers and bike riders in line with the National Transport Policy;
- Reallocating road space used for parking where pedestrian, cyclists and public transport users will benefit; and
- Using the planning and management of urban development to minimise the need for people to have to use private cars.

The challenge of a sustainable transport system is that it must meet the mobility and accessibility needs of people by providing safe and environmentally friendly modes of transportation. The needs of people belonging to various income groups are not only different, but also often conflicting in nature. For example, if a large section of the population cannot afford to use motorised transport – private vehicles or public buses – they have to walk to their place of work. Providing a safe infrastructure for pedestrians means either physically segregating road space for cyclists and pedestrians from motorised traffic, or, if that is not possible, reducing the speed of motorised traffic. A pedestrian-oriented hierarchy of transportation promotes density, safety, economic viability, and sustainability.

Principle II - Increased integration

Authorities will strive to achieve cities where places are interlinked through walking, bike riding and public transport routes that are efficient, direct, attractive and competitive to other modes of transport.

This can be realised by:

- Focussing more intensive commercial, residential and mixed-use development in the most accessible and connected locations;
- Facilitating sustainable transport links to key destinations and transport nodes beyond the boundaries of cities;
- Ensuring the design of streets and land uses reflects the needs of people walking, bike riding including the linking of these to public transport services and other public and open spaces including provision for adequate signage and markings;
- Discouraging car use and longer term parking in the most accessible and connected areas and locations in the city;
- Using connections between walking, bike riding and public transport routes to deliver improved transport interchanges, to enhance the public realm[8] and create people places[9] in coordination with key partners/ institutions; and
- Implementing walking infrastructure improvements through an area based approach centred in and around destinations.

8 Public realm is defined as any publicly owned streets, pathways, right of ways, parks, publicly accessible open spaces and any public and civic building and facilities.

9 Creating people places concerns the design of urban space which takes into account the unique characteristics of a location, people's enjoyment, experience and health, and encourages excellence and collaboration in the design and custodianship of urban places.

10 For example, traffic calming measures such as speed bumps as in current use.

11 These days, on high volume urban roads, traffic lights are preferred because they take up less space and are much safer for pedestrians. They also require drivers to make fewer decisions and are very flexible.

Principle III - Improve safety and acessibility

Authorities will work to provide conditions which allow people of all abilities to feel safer using their streets and sustainable transport options.

- Encourage walking and bike riding in city streets, activity centres and local shopping areas by reducing speed limits using an area based approach;
- Ensuring the walking and bike riding network of routes are well maintained in accordance with the appropriate standards;
- Addressing safety issues and the perceptions of safety within the urban environment that act as barriers to people choosing to walk, ride or catch public transport;
- Increasing road user safety based upon a hierarchy of vulnerability in the following order of priority: pedestrians (especially disabled people, young and old), bike riders, and then motor vehicles, which reflects the new road user hierarchy through awareness campaigns and education;
- Employing local area traffic management measures that reflect the road user hierarchy, influences driver behaviour and reduces the convenience[10] of car use, to provide safer streets for everyone;
- In selective areas, widening footways and bike facilities on identified walking and bike riding routes by reallocating road space in favour of pedestrians and bike riders over cars; and
- To improve road safety no more roundabouts[11] will be built on arterial roads in cities.

Principle IV – Raise profile

That authorities will strive to raise the profile of walking, bike riding and public transport and the benefits of these transport modes through the provision of information, facilities and active promotion to drive change in travel behaviour.

This can be realised by:

- Advocating and collaborating with key stakeholders, to influence decision making and secure sufficient funding in order to encourage growing numbers of people to walk, ride or catch public transport;
- Increasing the community's level of awareness of the benefit in choosing to travel by walking, bike riding or catching public transport over using a private vehicle;
- Influencing the community's decisions[12] to travel via sustainable transport by providing appropriate support, information and skill development; and
- Strengthening the information base to measure changes and trends to provide enhanced understanding of issues relating to sustainable transport.

12 *For example: where an alternative mode of transport is available changes in travel behaviour can reduce car usage (and correspondingly higher levels of walking, cycling and public transport use) by: providing people with information to correct misperceptions about the cost, convenience and amenity of alternatives to the private car providing people with opportunity and incentive to try alternatives in some cases (e.g. workplace, schools) making selective improvements to facilities to enhance walking, cycling or public transport options.*

Principle V – Improve urban air quality

That authorities will strive to raise and improve air quality and reduce noxious emissions from transport and mitigate climate change.

This can be realised by moving towards:

- Modern public transport vehicles;
- Regulation of emission through the vehicle fitness test;
- Alternative low polluting fuels; and
- Fiscal incentives that support the above.

Cities are increasingly taking actions to reduce emissions of carbon dioxide in their communities and municipal operations However, many cities lack the quantitative information needed to estimate policy impacts and prioritize city actions in terms of carbon abatement potential and cost effectiveness

That Government and city authorities undertake research and provide methodologies to assess the carbon abatement potential of a variety of city actions, such as:

- Strategies that increase the use of public transport;
- Policies that incentivise more efficient and lower polluting fuels;
- Policies that reduce vehicular travel; and
- Strategies for fostering safe no-motorised transport.

Principle VI – Improve public transport regulation

The Government will develop the legal and institutional framework that allows for effective regulation, planning and implementation of urban public transport services that meet the public interest.

This can be realised by:

- The establishment under law of an Urban Areas Transport Authority (UATA);
- Equipping the authority with powers and duties to plan, coordinate and procure efficient public transport services that meet public needs;
- Building capacity in the authority to enable it to discharge its functions; and
- Ensuring sustainable funding of the authority through fees from franchised bus route companies.

Principle VII – Adopt objective-led planning

City authorities will prepare Urban Transport Plans for their cities based on the above principles.

This should be realised by:

- Setting objectives for the plans;
- Using the objectives to generate and appraise detailed policies and interventions;
- Consulting with local stakeholders; and
- Using the objectives to provide a framework for evaluation.

12.6 Making the best use of road space

Road space in urban areas is limited by the urban form and by the fact that land prices for expansion of the network that are much higher than in rural areas. Expansion of the road capacity to deal with congestion is often not economically or socially efficient as:

- It tends to favour the more well-off (car users) members of society;
- Economic benefit ratios are limited by high costs; and
- Capacity increases tend to be taken up by increased private car use, rather than benefits to existing users.

For these reasons, it is recommended that increases to highway capacity are limited to those that:

- Seek to benefit public transport as a priority; and
- Utilise the existing road space through improved traffic management measures.

12.7 **Moving towards higher capacity public transport**

A large number of low capacity minibuses is an inefficient way of moving a large number of passengers. Large buses, with an appropriate frequency can offer a much higher standard of service, whilst at the same occupying less road space.

The highest hourly flow in Lilongwe of 4,358 passengers (Table 8.1 and 8.2) is currently carried by 287 minibuses. Table 12.1 shows the number of replacement larger buses required dependant on capacity. A massive decrease in the number of vehicles required is evident from this.

When priority measures are provided for buses, the effective capacity increases. Modern Bus Rapid Transit (BRT) systems have capacities as outlined in Table 12.2, dependant on the amount of priority provided. Given the anticipated growth in public transport use, hourly capacities in certain corridors in the order of those shown in Table 12.2 are going to be required in Lilongwe and Blantyre within 20 years.

Moving to higher capacity public transport will require a planned approach with public sector interventions to ensure that capacity is appropriate, safe, and meets passenger needs.

Table 12.1 Bus capacities and vehicle requirement, peak hour flow, Lilongwe

Capacity of bus (passengers)	Required buses per hour
60	74
88	50
115	38
2031	60.4
2036	58.4

Table 12.2 Bus rapid transit system capacities

Facilities	Cities	Observed peak hour capacity
Designated lane	Ankara, Abidjan	7,300 – 19,500
Designated lane with feeders	Curitiba	9,900
Designated lanes with bus ordering (travelling in clusters)	Porto Allegre	17,500 – 18,300
Designated lanes with overtaking lanes, passing at stations and express routes	Belo Horizonte, Sao Paulo	15,800 – 20,300

Large taxi stand next to the bus ternminal in Blantyre

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Malawi National Transport Master Plan

13 Proposed interventions

Urban Transport Sub-Sectoral Plan

13 Proposed interventions

13.1 Legal and regulatory reform

13.1.1 Background

The use of low capacity vehicles for public transport is highly inefficient. The reliability of public transport in urban areas is very low at present, because of the following reasons:

- Operation of small minibuses;
- Unsafe infrastructure and driver behaviour which leads to many traffic accidents;
- Unauthorised parking and on-street loading and offloading; and
- Non-motorised vehicles sharing the carriageway with motorised vehicles.

There is a lack of coordination between different institutions and agencies that are responsible for transport in Malawi and in the cities. These institutions include; the City Assemblies and the surrounding District Local Governments, the Ministry of Transport and Public Works, the Roads Authority, the MOAM and the minibus operators themselves.

This lack of coordination, together with unregulated public transport system, has created a clear and present exigency within the two main cities which needs to be addressed urgently. In order to improve this situation, it is recommended that public transport planning for the cities is organised under a single Authority, known as the UATA. As there is no specific transport legislation for the cities, it is necessary that to bring forward new legislation to establish UATA, along with the powers and the authority to enable UATA to perform its functions efficiently and effectively.

13.1.2 Key issues

In summary, the key issues that adversely affect public transport are:

a. With increasing population and car ownership in the cities, there is increasing traffic congestion due to an absence of organisation;

b. Environmental problems accruing from the heavy traffic such as air and noise pollution;

c. Lack of coordination between different institutions and agencies that are responsible for transport in Malawi;

d. Increased cases of traffic accidents; and

e. Inadequate funding and poor resource allocation towards organization of public transport.

13.1.3 Objectives

The overall objectives of the proposed UATA are to:

- Regulate all public transport within the urban areas, and provide for the organisation, management and coordination of public transport within the urban areas;
- Introduce, encourage and enable sustainable competition in the public transport sector through licensing and concessioning of operators to achieve efficient and quality services;
- Promote and develop public transport in the urban areas for the benefit of the passengers and other users of this mode of transport in the urban areas; and
- Develop an integrated public transport system aiming to achieve a modal shift that favours public transport and non-polluting strategies.

13.1.4 Proposed duties of UATA

In the light of the above issues, it is necessary for the UATA to be established in order to:

a. Regulate all public transport services in the urban areas;

b. Plan and coordinate the supply of adequate, effective and quality public transport in the urban areas;

c. To develop implementation mechanisms for planning and coordination of public transport in the urban areas; and

d. To provide an overall vision and strategic planning for public transport in the urban areas.

In order to maximise efficiency, a single Authority is proposed to perform the following specific functions:

a. To plan and coordinate the supply of adequate, effective and quality public transport in the urban areas in a regulated environment;

b. To coordinate with concerned authorities in urban areas on traffic management, safety, roads and transport planning to ensure effective public transport systems;

c. To take the lead on policy, and design of measures to foster and protect non-motorised transport

d. To develop strategic plans for public transport in the urban areas in line with national government policies;

e. To advise the Minister of Transport and Public Works on the development of public transport policies;

f. To ensure that public transport policies adopted by the Government are implemented and that local transport schemes are in line with these policies;

g. To promote public transport in the broadest sense;

h. To manage and maintain such infrastructure that assists public transport operations;

i. To grant, renew, reject, suspend and revoke operational licenses and concessions to operators of public transport on a route, groups of routes or another basis;

j. To collect operational license fees, concession fees and all other revenues, levies and charges in connection with the provision of public transport services,

k. To develop a fare and ticketing system for all operators;

l. To distribute public transport revenues in accordance with set rules;

m. To coordinate with Local Governments and other executing agencies in urban areas in the management of public transport;

n. To manage data collection and analysis on public transport within the urban areas;

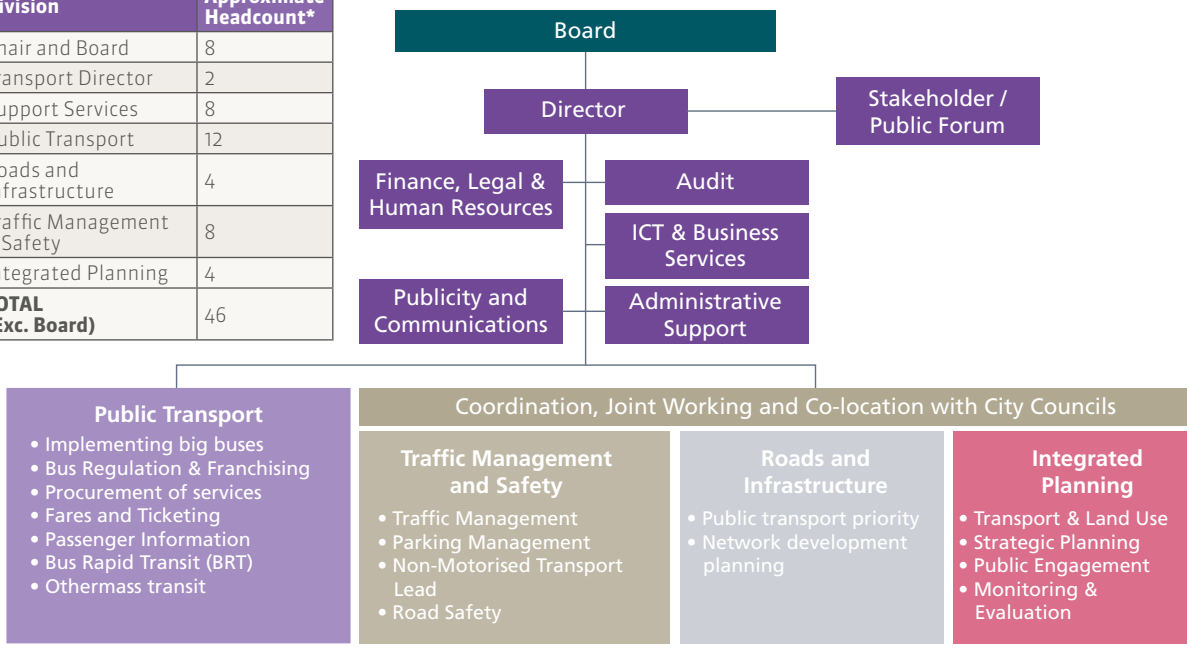
o. To undertake research and development on public transport;

p. To monitor, evaluate and report on public transport within urban areas; and

q. To supervise public transport operators within the urban areas.

Figure 13.1 Proposed structure of Urban Areas Transport Authority

Division	Approximate Headcount*
Chair and Board	8
Transport Director	2
Support Services	8
Public Transport	12
Roads and Infrastructure	4
Traffic Management & Safety	8
Integrated Planning	4
TOTAL (Exc. Board)	46



13.2 **Institutional coordination**

Whilst urban transport planning can be complex, it needs to reflect the responsibilities of all stakeholders, in order to ensure sustainable outcomes. A formal co-ordination mechanism is needed across all institutions with a view to integrating urban transport policy development and policy implementation. An Urban Transport Co-ordinating Committee is proposed with the membership and responsibilities outlined in Table 13.1.

Table 13.1 Proposed Urban Transport Co-ordinating Committee

Institution	Role
Ministry of Transport and Public Works	▪ Policy development and co-ordination ▪ Major projects – feasibility and development
City Councils	▪ Policy implementation ▪ Integration of urban transport initiatives into development plans
Ministry of Finance and Economic Development	▪ Funding development projects ▪ Development partner co-ordination
Ministry of Natural Resources, Energy and Environment	▪ Fuel efficiency ▪ Air pollution
Roads Authority	▪ Strategic traffic management ▪ Safety audits
Directorate of Road Traffic and Safety Services	▪ Statistics on vehicles numbers type, age, emission levels ▪ Standards for emissions ▪ Road safety
National Road Fund Administration	▪ Funding road maintenance

13.3 Universal design

Universal Design makes provision for ensuring that there is appropriate pedestrian access for the elderly, men and women in wheelchairs and people walking with small children or with pushchairs. In urban areas Universal Design infrastructure should include ramp alternatives where there are steps or kerbs and hand-railings alongside steps and where paths have dangerous side drops. Footways, footpaths and cycleways should be free from raised obstructions, dangerous holes, uncovered cross drains and unnecessary poles and signs. Street furniture should not produce narrow pinch points. Street lighting and clear signage are other features of 'Universal Design' concepts, as these benefit pedestrians of all abilities, as well as bicyclists and all road users. When incorporated at the design stage, Universal Design principles have negligible effect on overall costs, but benefit a wide range of pedestrians, including disabled people (VTPI, 2012; Venter et al, 2004; NZ Transport Agency 2009)[13].

The Government should require that appropriate 'Universal Design' principles will be included in all new and refurbished urban transport infrastructure. The Government will expect existing urban transport infrastructure that is non-compliant will gradually be retrofitted to 'Universal Design' principles, with emphasis on priority situations where existing obstructions and dangerous places cause problems for vulnerable pedestrians and users of mobility devices.

Universal Design should also apply to public transport, particularly new systems such as Bus Rapid Transit (section 14.4.2). Access to buses be flat and at-grade, and the interior of vehicles should be designed with the mobility impaired in mind, with appropriate handrails and space for mobility devices or push chairs. Such space can be limited to off-peak use if necessary.

13 *Transport Agency 2009. Pedestrian planning and design guide. NZ Transport Agency, Wellington, New Zealand. 188p. ISBN 978-0-478-35228-3. Available from: http://www.nzta.govt.nz/resources/pedestrian-planning-guide/docs/pedestrian-planning-guide.pdf*
Venter C, Sentinella J, Rickert T, Maunder D and Venkatesh A, 2004. Enhancing the mobility of disabled people: guidelines for practitioners. Overseas Road Note 21d, Transport Research Laboratory, Crowthorne, UK. ISSN0951-8797. Available from: http://www.transport-links.org/transport_links/filearea/publications/1_831_ORN%2021.pdf
VTPI, 2012. Universal design: transportation systems that accommodate all users, including people with disabilities and other special needs. TDM Encyclopedia, Victoria Transport Policy Institute (VTPI), Canada. 17p. Updated 22 February 2012. Available from: http://www.vtpi.org/tdm/tdm69.htm

13.4 Mass public transport

13.4.1 Bigger buses

Road based mass transit vehicles (conventional buses, guided buses, bus rapid transit) are a more efficient user of scarce road space than private vehicles. Their cost per passenger kilometre is lower than the cost of private transport and of minibuses, which can translate into personal and societal cost savings. Mass transit vehicles have more efficient engines than smaller vehicles leading to reduced fuel consumption.

A bus with a carrying capacity of 108 passengers will replace around 7 minibuses. The minibuses would use around 23-25 litres of diesel for a 20km journey, whereas the bus would consume 8-10 litres. In terms of both fuel consumption and CO_2 emissions a bus could replace the equivalent of 14 private vehicles.

Recommended actions are:

- Phase out minibuses on high demand urban corridors; licence only vehicles with more than 38 seats;
- Sensitise existing owners and operators on the financial benefits of big bus operations;
- Franchise routes for big buses, where minibuses shall not operate;
- Establish priority measures (bus lanes and priority traffic signals) on high ridership corridors; and
- Develop a feeder service plan for minibuses.

As an example, the peak hour passenger flow on Mzimba Road in Lilongwe is currently 1,669. By 2026, this demand could increase to over 3,242 passengers per hour. Bigger buses are required for this demand, and the assumptions for such a service are listed in Table 13.2. The operating costs for the service are shown in Table 13.3. The breakdown of operating costs shown in Figure 13.1 is similar to the breakdown for minibuses (Figure 9.2) and emphasises the high cost of fuel.

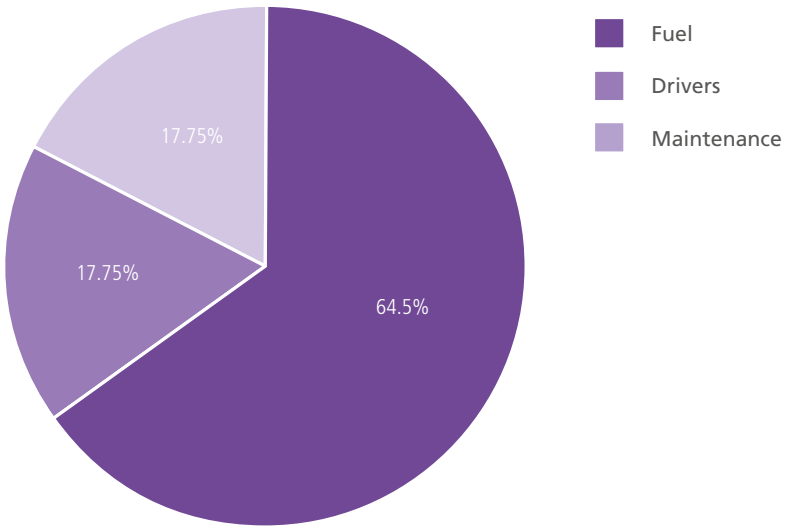
Table 13.2 Mzimba Road bus service assumptions, 2026

Item	Assumption
Peak hour flow	3,242 passengers per hour
Daily passengers	20,525
Bus capacity (seating and standing)	108
Average speed	25kph
Operating hours	12
Dead mileage	10km
Fuel consumption	2.9 km/litre
Fuel cost	815.8 MWK per litre
Average fare	MWK 280
Average trip length	6 km

Table 13.3 Annual bus operating costs for Mzimba Road service

Item	US$ million per year
Fuel	1.09
Drivers	0.30
Maintenance	0.30
Total	**1.69**

Figure 13.2 Bus operating costs, Mzimba Road service



The forecast increase in demand for public transport in Lilongwe and Blantyre makes the case for the introduction of big buses across all the trunk routes. By 2026, big buses should be operating on all the main routes identified in Table 8.1, representing 28% of all public transport users. Minibuses would still be needed to act as feeder services to the trunk routes and to penetrate areas with narrow roads where bigger buses were not able to ply. A fleet of 175 big buses would be needed, along with the institutional arrangements outlined in para. 13.1. Estimated operational costs are set out in Table 13.4, set against forecast income of $14m per year.

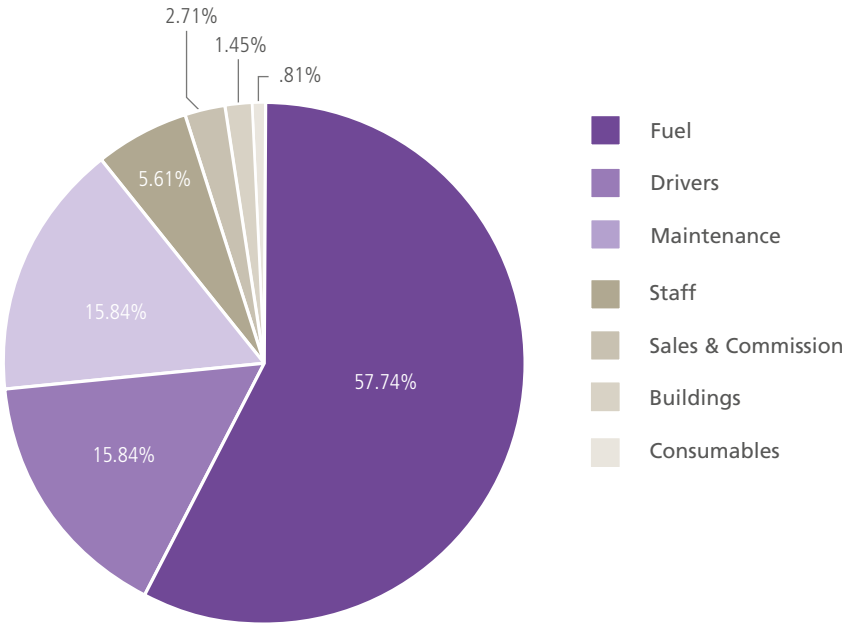
Table 13.4 Bus fleet operating costs, 2026

Item	US$ million per year
Fuel	6.38
Drivers	1.75
Maintenance	1.75
Sales and Commission	0.30
Staff	0.62
Buildings	0.16
Consumables	0.09
Total	**11.05**

Bus services will operate more efficiently, both financially and in passenger interests, if provided with priority measures such as bus lanes. Bus lanes should only be provided for high capacity buses. They should be introduced under specific legislation (usually a roads act) that empowers city councils or other authorities to designate a part of the highway (or all of a highway) for the use of only certain classes of vehicle. Regulations should then be drafted to cover issues such as the hours of operation, and signage that is legally enforceable.

Figure 13.4 Bus lane, Liverpool, UK

Figure 13.3 Forecast bus fleet operating costs, Lilongwe, 2026



13.4.2 Bus Rapid Transit (BRT)

The Lilongwe Master Plan contains a proposal for mass transit, broadly focussed on a north-south corridor, possibly along the alignment of the M1. It is recommended to modify this proposal slightly so that it is moved away from the main highway, in order to avoid conflicts over road space allocation. It is proposed a BRT scheme somewhat on the western of the city to capitalise on existing development and demand and to foster growth along that corridor, in line with the development plan proposals. Currently 25% of all minibuses operating in Lilongwe have an origin or destination in Area 25.

The 20km BRT mass transit scheme is designed to revolutionise public transport in the capital city through a dedicated system of fast, reliable, comfortable and affordable buses. The system will link the employment centres of Kanengo and Old Town to the large and growing residential areas of Area 25, Area 47, and Area 49 as well as serving the National Stadium and the retail areas of CrossRoads and City Mall.

Buses with a capacity of 150 passengers will operate at a frequency of 60 buses per hour along the line, giving a capacity of 9,000 passengers per hour, the equivalent of over 520 existing minibuses.

All bus stations would be secure and provide shelter from both sun and rain. They must incorporate Universal Design for easy pedestrian access and provide adequate bicycle parking facilities. In addition, integral to BRT planning and implementation will be the development of suitable medium-distance pedestrian and bicycle routes, with appropriate infrastructure to allow easy NMT access to BRT stops and terminals.

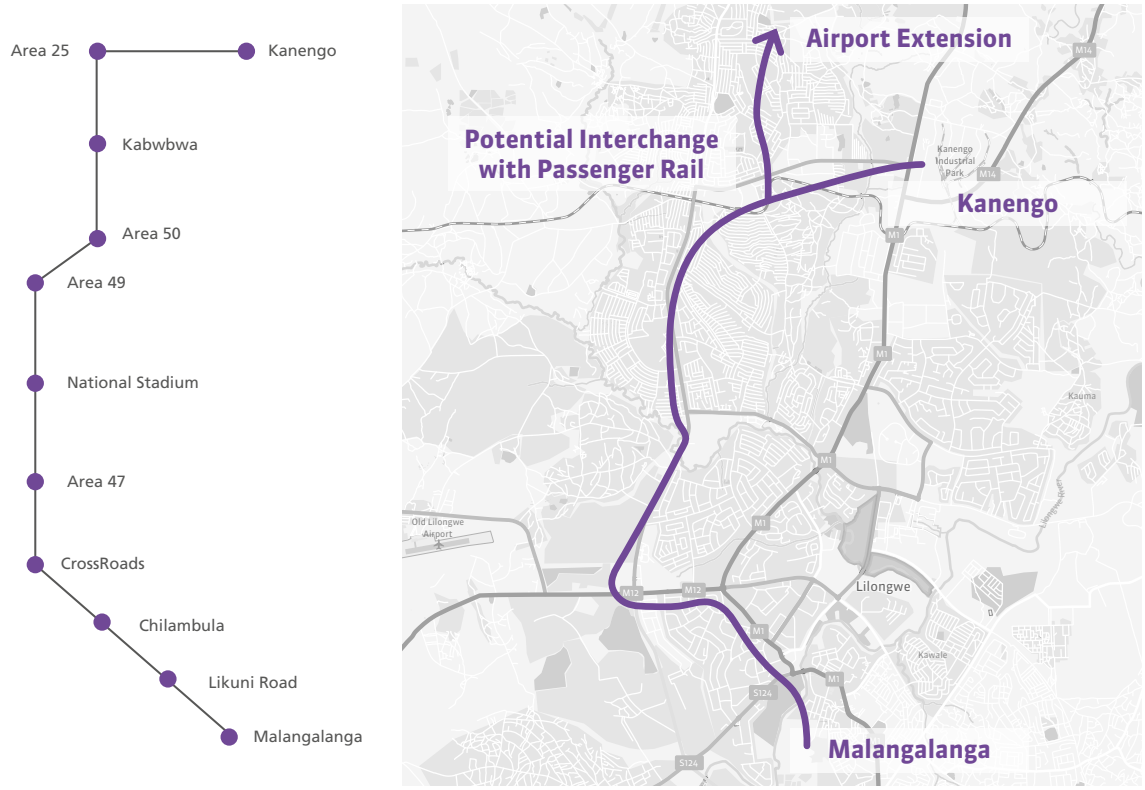
Electronic stored value ticketing will be used to minimise passenger boarding times and to protect revenue. All ticketing will be done off-bus to facilitate speedy bus operations.

The scheme will be built on new infrastructure where possible to maximise penetration and accessibility, and to avoid having to convert and widen existing roads.

Most of the terrain is relatively flat, but the scheme would require a new bridge across the Lilongwe River in order to access Old Town.

The scheme will cost around $110 million, and could be financed through development partner support for the infrastructure with operations concessionned to an experienced public transport operator.

Figure 13.5 Lilongwe bus rapid transit route and stations



13.5 **Fuel efficiency and air pollution**

The fuel efficiency of vehicles in all the urban areas is low due to the relatively old age of vehicles, poor maintenance regimes, and increasing congestion. The adoption of minimum emission standards for all vehicles would ensure a signification reduction in fuel consumption and CO_2 emissions. Such standards have been adopted in most developed countries, and are increasingly being adopted in developing countries such as India, Brazil, South Africa and Mauritius. Fuel efficiency and emission standards tend to be directly linked as cleaner and more efficient vehicles are promoted in the market. Gains accrue to vehicle owners and users, as well as the state through improved fuel security and health benefits.

Adoption of standards can be incremental, reflecting the current state of the vehicle fleet immediately, and moving to more rigorous standards over time. Benefits on fuel efficiency can be gained through greater use of bio-fuels, dual-fuels and hybrid vehicles, with the potential for import duty variations to encourage this.

The MoTPW should be responsible for the adoption of standards with DRTSS implementing and enforcing them. Capacity increases are required for the measurement and monitoring of vehicle emissions.

The use of diesel fuel is becoming of increasing public importance. Although the CO_2 emissions from diesel are less than those of petrol (gasoline), the air pollution impacts are much greater. In particular, diesel engines contribute to air pollution in two key ways – through the production of particulate matter (PM) and nitrogen oxides (NOx). Very fine soot PM can penetrate the lungs and can contribute to cardiovascular illness and death. Nitrogen oxides can help form ground level ozone and this can exacerbate breathing difficulties, even for people without a history of respiratory problems.

To combat this, the mayors of Paris, Mexico City, Madrid and Athens have stated that they will ban the use of diesel cars and trucks in their respective cities by 2025. They have committed to providing incentives for alternative vehicle use and to promote walking and cycling. London has pledged to stop procuring double-decker buses that run purely on diesel from 2018, and in future all new single-deck buses will be zero-emission. New York, Amsterdam and Cape Town, have also committed to phase out the procurement of diesel buses by 2020. Possible substitute fuels include the world's first double-deck hydrogen-fuelled bus, which will be trialled on London's roads in 2017.

Single decker electric buses are already in service in the US. Electric motors have very high torque and can deliver that torque at low speeds typical of bus use. Batteries can recover energy from braking with the overall result that an electric transit bus uses 20% of the raw energy a diesel bus would require to go the same distance. In addition, emissions from electric buses are effectively zero, which can be compared with conventional buses in Table 13.5. Potential savings from conversion of half the minibus fleet to bigger buses[14].

14 Volvo

Table 13.5 Typical annual emissions from public transport buses

Bus Power	CO2 (kg)	CH4 (kg)	CO (kg)	NOx (kg)	HC (g)	PM (g)
Diesel	94,710	60.9	22.5	27	4,200	423
Compressed Natural Gas	97,749	38,843	360	108	1,000	102
Hybrid	69,626	45.7	16.9	21	3,200	298
Electric	0	0	0	0	0	0

Source: Michael Linse, Zach Barasz, 2015

The Volvo 7900 Electric Hybrid can operate exhaust emission-free on electricity for about 70 per cent of its route. Battery recharging takes 3 to 4 minutes with so called opportunity charging. Energy consumption is about 60 per cent lower than for a corresponding diesel bus.

Volvo's electric hybrids have entered service in Gothenburg, Stockholm, Hamburg, Luxemburg, Charleroi and Namur (Belgium) and Curitiba. Obviously, the bus requires a reliable electricity supply. It may only be a long-term option.

Figure 13.6 Volvo 7900 Hybrid and charging station in Belgium

Source: Volvo

On-street parking in Blantyre causes a major roadside friction

13.6 **Cycling**

Cycling in Malawi has grown in the last 5 years, largely as a result of its affordability. Cycle use, as a form of public transport has grown significantly in urban areas, particularly in Lilongwe. Cycle use will continue to grow naturally in the medium term, and can be fostered to play a greater role in the urban transport system over the long term. Cycling can be unsafe, where the road infrastructure and motorised vehicle driver attitudes are not aligned with cycling as a priority mode of transport. Therefore, the measures proposed are intended to foster cycling and improve its safety, for both public and private use.

13.6.1 **Cycle lanes**

Mixing cyclists with motorised vehicles on the same carriageway can be dangerous in urban areas, even at low traffic speeds. The implementation of cycle lanes is a priority on existing 2-lane carriageway roads. A priority list of roads with high motorised and cycle traffic should be prepared within each urban area for early implementation.

The candidate roads for priority action are:

Lilongwe

- M12, CrossRoads to T365 junction – 7km;
- M1, Lubani to Bunda turn off – 8km;
- Kenyatta Drive, Kamuzu Procession to Presidential Way - 5km;
- Mzimba Street, Kamuzu Central Hospital to Kawale – 1.5 km;
- Paul Kagame Road - 4.5 km;
- M1, Ufulu Road to Area 18 roundabout – 3.5 km; and
- Area 18, National Stadium to Area 18 roundabout 6.5 km.

Blantyre

- M1, Victoria Avenue to Zingwangwa - 6km; and
- M1, Glyn Jones Road to Chileka Road – 9km.

Mzuzu

- S108 -5km.

Zomba

- S143 – 5km.

The cost of a cycle lane is of the order of MWK 90 million per kilometre. The above roads (total 55km) could be improved with cycle lanes at a cost of MWK 5.0 Bn, or MWK 1.0 Bn per year in a 5-year programme. The introduction of cycle lanes will add to the effective capacity of the roads above because cycles are removed from the main carriageway where they reduce the theoretical capacity of the road. Implementation of cycle lanes will defer possible expenditure on capacity increases to the road itself.

Cycle lanes can be dedicated for cycles only (Figure 13.6) or shared with buses (Figure 13.7).

Figure 13.7 Cycle lanes

Cycle Lanes (left to right): UN Avenue, Nairobi; T4 Chipata, Zambia

Figure 13.8 Bus and cycle lanes

Left: London; right: Liverpool

13.6.2 Cycle paths

In addition, the creation of cycle paths, dedicated routes for cycles not attached to a road will be useful in providing links within and between the developing areas of the cities. At first these can be unpaved – what is important is to create and protect a right of way. In Lilongwe cycle paths can enhance accessibility to/from and within the proposed government development zones in Area 35 and Area 44, as well providing linkages between Areas 25, 50 and 49.

13.6.3 Kabazas

Kabazas, or public transport cycles should be encouraged, particularly where they can play a long-term role as part of the overall transport network. This can include making public infrastructure provision for them at important bus stopping points and BRT stations in the form of shelters and fare tables for nearby destinations. Any regulation of kabazas should be extremely 'light touch', designed to improve safety. This can include road safety awareness, safe bicycle conversion practice, and wearing high visibility vests. These can be implemented through sponsorship by local companies.

13.6.4 Bike sharing

Bike share programmes are now common in European cities, and schemes are now being developed for Johannesburg, Nairobi and Kampala. Under such a scheme a traveller can pick a bike at one location and cycle it to another for small fee. Programmes usually need a sponsor to start off the scheme, such as UN-Habitat in Nairobi. Issues critical to the success of a scheme are charge rates and payment methods, the design of bikes and docking stations, and measure to prevent theft. Such schemes are most successful in conjunction with priority measures such as cycle lanes.

13.6.5 Bicycle commuting

Public authorities can take a lead in promoting Bicycle Commuting Campaigns. Typically, the biggest obstacles to increased cycling are concerns over road safety, and the lack of secure facilities for cycles at the workplace. Public authorities can encourage cycle facilities at the workplace through awareness campaigns, and by providing such facilities for their employees and visitors at National and Local Government offices. Later, the provision of cycle facilities, such as secure parking, could be required to secure planning permissions for new developments, through development control legislation. City councils should work with large employers in their areas to promote cycling to work, particularly through assisting with the identification of safe routes for cyclists.

13.7 **Pedestrian facilities**

In para 8.8 it was noted that within all cities walking will be the dominant main mode of transport in 20 years' time. Furthermore, walking is the sub-mode of transport for virtually all travellers – to and from public transport, and often at the beginning and end of car journeys in urban areas. The ability to walk safely within urban areas is a basic human right, but one that is not fully catered for yet. Since for many urban dwellers, walking is the only mode choice, investment in pedestrian facilities is a priority in terms of both meeting transport needs and social equity.

13.7.1 **Footways**

Sidewalks or footways are "pedestrian lanes" that provide people with space to travel within the public right-of-way that is separated from roadway vehicles. Footways reduce pedestrian collisions with motor vehicles. Such facilities also improve mobility for pedestrians and provide access for all types of pedestrian travel. Footways should be part of every new and renovated facility and every effort should be made to retrofit streets that currently do not have footways

Footways can be constructed from concrete, asphalt, crushed stone, or other materials if they are properly maintained and accessible (firm, stable, and slip-resistant).

A minimum width of 1.5 m for an urban footway is recommended, which allows two people to pass comfortably or to walk side-by-side. Wider footways should be installed near schools, at public transport stops, in CBD's, or anywhere high concentrations of pedestrians exist. Footways should be continuous along both sides of a street and should be fully accessible to all pedestrians, including those in wheelchairs.

The cost for concrete kerbs and footways is approximately $25/linear meter for kerbing and $60/square meter for footways. Asphalt curbs and walkways are less costly, but require more maintenance, and are somewhat more difficult to walk on for pedestrians with mobility impairments.

All urban streets should have footways, with the possible exceptions of roads with very low levels of motorised traffic (usually cul-de-sac), or where a shared surface is preferred. Where footways are protected by a raised kerb they should be visually demarcated through high-visibility markings, and a textural and/or colour change.

Where a raised footway is interrupted by a vehicular access to premises, the general principle should be that that the pedestrian facility stays at the same level and the motorised access should change level. This is not possible at road junctions (except with speed tables), and hence kerb ramps are needed.

13.7.2 **Kerb ramps**

Kerb ramps provide the access between the sidewalk and roadway for people using wheelchairs, push chairs, walkers, crutches, handcarts, bicycles, and also for pedestrians with mobility impairments who have trouble stepping up and down high kerbs. Kerb ramps should be installed at all intersections and locations where pedestrian crossings exist. Wheelchair ramps must have a slope of no more than 1:12 (must not exceed with a maximum side slope of 1:10). Where feasible, separate curb ramps for each crossing movement at an intersection should be provided rather than having a single ramp at a corner for both movements. This also provides improved orientation for visually impaired pedestrians. Tactile warnings should be used to alert pedestrians to the footway/street edge. All newly constructed and improved road projects should include kerb ramps. In addition, all agencies should upgrade existing facilities. They can begin by conducting audits of their pedestrian facilities to make sure that public transport services, schools, public buildings, and parks, etc. are accessible to pedestrians who use wheelchairs.

13.7.3 Crossings

Marked pedestrian crossings indicate optimal or preferred locations for pedestrians to cross and help designate right-of-way for motorists to yield to pedestrians. Pedestrian crossings should be installed at signalised intersections and other selected locations.

Pedestrian crossings should be installed at all locations where pedestrian flows warrant them: near to schools, major public transport stops, hospitals, and in shopping areas. These can be unprotected – in the form of black and white markings parallel to the footway, or signal protected either at intersection traffic signals, or stand-alone protected crossings (e.g. on Paul Kagame Road, Lilongwe). The general criterion for crossing design are set out in Table 13.6.

Table 13.6 Criteria for pedestrian crossings

Type of crossing	Criteria for implementation
Unprotected	Vehicle speeds less than 50kph P less than 1,000 per hour V less than 500 per hour P at least 2 x V PV^2 greater than 0.6×10^8
Signal protected	PV^2 greater than 0.9×10^8
Refuge	PV^2 greater than 0.4×10^8 Road width greater than 7.8m

V=vehicle
P=pedestrians

In some cases, pedestrian crossings can be raised and should often be installed in conjunction with other enhancements that physically reinforce pedestrian crossings and reduce vehicle speeds. Advance warning signs should be placed well before crossings. Driver awareness on the priority of pedestrians on crossings needs to be raised.

Protected pedestrian stages should be designed as part of all new signalled intersections, and retro-fitted to existing ones. This can be done through 'all red' phases, or careful design that allows pedestrians to cross safely while vehicles move through other parts of the junction.

It is important to ensure that crossing markings are visible to motorists, particularly at night. Pedestrian crossings should not be slippery or create tripping hazards. One of the best materials for marking pedestrian crossings is inlay tape, which is installed on new or repaved streets. It is highly reflective, long-lasting, and slip-resistant, and does not require a high level of maintenance. Although initially more costly than paint, both inlay tape and thermoplastic are more cost-effective in the long run. Inlay tape is recommended for new and resurfaced pavement, while thermoplastic may be a better option on rougher pavement surfaces. Both inlay tape and thermoplastic are more visible and less slippery than paint when wet. Estimated costs per average crossing are in the range $50 to $150.

Figure 13.9 Pedestrian crossings

Top: Staggered signal protected crossing (UK Design); Bottom left:Pedestrian crossing with refuge (USA); Bottom right: Unprotected crossing with refuge (UK)

13.7.4 Bus and transit stops

Bus stops should be located at intervals that are convenient for passengers. The stops should be designed to provide safe and convenient access and should be comfortable places for people to wait. Adequate bus stop signing, lighting, a bus shelter with seating, are desirable features. At major BRT stops, the provision of secure cycle parking should also be considered. Bus stops should be at highly visible locations where pedestrians can reach them easily by means of accessible travel routes. Therefore, a complete footway system is essential to support a public transport system. Convenient crossings are also important.

Proper placement of bus stops is key to user safety. For example, placing the bus stops on the near side of an intersections or pedestrian crossing may block the pedestrians' view of approaching traffic, and the approaching drivers' view of pedestrians. Approaching motorists may be unable to stop in time when a pedestrian steps from in front of a stopped bus into the traffic lanes at the intersection.

Far-side bus stops generally encourage pedestrians to cross behind the bus. Relocating the bus stop to the far side of the intersection can improve pedestrian safety since it eliminates the sight-distance restriction caused by the bus. Placing bus stops at the far side of intersections can also improve general traffic flow.

Ideally, in the future, bus stop locations should be fully accessible to pedestrians in wheelchairs, should have paved connections to footways where landscape buffers exist, and should not block pedestrian travel on the footway.

13.7.5 Pedestrian priority

Pedestrianisation of existing streets can be done to enhance the urban ambience, and promote activities such as retailing, culture and leisure in city centres. Removing motorised vehicles not only adds to safety but it can act as a deterrent to car use, particularly where alternative high quality public transport is in place.

Shared surfaces can be used to give pedestrians priority over the whole carriageway, most usually using a distinguishing textured material. This is best implemented on low traffic volume roads, or where private vehicles are banned and pedestrians share the road with public transport.

13.7.6 Footbridges

Urban footbridges are designed to permit traffic flows and reduce accidents by providing a safe means to cross main roads. Some existing footbridges were not constructed to Universal Design principles and they do not have ramps that permit their use by a wide range of people, including those with bicycles, wheelchairs and pushchairs. Pedestrians prefer not to use footbridges (which require time and energy to climb) and they risk accidents by crossing the traffic lanes. On roads where it is appropriate to stop the traffic, level pedestrian crossings with islands and traffic control are more convenient for pedestrians.

Figure 13.10 Footbridges in Blantyre

Left, pedestrians prefer to cross at grade. Right, no safety measures on the handrails on a footbridge near a school

The provision of adequate safe crossing facilities for pedestrians and NMT users on busy or dangerous national and urban roads should be a priority. The benefits to pedestrians of at-grade crossings are maximised where there is adequate safety, compliance and enforcement. Where traffic and pedestrian consideration require the provision of footbridges, these should, as far as practicable, incorporate Universal Design principles.

13.8 **Highways**

Figure 13.1 indicates that both the share and the absolute number of motorised trips in the urban areas will rise dramatically in the next 20 years. Of particular concern is the expected growth in the unrestrained demand for private transport trips (largely by private car), as shown in Figure 13.11. This in itself will place a huge strain on the existing road infrastructure.

The approach of 'predict and provide' for increasing private transport use has largely been discredited in European cities, with the accent on public and non-motorised forms of transport. However, it is necessary to ensure that there is sufficient highway capacity to ensure that public transport vehicles can move easily. Therefore, there is merit is an additional highway provision to meet this end, as well as providing a reasonable level of service for private vehicles.

The major cities of Blantyre and Lilongwe are sufficiently complex in terms of the road network and traffic patterns that more sophisticated tools are required to analyse the impacts of interventions on traffic congestion and speed. These city councils need to have capacity in urban transport modelling.

Figure 13.11 Forecast daily car trips in urban areas

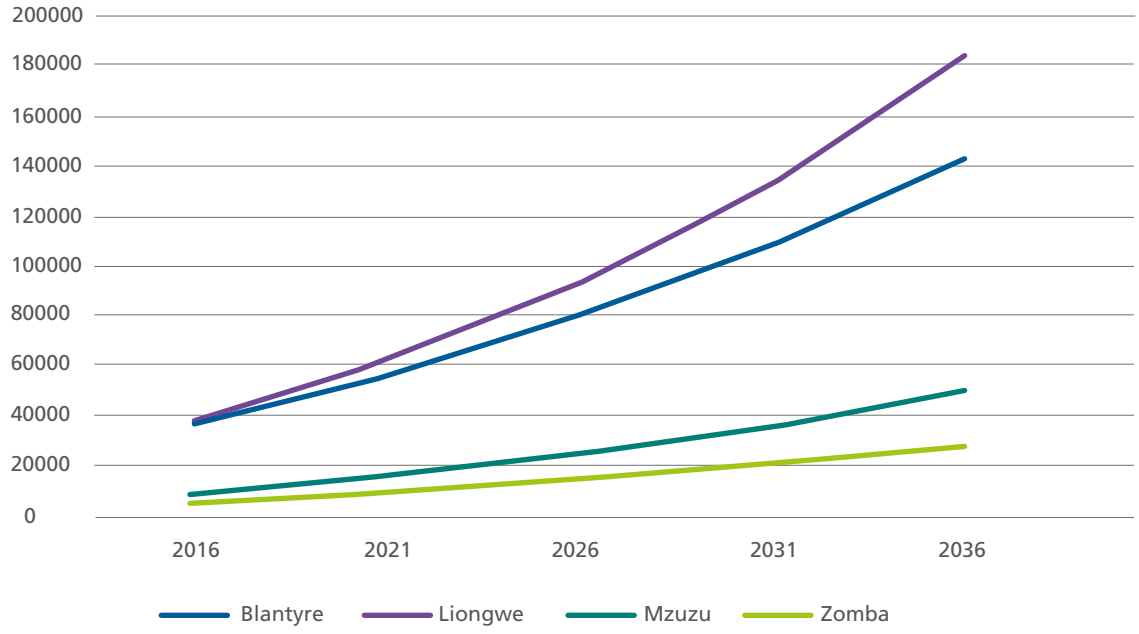


Figure 13.12 Gateway Mall, Lilongwe

Malawi's first out of town shopping mall is sited close the Lilongwe Western By-pass

13.8.1 **New roads**

In line with the assessment in Section 10.2, there is a case for additional highway capacity in the cities to remove through traffic from the main centres of activity. This generally calls for the provision of bypasses. These need to be carefully planned, so as to cater for through traffic whilst not being attractive to local (short-distance) movements which might erode the benefits. However, as the cities develop, it is hard not to see land use intensification taking place close to by-passes in the future, as they will offer improved accessibility compared to the more congested city centres. Gateway Mall, Lilongwe (Figure 13.12) is an example of this.

Figure 13.13 Lilongwe by-passes

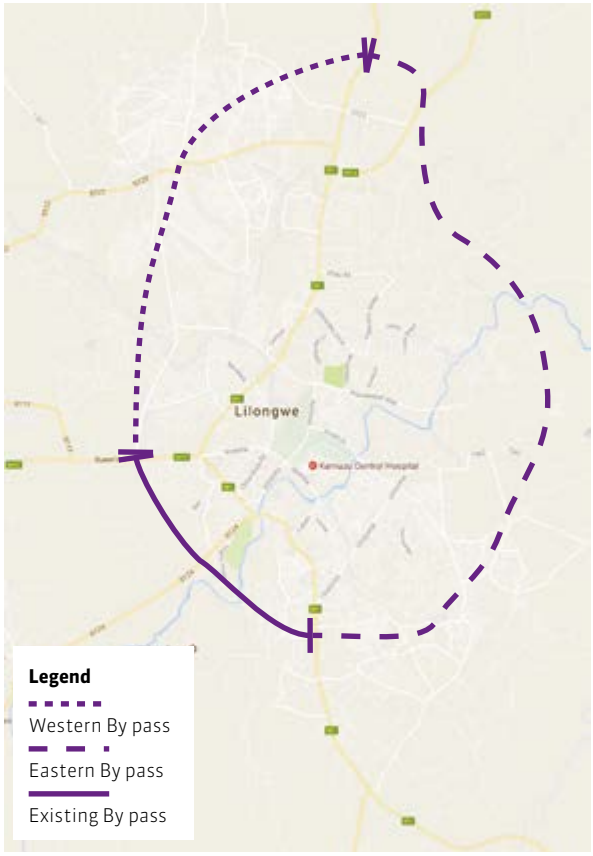
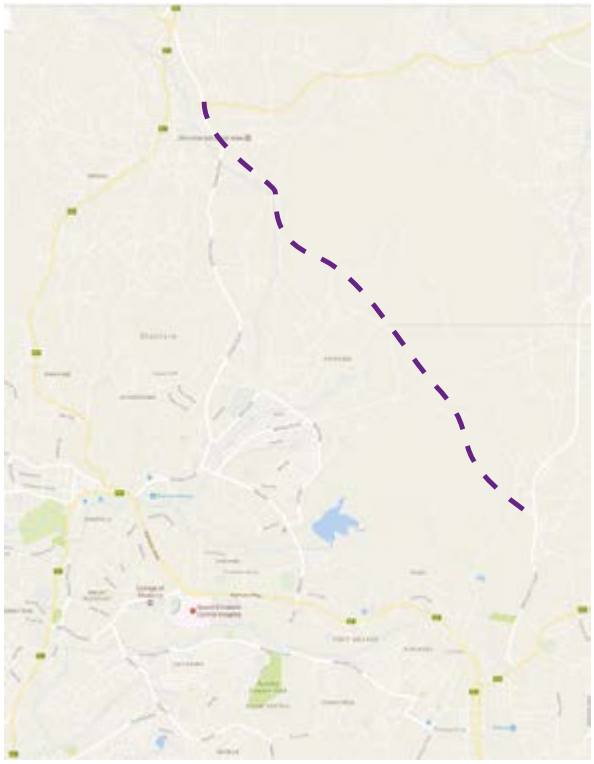


Figure 13.14 Blantyre Inner Relief Road



Proposed priorities for the construction of bypasses are:

1. Lilongwe North Western Pass – linking the M12 and existing Western Bypass at Gateway Mall to the M1 north of Kanengo, with an airport spur to KIA. The road should be limited access with junctions with the S122 Mzumanzi, access to Area 25, and Access to Area 55. (12km).
2. Mthandizi- Mpingwe (Limbe By pass), linking the M2 and M3 (3.6km).
3. Ndirande-Nkolokoti linking Makata to Nkolokoti Road in Blantyre (3km).
4. Misesa-Soche Hill–Manja in south Blantyre (4km).
5. Mzuzu Western Bypass, following the alignment of existing unpaved roads which widening and upgrading. The first 4km has been constructed by NOCMA as part of access to its strategic fuel reserve.

Future proposed candidates are:

1. Lilongwe Eastern By pass (20km)
2. Blantyre Inner Relief Road (14km

Figure 13.15 Impression of elevated expressway, Blantyre

Blantyre-Limbe Elevated Expressway. This 8km of elevated road would run above the Kamuzu Highway in Blantyre between Limbe at the M2/M3 junction to Mbayani on the M1. It would provide a seamless connection between these two points as well as having free-flowing on/off ramps at Chichiri, College of Medicine, and Blantyre CBD. The expressway would offer a fast flowing alternative to the congested Kamuzu Highway, and provide relief to it at the same time which would allow for the provision of dedicated lanes for fast urban public transport.

The $168 million project will be financed under a Public Private Partnership (PPP) arrangement with a concessionaire appointed to design, construct, manage, operate and maintain the highway which will include installation of computerised chip reading system, provision of high visibility lighting, safety feature and a control centre.

Tolls are expected to be around MWK 375 per km. There will be no toll gates; instead payment will be made through pre-paid re-chargeable windscreen mounted chips, debited by local sensors. Payment can be made manually or through a Smartphone App. Enforcement will be through close circuit TV, and optical character recognition of registration plates, linked to the MalTIS system.

13.8.2 Road widening

Road widening proposals for all cities should be carefully appraised. As noted earlier, it is junctions that limit the capacity of the road system, and where possible these should be improved first.

13.8.3 Truck Routes

Authorities should consider measures to remove heavy goods vehicles from roads in urban areas which are inappropriate. There are two potentially complimentary options:

- Advisory routes: signed routes for vehicles above any designated weight along roads which have sufficient width, capacity and appropriate adjacent land uses;
- Truck bans: on specific roads or into and within specific areas designed to protect urban areas from large and heavy vehicles.

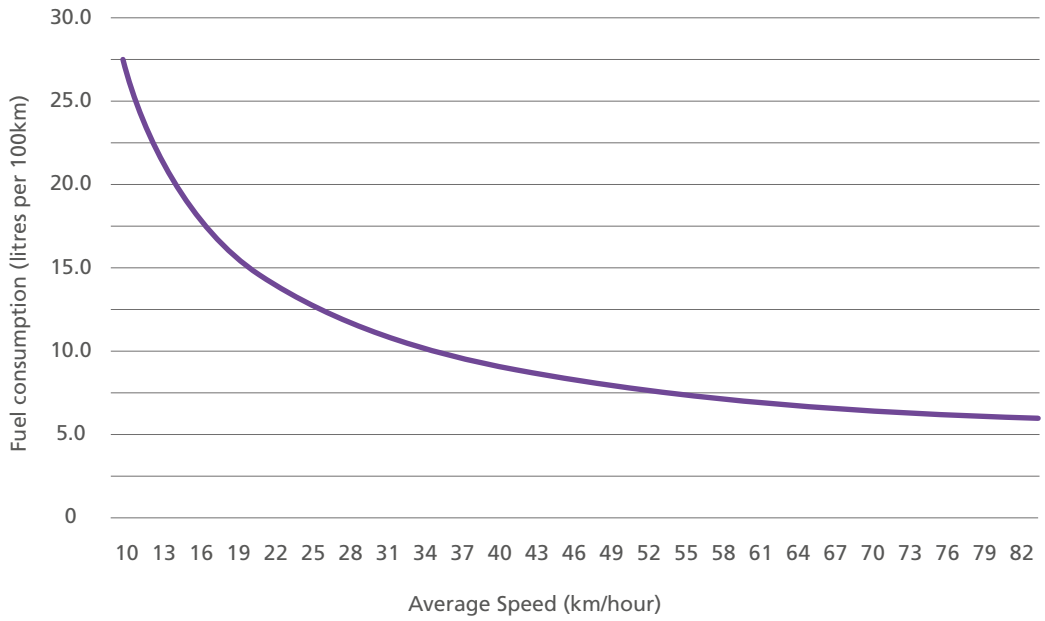
13.9 Congestion and traffic management

13.9.1 Costs of congestion

If no significant interventions are made in the urban transport system, traffic congestion will rise inexorably, more so in peak times of demand. Congestion has two major impacts: increased fuel consumption due to lower average speeds, and a loss of productive time. Significant congestion is currently evident at peak times in both Blantyre and Lilongwe. It is now spreading into to the off-peak periods as well.

The private vehicle trip forecast for Blantyre and Lilongwe , as presented in Figure 13.11, has been used to assess the impact of congestion in future in those two cities. Fuel consumption increases with average speed, and the relationship for a typical saloon vehicle with an engine size of around 1,000c.c. is shown in Figure 13.16.

Figure 13.16 Fuel consumption and average speed



A single current average speed of 29 kph for peak periods was taken for both Lilongwe and Blantyre. Whilst this speed is higher than observed in Blantyre (Table 10.1), the observations in Blantyre were of roads known to be relatively congested. Hence the average speed in the city ought to be higher than those observed. An off-peak average speed of 35 kph was assumed. Congestion will force average speeds down, and the possible consequences are set out in Table 13.7. The estimated speed is based on the assumption that, unless there is a major intervention, there will be a small exponential decrease in speed due to increased private car demand. With unrestrained demand it is not unreasonable to suppose that average speeds in Blantyre and Lilongwe in 15 years' time could be similar to current speeds in Nairobi (Table 10.2).

Table 13.7 Assumed average speeds in Lilongwe and Blantyre

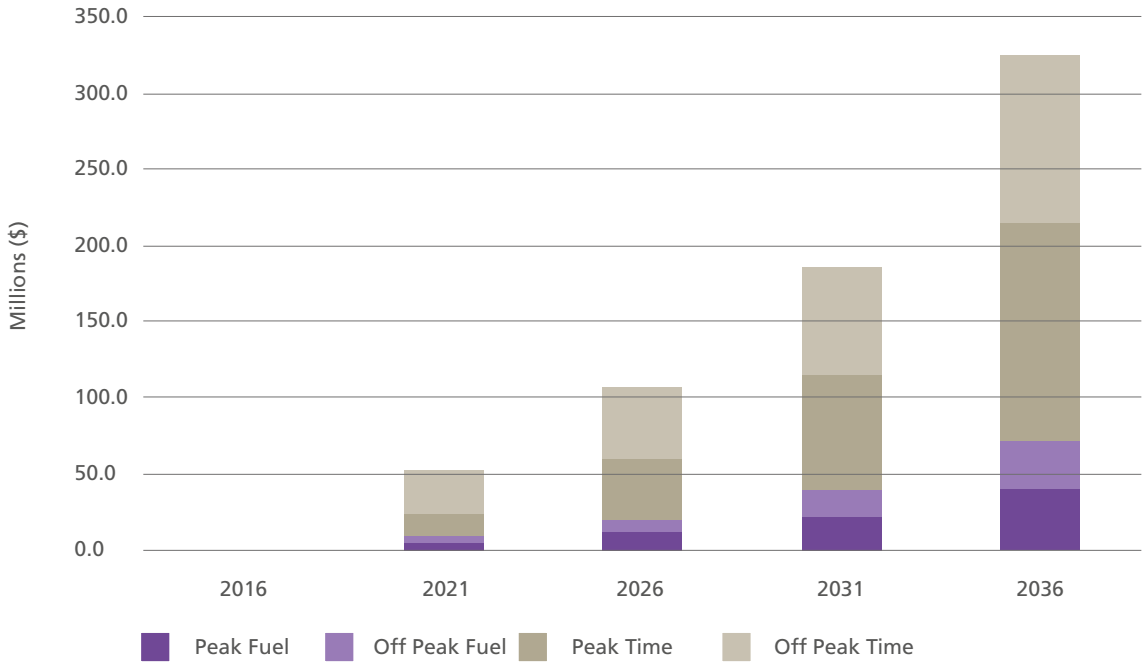
Year	Peak (kph)	Off peak (kph)
2016	29	35
2021	27	33
2026	24	30
2031	20	26
2036	16	22

An average (diesel and petrol) fuel price of MWK 825 per litre is assumed, along with an average tips length of 5km. The value of time for car users is taken to be MWK 1,203 per hour, from the NTMP Stated Preference Surveys. 51% of private vehicle trips take place in the peak four hours. The estimates for congestion costs presented in Table 13.8 and Figure 13.17 are relative to 2016. These costs are only for private vehicles, and exclude public transport and goods vehicles.

Table 13.8 Incremental costs of traffic congestion in Lilongwe and Blantyre, relative to 2016, $M

Year	Peak fuel	Off peak fuel	Peak time	Off peak time
2021	4.2	4.1	14.3	28.4
2026	10.8	10.2	37.8	45.6
2031	20.9	18.9	76.0	70.9
2036	38.1	32.6	143.5	110.4

Figure 13.17 Incremental costs of traffic congestion



By 2036, the costs of traffic congestion in the two major cities could be over $320 million. Even in 5 years' time, the costs could exceed $50 million. This emphasises the value of interventions to reduce congestion.

13.9.2 **Traffic management**

Traffic management is designed to ease congestion and improve road safety. The key factors affecting congestion are junctions, not the scale of road links between junctions (Figure 13.18). In urban areas, where a junction becomes congested it can create a queue of traffic that 'blocks back' to an upstream junction and reduce its effective capacity. This regularly occurs in Lilongwe – the Kamuzu Central Hospital roundabout becomes blocked due to queuing traffic on the Mzimba Road (east) exit, and this reduces entry capacities on all the junction arms. Then, the Mzimba Road (west) queue blocks back to the Amina House roundabout, causing additional congestion there. Similar effects are regularly observed in Blantyre on the Kamuzu Highway roundabouts, both in the evening peak and at lunch-time.

Figure 13.18 Lilongwe Bridge

The queue of traffic approaching the camera is delayed by the downstream junction, not width of the bridge

Roundabouts are prone to being blocked and that affects all entry traffic, whereas signals, can allow traffic flow to exits which are not blocked. Blocking of roundabouts is currently the subject of police over-ride (Area 18 roundabout, morning peak hours) who control entry flows.

For the key reasons of capacity and pedestrian safety, traffic signals are preferred in urban areas to roundabouts.

Traffic can also be managed through controlling directional traffic through one-way systems. These systems can allow parking on links and reduce the number of conflicting movements at junctions. The planned one-way system for Blantyre CBD needs to be implemented urgently. One-way systems use existing infrastructure efficiently, with minimal costs associated with signing and road markings. Before implementation, consultation should be held with local businesses, and before and after surveys carried out to monitor effectiveness. These should focus on journey times, as opposed to average speeds.

13.9.3 Traffic signals

At a junction, there are demands for movements which conflict with each other, for example turning traffic, minor road traffic, pedestrians etc. Traffic signals are designed to minimise the various conflicting manoeuvres at a junction by allocating time and road space to vehicle and pedestrian movements in a sequence. They should provide good facilities for all road users including cyclists, pedestrians and mobility-impaired users. Traffic signal design aims to give adequate time to each traffic stream and road user while keeping the overall cycle time as short as possible.

Signal design needs to be improved to increase throughput at junctions and reduce the potential for accidents. Key issues are addressed below.

Cycle times should generally be between 40 seconds and 120 seconds. Cycle times in excess of 120 seconds are not recommended as drivers and pedestrians can get frustrated with delays and can be tempted to take risks. Shorter cycle times (90 seconds or less) should be provided where pedestrian flows are relatively high. However, cycle times in excess of 120 seconds are acceptable in the context of restricting side road access onto a main road so long as drivers are informed by signage.

There must be at least one primary signal at each stop line. The primary signal is normally sited on the nearside (footway side), between 1m and 5m beyond the stop line. Additional primary signals should be sited on the offside on dual carriageways and at locations with a splitter/pedestrian crossing island in the centre of the road. On faster roads or roads with 4 or more approach lanes, high mounted or overhead additional signals should be considered. Similarly, if visibility of the signal heads is restricted by a crest in the alignment, then high mounted or overhead additional signals (6m) should be considered. Signals should be visible within the stopping sight distance of the junction. Neither parking/loading nor street furniture should block the approach view of the signals, within 40m of the signals.

Generally, there should be at least one secondary signal associated with every stop line. The secondary signals are normally sited on the opposite side of the junction where they can be seen easily by drivers waiting at the stop line. Where a vehicle is waiting to turn right at a junction and there is an opposing right turn movement with an early cut-off facility, drivers could be confused when the secondary signal for their movement turns to red. The driver would normally expect oncoming traffic to stop and would use the intergreen period to complete their turn. However, when an early cut-off phase operates then the opposing traffic continues to run.

The list of priority conversions of roundabouts to traffic signals is:

- Amina House, Lilongwe;
- Kamuzu Central Hospital, Lilongwe;
- Parliament roundabout, Lilongwe;
- Golf Club roundabout, Lilongwe;
- Chipembere Highway/Mahatma Gandhi Road, Blantyre;
- Chipembere Highway/Chileka Road, Blantyre; and
- Chipembere Highway/Makata Road, Blantyre.

Traffic signals need a constant power supply. This can be achieved through solar, but these must be protected from theft. Road user discipline is important and education and awareness programmes need to be stepped-up. Other road safety initiatives are more national and covered in the Roads Sub-Sector paper.

13.10 **Parking**

13.10.1 **On-street parking**

The removal of on-street parking can assist in reducing traffic congestion. However, in the short to medium term there could be pressure for this to be replaced by off-street facilities. Demand for parking will grow, and where there is a shortage of on-street spaces, these need to be managed to reduce impacts on congestion, and to maximise revenue to city authorities.

Each city needs to make a formal inventory of all existing and potential on-street parking spaces, along with usage. Car park demand in Blantyre is well in excess of supply (Figure 3.5).

Differential pricing of parking spaces should be introduced to reflect demand in the various areas of the cities. Pricing should be graduated (per hour) in order to dissuade long-term parking by commuters that contributes to peak hour congestion. Time limits (e.g. 4 hours) can be considered.

Management and revenue collection from parking should be contracted out to private companies, and city authorities should establish parking accounts so that income is transparent and reported upon. Contracts can be fixed price, or set at a percentage of revenues. Zones can be established so that contracts can be let to more than one company, in order to promote competition.

Reserved on-street spaces for adjacent business owners could be considered. This would remove the practice of informal reservation on public roads, and premium fees could be charged.

City authorities should use physical design solutions to reduce footway parking, through installing bollards and planting trees to create physical barriers to parking on footways.

13.10.2 **Off-street parking**

13.10.2.1 **Public parking**

It will be desirable to eliminate on-street parking on many streets in city centres, in order to free up space for pedestrians and other activities and improve urban design. The supply should be shifted to peripheral lots, which can be accessed from major arterials and avoid directing traffic through the narrower roads in city centres. Off-street parking should be developed and managed by the private sector, but since a loss of on-street parking will result in a revenue loss to authorities, consents for off-street facilities should include a revenue contribution clause to city authorities.

Off-street parking operated by the private sector should be licensed by city authorities so that they can impose tariff regimes that meet transport objectives. For example, tariffs should be progressive against length of stay to dissuade long-term parking, largely by commuters, who would have an alternative mode of transport under an improved bus system.

13.10.2.2 **Private parking**

Parking provided by developments for their own use should be regulated through car parking standards for development control. Authorities will need to take a view on whether standards should be maximum or minimum.

Minimum standards would require a developer to provide at least a certain amount of parking within the curtilage of the proposed building. This is designed to ensure that supply matches demand and that vehicles are not forced to park on-street.

Maximum standards require developers to provide no more than a set level of parking. This is designed to prevent developments from encouraging private car use, and hence reducing congestion.

In either case, city authorities should differentiate between operational parking – that which is necessary for the operation of the building – and would normally provide for service vehicles and visitors, and non-operational or discretionary parking, which could be provided for non-essential journeys and commuters.

Where developers are not able to meet a minimum requirement, they could contribute to the cost of public off-street parking through commuted sums. This would require legislation, most usually as an amendment to the planning acts.

Figure 13.19 Park and Ride

Left to right: Park and Ride bus (Bristol, UK); Park and Ride Car park (Salisbury, UK); UK road sign, under traffic regulations

13.10.2.3 **Park and Ride**

Park and ride is a mixed mode system in which a private vehicle is used in the first part of the trip from less dense areas to reach a car park located close to a main road. At this point the driver transfers to a dedicated bus service operating in the denser urban area, usually to the CBD or other centre. The key features of a successful park-and –ride operation are:

- The car park is located in a place which can be reached by private car without encountering traffic congestion;
- The car park is safe and secure, guarded and lit;
- Decent waiting facilities are provided;
- The bus service has a fixed timetable that makes wait times tolerable for passengers; and
- The bus operates on a route with bus priority measures.

Candidate project for park and ride are:

1. Lilongwe: car park sited at junction of M12 and Lilongwe by-pass, with bus priority measures starting 1km west of Crossroads roundabout, running east and south east to Old Town;
2. Blantyre: car park sited in Bangwe with priority measures running through Chipembere highway to Blantyre CBD; and
3. Zomba and Mzuzu on M-roads in medium to long term.

13.11 **Travel demand management**

Many of the proposals listed above are concerned with managing traffic (both motorised and non-motorised) safely and efficiently. Ultimately the demand for motorised travel within the cities may prove too great for traffic management measures to address successfully. Before that occurs, authorities may wish to consider interventions that restrain the use of private cars with in cities, in order to make the best use of existing assets, particularly the road infrastructure. Any such interventions can and should be wholly consistent with a sustainable urban transport strategy that seeks to prioritise public and non-motorised transport.

Any measures to restrain the use of private cars within cities should be preceded by the implementation of a decent public transport system. Prior to the introduction of any restraint mechanisms, interventions which promote efficiency should be considered such as:

- Staggering working and school opening hours to reduce peak period impacts;
- Restrict parking supply, and/or increase charges for long-term parking; and
- Promote car-pooling and car-sharing.

13.12 **Urban rail**

Previous studies have recommended the use of rail for commuters, either through new systems (such as LRT), or using the existing infrastructure. Considering the general principles of these, they are not appropriate for Malawi in the plan period for the following reasons:

- Urban commercial and residential densities will not reach levels that can sustain very high capacity transit systems;
- The capital cost of rail based transit is extremely high in comparison to the more appropriate BRT option; and
- Operations could demand a subsidy which would be unsustainable and financially unacceptable.

The possibility of using the infrastructure between, for example Limbe and Blantyre, for a commuter service has been reviewed. The single track is inappropriate for such a service, which would conflict with freight operations, and it is believed the latter should have a higher priority. Two new tracks would need to be constructed, which means that the proposal would have no benefit from existing infrastructure, except perhaps from the right of way. Existing passenger carriages are also inappropriate for commuters, and so new rolling stock would be required, along with totally new passenger stations.

For Lilongwe, the option of introducing passenger services between Mchinji and Salima was tested. In Lilongwe, such a service should be designed to interchange with the proposed BRT service by way of a new station in Area 25. This will attract a reasonable number of passengers and needs to be fully costed.

Current infrastructure costs for an urban light rail system of twin tracks and stations, are around US$20 million per kilometre. A minimum length of 15km would likely be needed to make a system attractive, giving a cost of $300 million. The current rail operation of locomotive hauled carriages is entirely inappropriate for urban transport operations, and new Diesel Multiple Unit (DMU) rolling stock would be needed, at a cost of around $50 million. It is vital that operating costs are covered by revenues so that such a system would not require subsidies. An urban rail system would be unlikely to pay back any of the capital investment without requiring much denser urban conditions than are expected in the next 20 years. Nevertheless, the potential for such systems should be monitored during the plan period.

13.13 **Coach Terminals**

Inter-city coaches are not considered part of the urban transport system, but their terminating points ought to be linked to the urban public transport system at a small number of designated areas with appropriate supporting infrastructure.

Currently inter-city coach terminals in Lilongwe and Blantyre are disparate. Currently, in Lilongwe coaches use terminal points at City Mall, Game complex car park, Pacific Hotel and Mbowe. In Blantyre Axa and National Bus have their own (separate) terminals whilst other coaches use Shoprite, Chichiri and Petroda filling station.

Sites should be identified for integrated coach terminals with office and retail components. These can funded entirely by the private sector, or under a PPP arrangement.

13.14 **Capacity building**

13.14.1. **Urban Areas Transport Authority**

This Sub-Sector Plan sets out a significant agenda for change for Malawi's cities. In particular, substantial improvements are put forward for public transport, traffic management, walking and cycling and parking in line with good practice in cities elsewhere in Africa, Europe or Asia. These improvements comprise major capital investment, extensive programmes of minor works and policy and regulatory reform to coordinate transport modes, address traffic congestion, support urban mobility, and encourage sustainable travel attitudes and behaviour.

However, in the short- to medium-term there is a need for institutional reform to support the primary urban transport strategy of moving towards organised and regulated public transport and mass transit. At present it is not appropriate to grant powers to individual City Assemblies to do this, since there is insufficient capacity. Nor would it be efficient to create urban transport authorities for each of the larger urban areas.

For these reasons, a national Urban Areas Transport Authority (UATA), with specific powers to plan, coordinate, and grant licences and concessions to appropriate public transport operators, is required. In pursuance of this the Authority would have a remit to assist city assemblies in investigating, planning and resolving complex multi-modal transport challenges in designated towns and cities. Like recent experience in Kenya, this will initially be a single body at national level with a centralised structure, working closely with City Assemblies. It would have the legal basis, capacity and skills to identify, plan and deliver modern public transport solutions, and in the interests of integrated transport would assist assemblies address the challenges of traffic management, land use and development control, public transport coordination, road safety and non-motorised transport. The Authority would work closely with the City Assemblies to ensure that solutions are flexible to local circumstances and principles of democratic accountability and representation are observed.

13.14.2. City councils

13.14.2.1. Immediate

Ultimately city councils need to play a key role in local development, in which transport will be a major part. A programme of capacity building for the four cities is proposed with the following four components:

Local Government finance

The objective is to increase the resource base of city authorities, and to improve transparency. Structural improvements to the framework of Local Government finance are needed, along with reform of the fiscal architecture. This component would also develop financial instruments, e.g. financial management system software, output based budgeting, and harmonised audits.

Spatial planning

The capacities of city councils to apply GIS as a tool in spatial development and revenue enhancement will be improved. Fiscal cadasters will be developed. GIS will be supported in the planning process, and co-ordination of all stakeholders in spatial planning strengthened.

Development control

Development control procedures and operations will be strengthened, and transport implications of development proposals identified. Legislative gaps will be identified and submitted to the Government.

Traffic management

Strengthening staff capabilities in road, footway, and junction design, traffic signal design and operation, and public transport operations and infrastructure needs.

13.14.2.2 Medium-term

It is proposed that MoTPW and MoLGRD jointly support a process of training, capacity building and technical and logistical support to city councils to improve not only their ability to prepare a robust and effective transport strategy and plan, but to deliver transport interventions using a range of funding sources. The latter may include, for example, programme management, scheme design and specification, contractor procurement and management, commissioning and maintenance. In many cases, the capacity of the local private sector to offer an effective contractor supply chain to city councils, including in public transport, will also have to be strengthened and the National Construction Industry Council (NCIC) may have an important role in this regard. Strengthening city council capacity and skills to plan and deliver local transport may also be a strong candidate for future technical assistance from respective donor agencies.

Depending on their size and capacity, city councils may be encouraged to share resources with neighbouring districts when developing their plans or procuring contractors for works, especially if, and as, population and economic catchment areas extend beyond central city administrative boundaries.

Finally, it has been proposed in the Institutional Reform Plan that MoTPW itself be restructured following the abstraction of a range of current regulatory and operational functions to new agencies. One element of this restructuring would be to create a department for the regulation, funding and coordination of local transport. This will include urban transport planning and delivery as appropriate.

Minibus terminal next to the central market in Mzuzu

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Malawi National Transport Master Plan

14 Action plan

Urban Transport Sub-Sectoral Plan

14 Action plan

14.1 Overall strategy

The action plan for implementation will be based on the general principles set out in Table 14.1.

Table 14.1 Implementing the Urban Transport Sub-Sectoral Plan

Stage	Years (approx.)	Purpose	Components
I	2016-2026	▪ Undo the mistakes of the past ▪ Build capacity ▪ Improve safety ▪ Improve public transport ▪ Improve traffic management ▪ Increase the resource base ▪ Move to sustainable options	▪ Minor infrastructure works ▪ Training and technical assistance ▪ Policy and design for non-motorised transport ▪ Regulatory and legal reform for public transport ▪ Establish UATA ▪ Move to higher capacity public transport ▪ Basic traffic management and safety measures ▪ Parking control and revenue collection ▪ Enhanced development control powers
II	2026-2036	▪ Respond to land use change ▪ Plan effective solutions ▪ Deliver infrastructure projects ▪ Improve public transport	▪ Design and implement transport initiatives with land use development ▪ Overall transport plans ▪ Larger scale interventions ▪ Integrated traffic management

14.1 **Overall strategy**

The immediate priority is for capacity building within the city authorities and the establishment of a firm legal and institutional base on which the development and implementation of key measures can be built.

Projects and programmes are shown in Table 14.2, and the Action Plan in Table 14.3.

Table 14.2 Urban transport projects and programmes (US$)

Sl		2017-2022	2022-2027	2027-2032	2032-2037
Major projects					
54	BRT design	5,000,000.00	3,000,000.00		
55	BRT pilot		60,000,000.00	60,000,000.00	-
56	BRT schemes			20,000,000.00	80,000,000.00
57	Mzuzu bypass	2,000,000.00	6,000,000.00		
58	Coach terminals	10,000,000.00	20,000,000.00	20,000,000.00	10,000,000.00
59	Road widening schemes	22,000,000.00	11,000,000.00	11,000,000.00	11,000,000.00
	Minor capital works and programmes				
60	Traffic signal programmes	5,000,000.00	10,000,000.00	10,000,000.00	10,000,000.00
61	Traffic management	5,000,000.00	3,000,000.00	3,000,000.00	3,000,000.00
62	Cycle lanes	5,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00
63	Footways	5,000,000.00	15,000,000.00	15,000,000.00	15,000,000.00
64	Design guidelines for urban roads	500,000.00	-	-	-
65	Road safety programmes	5,000,000.00	3,000,000.00	3,000,000.00	3,000,000.00
66	Cycling	3,000,000.00	1,000,000.00	1,000,000.00	1,000,000.00
67	Truck routes	1,000,000.00	1,000,000.00	1,000,000.00	1,000,000.00
68	Car parking plans	1,000,000.00	-	-	-

Sl		2017-2022	2022-2027	2027-2032	2032-2037
69	Park and Ride operations	-	5,000,000.00	-	-
70	Street lighting	2,000,000.00	2,000,000.00	2,000,000.00	2,000,000.00
Institutional and regulatory					
71	Establish Urban Areas Transport Authority (UATA)	3,000,000.00	-	-	-
72	Improve revenue collection	-	-	-	-
73	Capacity building	5,000,000.00	4,500,000.00	-	-
74	Adoption of sustainable urban transport policy	500,000.00	-	-	-
75	Develop public transport networks	1,000,000.00	-	-	-
76	Off-street parking - concessions	-	-	-	-
77	Off-street parking structures - licensing	-	-	-	-
78	Big bus concessions	-	-	-	-
78	Develop standards for long term low emission vehicles	-	1,000,000.00	-	-
	Sub Total	**81,000,000.00**	**153,000,000.00**	**158,000,000.00**	**148,000,000.00**

Table 14.3 Action Plan

Item	2017-2022	2022-2027
Cabinet paper for UATA bill	x	
Establish urban transport coordinating committee	x	
Adopt universal design principles	x	
Sensitise minibus owners and drivers	x	
Report on appropriate bus capacities, engine types and fuel types	x	
Identify corridors for public transport priority improvements	x	
Pre-feasibility report for Lilongwe	x	
Pre-feasibility report for Blantyre	x	
Feasibility and detailed design for pilot BRT scheme - Lilongwe	x	
Establish BRT infrastructure and operating modalities	x	
Long-term paper on fuel types in urban areas	x	
Cycle lane designs for urban areas	x	
Establish council-cycle operators forum	x	
Paper on bicycle sharing	x	
Footway improvement programme for urban areas	x	
Pedestrian crossing programme for urban areas	x	
Develop advisory truck routes in the 4 urban areas	x	
Implement Blantyre CBD traffic management plan	x	
Traffic management plans for 3 urban areas	x	
Identify junctions for conversation to traffic signals	x	
Undertake parking inventories	x	
Prepare legislation for commuted sums for parking	x	
Investigate options for on-street parking control	x	
Identify park and ride sites	x	
Legislation for traffic impact assessments		x
Investigate staggering working and school opening hours	x	
Identify sites for coach terminals	x	
Street lighting plan	x	

Bycicle taxis sharing same carriageways with motorised vehicles in Mazuzu on the M1

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Malawi National Transport Master Plan

Appendix A
City profiles

Urban Transport Sub-Sectoral Plan

A.1 **Blantyre**

A.1.1 **Background**

From 1876 to 1905, urban development in Blantyre was confined to three areas within 2km of each other; Blantyre Mission at Henry Henderson Institute (HHI), Mandala and Government zone and commercial centre triangle marked by Haile Selassie Road, Glyn Jones Road and Hannover Street.

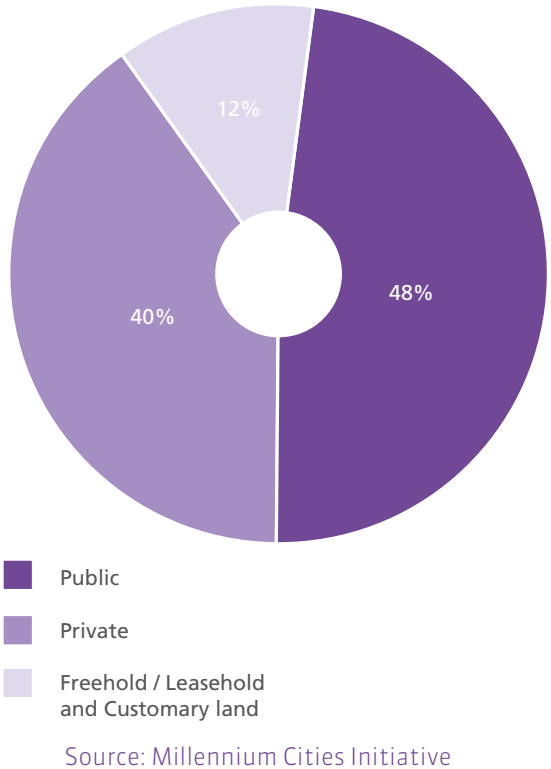
The development of Limbe started in 1906 following the establishment of the Shire Highlands Railways Company headquarters and repair and servicing facilities and Imperial Tobacco Group (ITG) packaging and tobacco grading factory nearby. The establishment of these operations led to the increased growth of Limbe town which saw the establishment of wholesale and retail shops and low to medium density housing for staff in the areas surrounding Limbe. The city's status as Malawi's centre of commerce and industry began through its role as a centre for colonial trade in ivory. To this day, Blantyre still maintains its grip as the commercial capital of Malawi. The Millennium Cities Initiative (MCI) chose Blantyre as a Millennium City with immense potential for rapid growth.

A.1.2 **Land**

Blantyre city located in Blantyre district covers an area of 220km^2 and is situated in the Shire Highlands at an altitude of approximately 1,150m above sea level. The topography of the city is varied, comprising relatively flat areas, rolling terrain, several small hills and streams. The city is divided into 26 administrative wards with land ownership shown in Figure A.1.

Figure A.1 Blantyre City land ownership categories

Figure A.1 Blantyre City land ownership categories



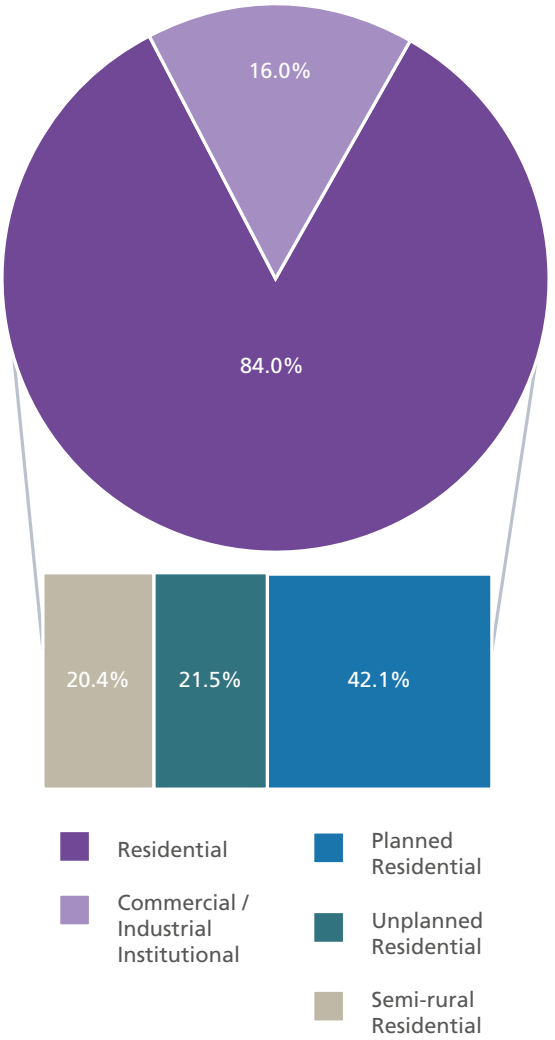
Source: Millennium Cities Initiative

Land management is challenging in the city as the ownership of land is shared amongst a variety of players:

1. Ministry of Lands, Housing and urban Development (MoLHUD);
2. Malawi Housing Corporation (MHC);
3. Private Sector;
4. Blantyre City Council (BCC); and
5. Local Chiefs and Leaders.

Land usage in the city is planned as illustrated in Figure A.2.

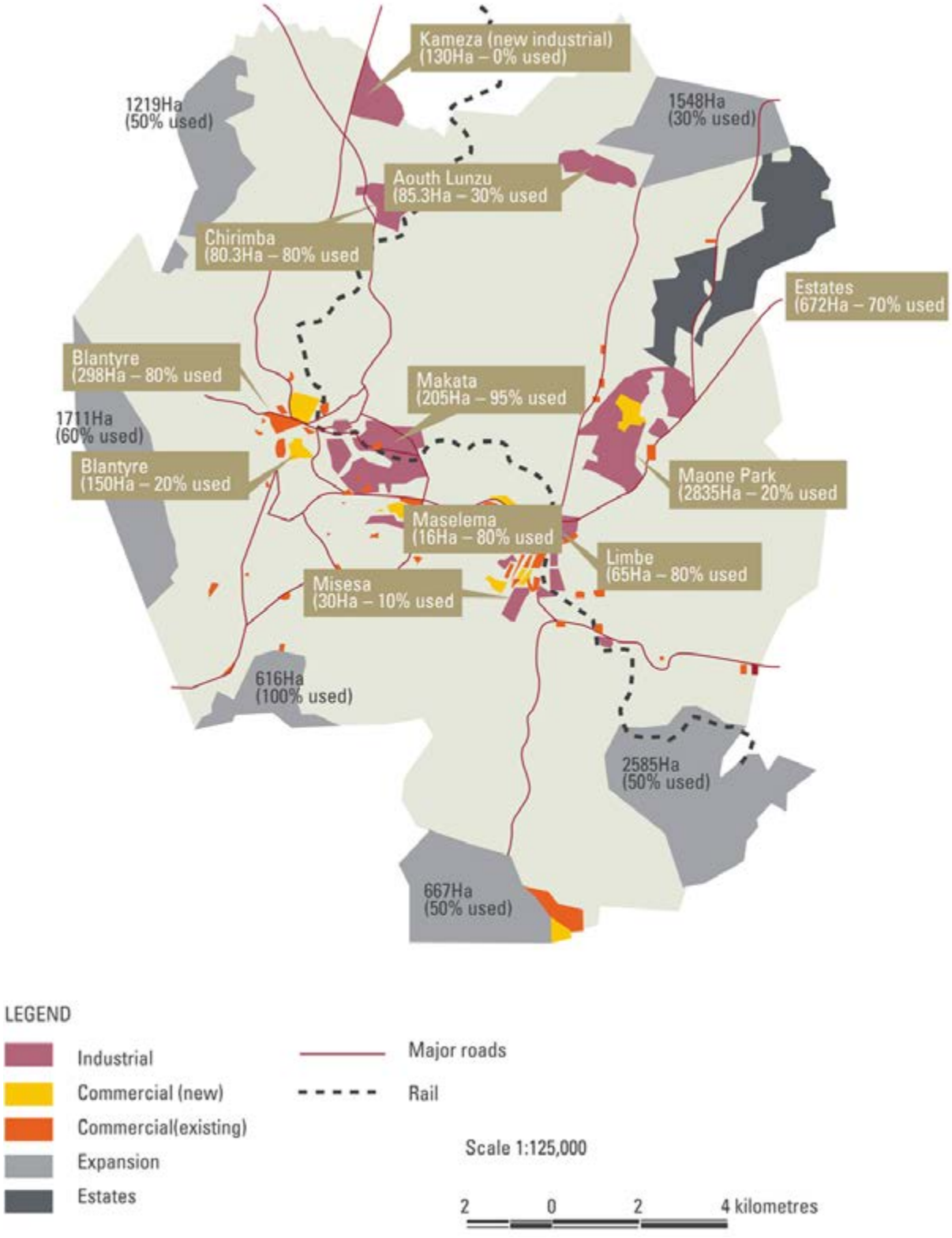
Figure A.2 Blantyre City planned land usage



BCC is responsible for the provision of high density plots amongst other mandates. In recent years, the low-income plots have been absorbed by medium and high income people who can afford them. This has led to unplanned and haphazard developments, a situation that is exacerbated with the local chiefs who allocate land without following any layout plans.

Recognising the issues of land availability and acquisition, the Blantyre City Assembly (BCA) in 1999 created the Blantyre City Urban Structure Plan. As part of this plan, BCA introduced land zoning for industrial, commercial and estate land as shown in Figure A.3. At the same time, BCA have shown willingness to being flexible with the land zoning, where business proposals for land usage is robust. Some industrial areas such as Maone Park are not completely occupied.

Figure A.3 Blantyre City commercial and industrial land stock



Source: Blantyre, Malawi – Potential opportunities for Investors (2009)

A.1.3. **Population**

In 2007, it was estimated that about 72% of the urban population in the city lived in the unplanned areas which are Low Income Areas (LIA), occupying up to 23% of the land in the city. Table A.4 shows the population living in the unplanned areas of Blantyre as of 2007.

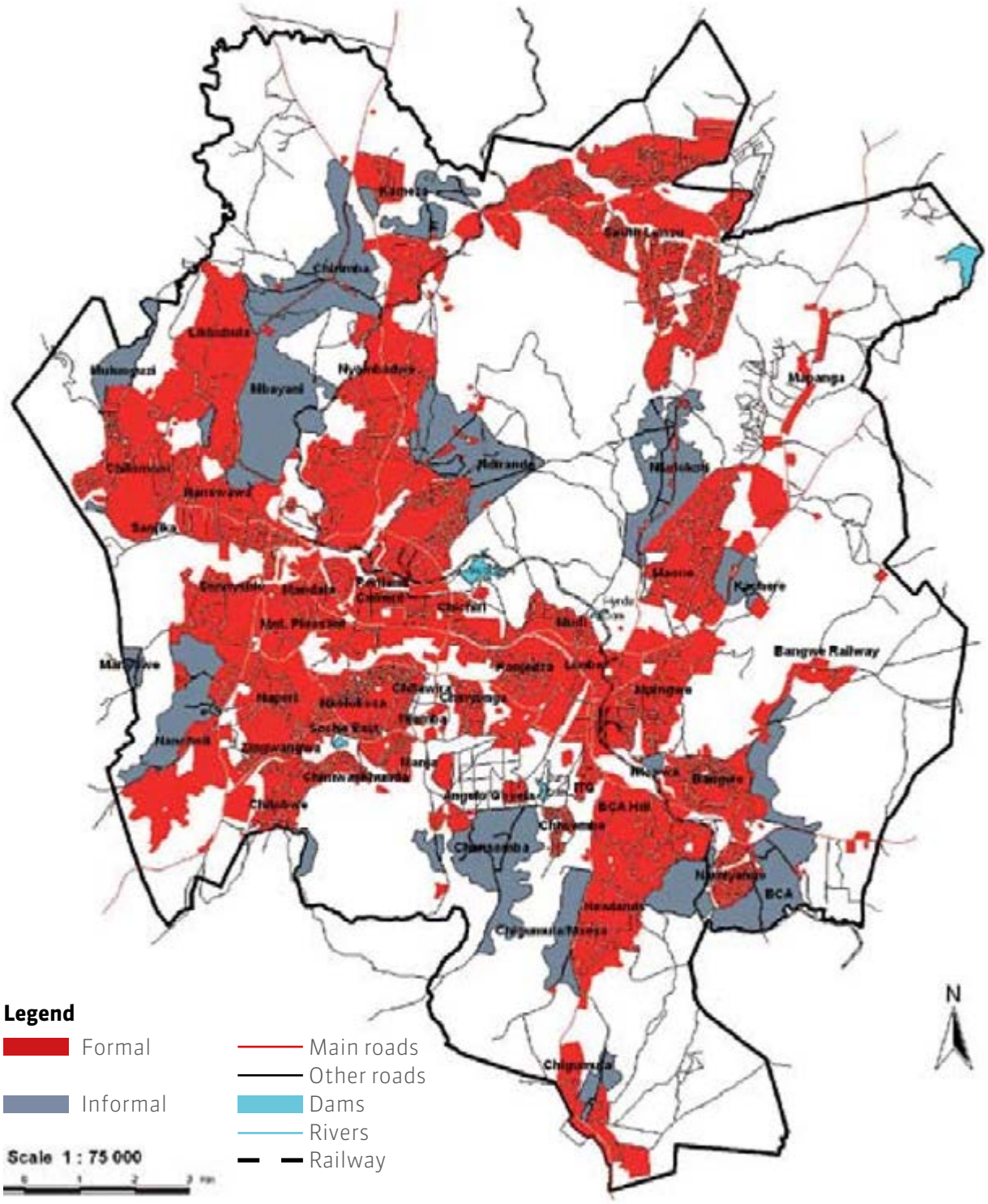
Table A.4 Population of the unplanned areas of Blantyre City

Unplanned area	Population (2007)	Unplanned area	Population (2007)
Ndirande (Safarao, Makata, Zambia, Chrimba)	118,424	Nkolokoti	10,278
Bangwe / Namiyango	39,966	Nancholi	9,148
Machinjiri	38,966	Misesa	8,595
Chilomoni	32,094	Kameza	8,558
Mbayani / CheMussa	25,405	Manyowe	8,493
Basiyele	22,491	Sigelege	7,311
Chigumula Chiswe	22,317	Manase	6,600
Chilobwe Chatha	18,970	Kachere	6,401
Mzedi	15,482	Soche	6,264
Naotcha	14,483	Makheta	4,986
Chiwembe	13,341	Ntopwa	3,789

Source: UN-HABITAT, Blantyre City Urban profile, 2011

Figure A.4 shows the location of the formal and informal settlements in Blantyre City.

Figure A.4 Formal and informal settlements of Blantyre City



Source: BCA, Strategic Planning and Social Inclusion Agenda

The above unplanned areas have developed without following building regulations and where housing construction and selling of land is uncontrolled. It should also be noted that the city's daytime population soars, because people from surrounding areas travel to the city during the day. This is putting tremendous pressure on the existing infrastructure to provide adequate services.

A.1.4 **Economy**

The commerce, trade and industry sector is the major employment generator in the city and has the greatest multiplier effect on the urban economy. The primary sectors, including agriculture, fishing and mining, make up a small portion of the city's economy. The city has the largest number of manufacturing plants in the country and has eight designated industrial areas as shown in.

Table A.5 Blantyre City designated industrial sites

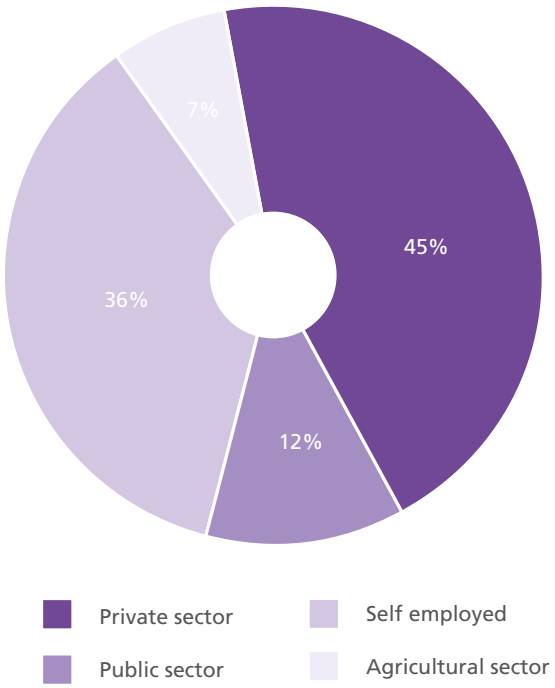
Name	Category
Makata	Heavy
Ginnery Corner	Light
Maselema	Light
Limbe	Heavy
Chirimba	Heavy
Maone	Light
Chitawira	Light
South Lunzu	Light

Of the above heavy industrial sites, Makata and Limbe are the most developed, hosting more than 30 companies, while Chirimba is the least developed in terms of the number of industries.

A.1.5 **Employment**

The city offers numerous economic opportunities. Finance, retail trade, construction, manufacturing of food products, transport, textile manufacturing, motor vehicle sales and maintenance and public administration are the most vibrant economic activities in the city. The informal sector employs about 18% of the city's population and plays a major role. Employment by sector is shown in Figure A.5.

Figure A.5 Blantyre City employment by sector



A.1.6 **Education**

In 2010, it was reported that there were 83 primary schools in the city, divided between six education zones; Bangwe, Chilomoni, Limbe, Ndirande, South Lunzu and Zingwangwa. Of the 83 primary schools, 57 were government operated while the remaining 26 were private. During the same period, the number of secondary schools was 59 of which 29 were public secondary schools, 28 were private schools and 2 were grant aided schools.

A.1.7 **Water**

Blantyre Water Board (BWB) supplies potable water for commercial, industrial, institutional and domestic use in the city. Water for the city is extracted from the Shire River at Walker's Ferry which is located 40km from the city. Walker's Ferry is also BWB's main treatment plant and it provides water to about 85% of the city's population and has a daily production capacity of 108,000,000 litres per day but currently only produces 78,000,000 litres. BWB also have the Mudi Treatment Plant which is located within the city and was originally designed to serve the old townships of Blantyre and Limbe. The Mudi Treatment Plant has a capacity of 8,000,000 litres at Mudi Dam and it provides about 10% of the water used in the city.

A.2 **Lilongwe**

A.2.1 **Background**

Lilongwe City, named after the Lilongwe River which runs through the city, became the official capital of the Malawi in 1975. The city's central position in the country played an instrumental role in it being designated Malawi's capital city.

The emergence of a major tobacco industry in the surrounding areas increased Lilongwe's importance as an agricultural market centre. The city consists of two contrasting parts, Old Town and New Town. Old Town is the area where the original fishing village was located and today it continues to have the appearance of a traditional African settlement with open air markets and numerous small shops and other businesses. New Town came into existence after Lilongwe became the capital and has modern buildings including the national legislative building, government ministries, embassies and commercial offices.

Since becoming the capital of Malawi, Lilongwe has grown dramatically partly due to the numerous diplomats and expatriate communities that reside in the city. There are also a number of Non-Governmental Organisations (NGOs) located in the city. In addition, the city hosts foreign aid workers, diplomats from dozens of nations and international corporations.

A.1.2 **Land**

Lilongwe City has a total area of 456 km^2 of which 60% is public, 30% is private and 10% is customary land. The following are the main land owners in the city:

- MoLHUD;
- Lilongwe City Council (LCC);
- Lilongwe District Assembly (LDA); and
- Chiefs who claim administration as de facto landlords and managers of public land.

The current land use for the city is shown in Figure A.6 below and

Figure A.7 shows a map of land use across the city. Agricultural land use occupies more than half of the land in the city and accounts for 21,646 ha followed by residential land use which occupies 23.7%.

Figure A.6 Lilongwe City land use

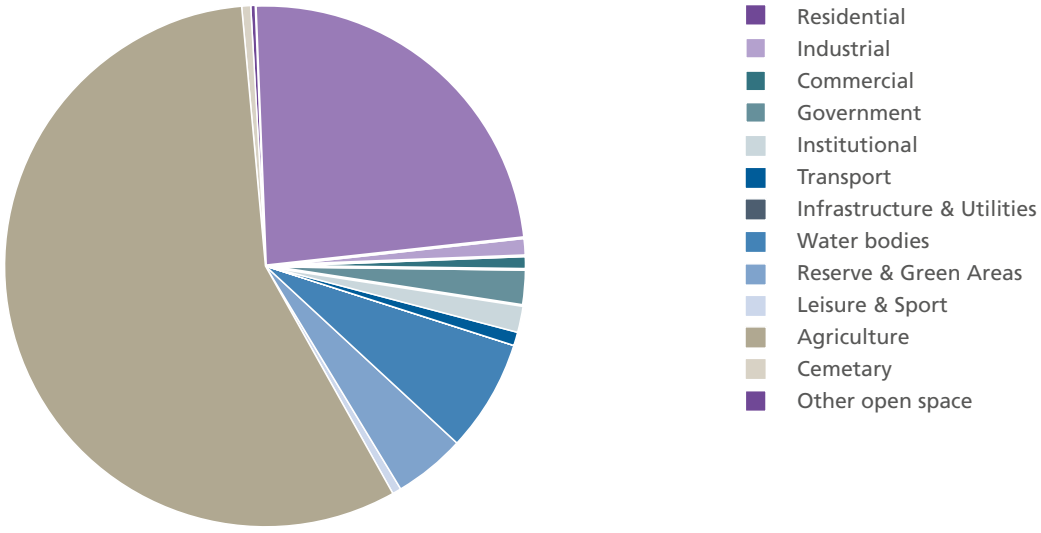
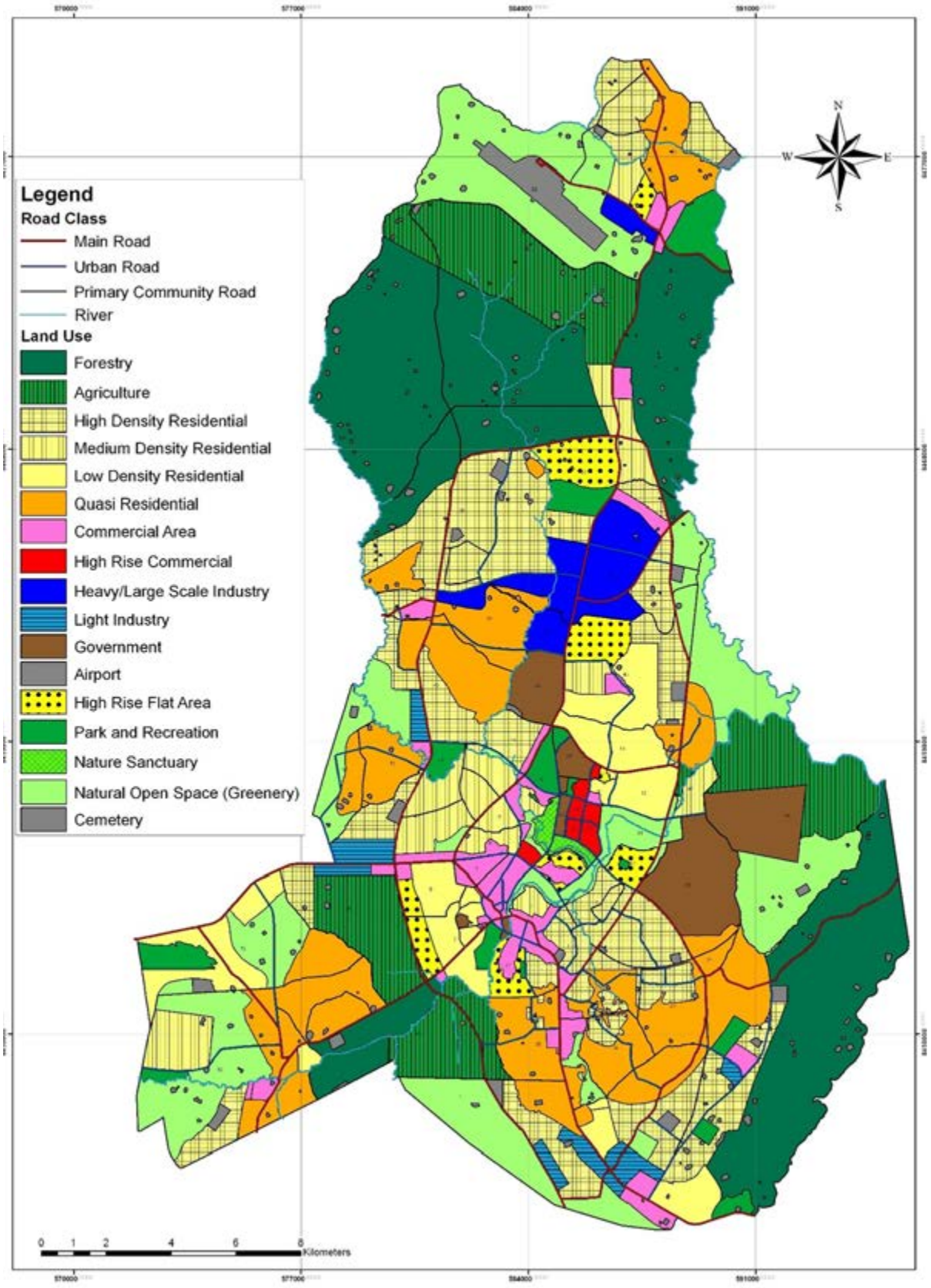


Figure A.7 Future land use plan for Lilongwe City



Source: Study on Urban Development Master Plan for Lilongwe, 2010

A.2.2.1 **Residential**

Unplanned settlements in the city occupy the largest share of residential land use as shown in Table A.6.

Table A.6 Residential land use in Lilongwe City

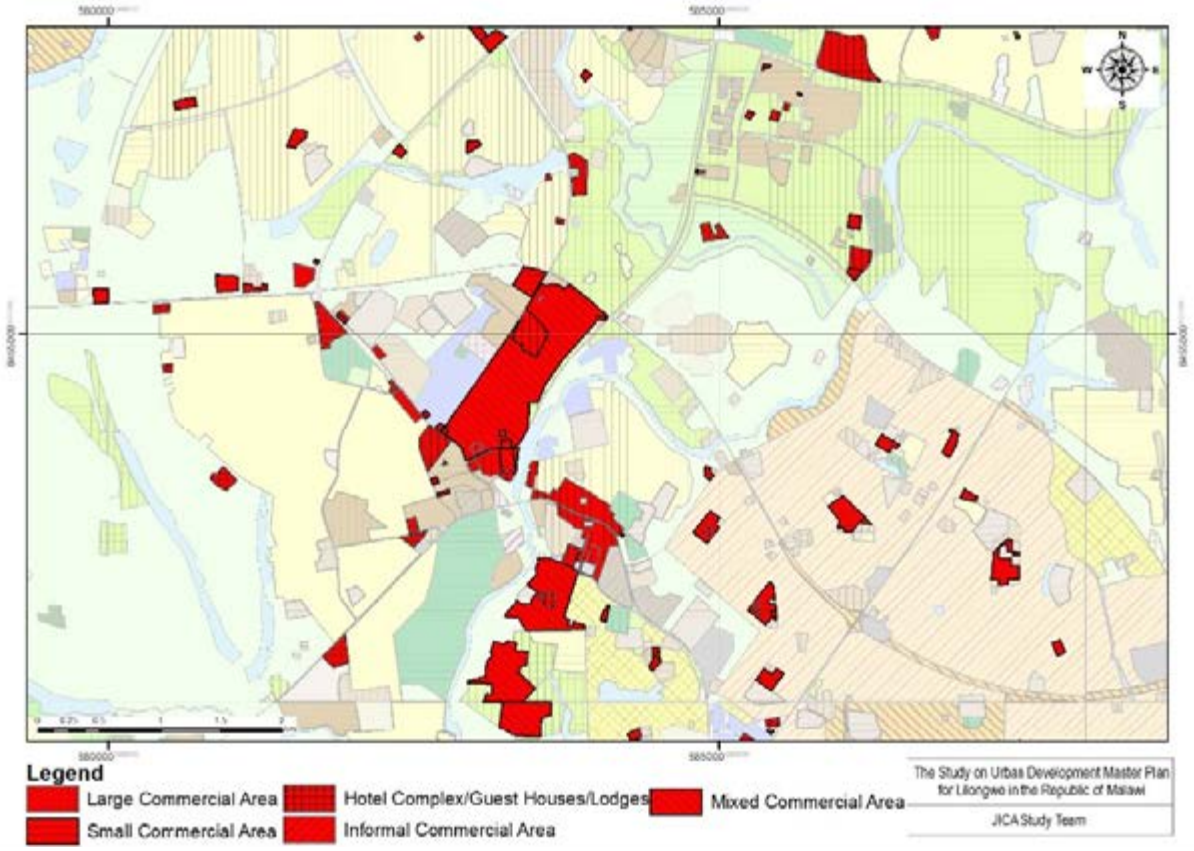
Residential sub categories	%
Unplanned settlements	39.7
High density traditional housing	18.9
Low density housing	14.4
Indigenous village	11.8
Medium density housing	9.1
High density permanent housing	3.7
Institutional housing	2.5

A.2.2.2 **Commercial**

Past urban plans for the city, including the Outlining Zoning Scheme, advocated the concept of the multi-centre structure comprising of four sectors namely; Old Town, Capital Hill, Kanengo and Lumbadzi. Each sector was supposed to function independently with a view to avoid on-pole concentration and promote an even growth structure. However, the concept has not materialised, instead the city has grown and continues to grow as one organic entity.

Several shopping malls have recently been developed and located independently in the residential areas or around the traffic centres. There are also a lot of support function offices and shops that are located adjacent to the city centre zone. The location of these commercial land uses in shown in Figure A.8.

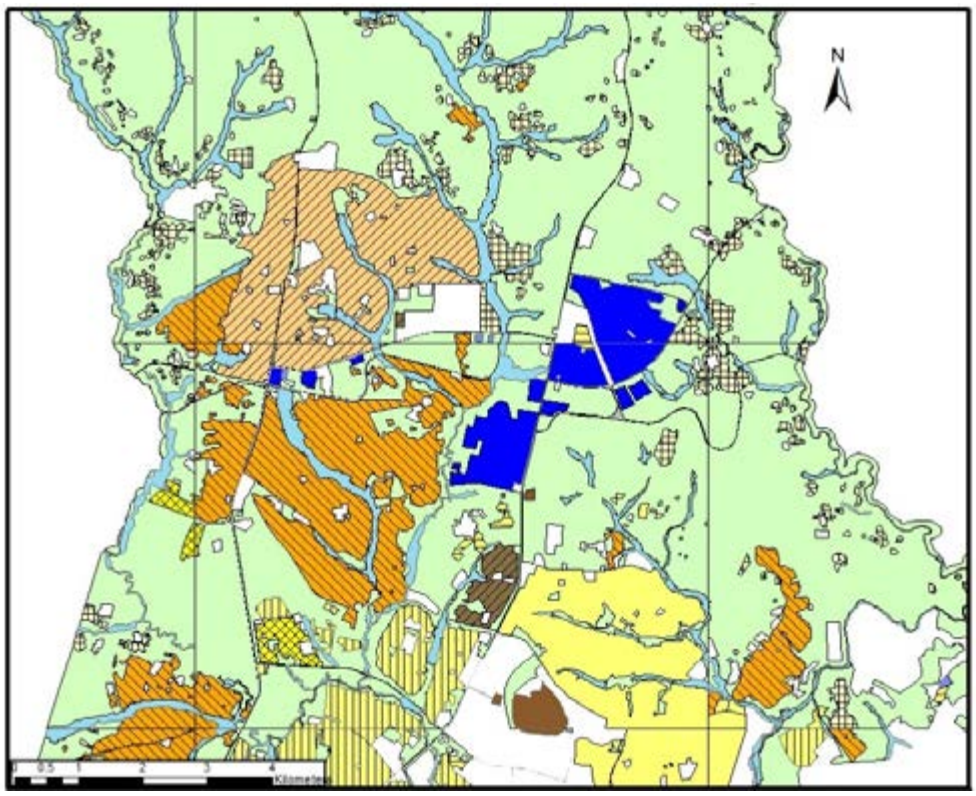
Figure A.8 Location of commercial land use in the central part of Lilongwe City



Source: Urban Development Master Plan for Lilongwe

Kanengo Industrial Zone has been appointed as a major industrial location in the city under the Outlining Zoning Scheme, as shown in Figure A.9. It has accommodated big capital-intensive industries such as tobacco processing and is expected to continue to accommodate new industrial factories.

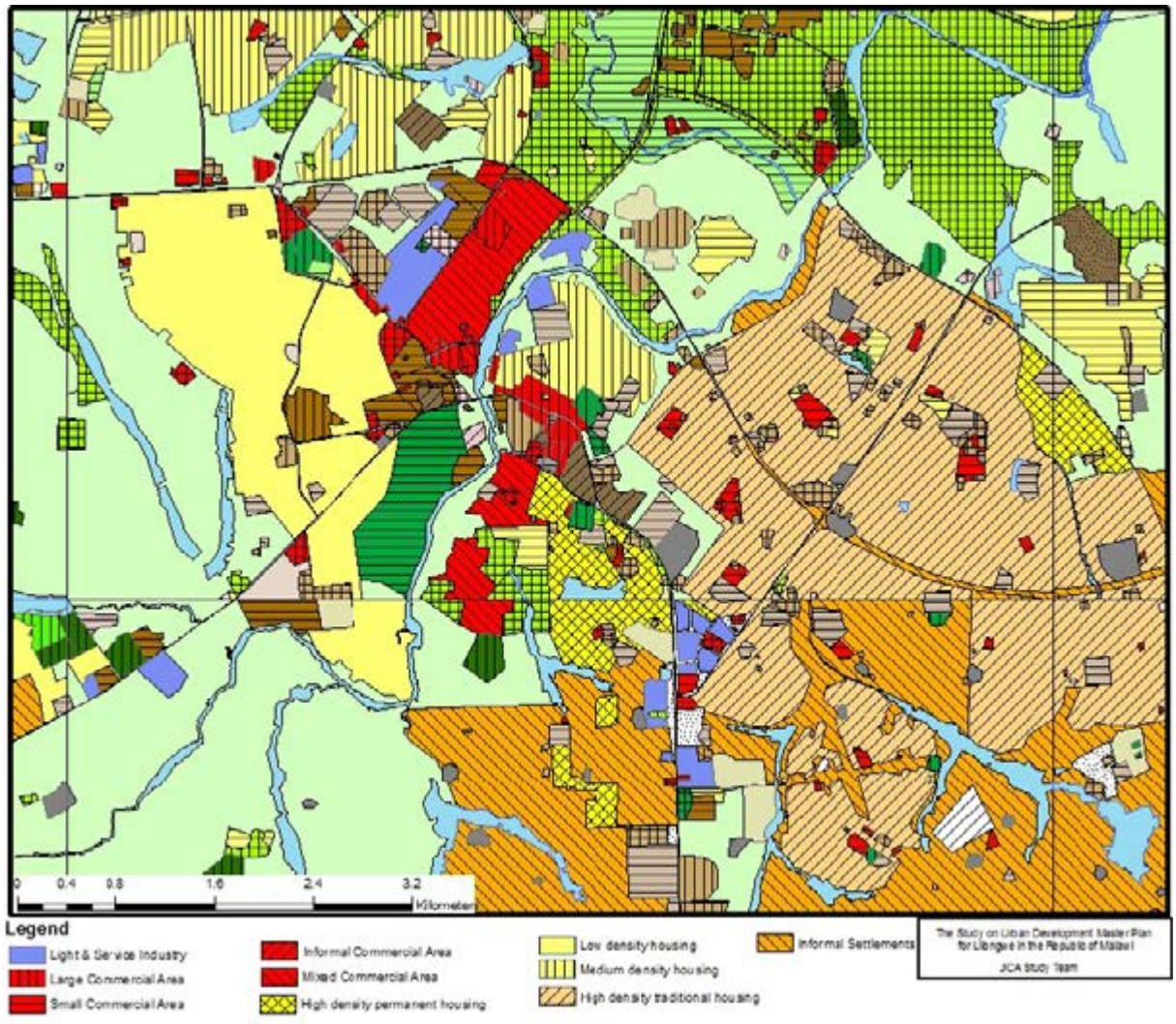
Figure A.9 Kanengo Industrial Zone current land use



Source: Urban Development Master Plan for Lilongwe

Another industrial zone is Old Town which has a lot of small light industrial workshops. The typical industries in the location are wood processing and furniture manufacturing, food processing, and durable goods manufacturing and related warehouses. The industrial land use in Old Town is shown in Figure A.10.

Figure A.10 Old Town industrial land use



Source: Urban Development Master Plan for Lilongwe

The city currently covers Areas 1 to 57, in addition Area 58 is scheduled to come under jurisdiction. The housing development and urban sprawl are very active in the city and particularly in the southern region. The urban expansion axis is now extending mainly to the southeast and to the west to a limited degree. For this reason, the urban structure plan for the city proposed a slightly expanded area, which includes Areas 59, 60, 61 and 62 as shown in Figure 4.1. It is up to the LCC to start taking the necessary steps to extend the city boundaries.

A.2.3 **Future land use plan**

The jurisdiction area of the city is to be enlarged in response to the progress of urbanisation. Almost half of the planning area will be used for urban land use purposes (residential, commercial, industrial and government), while the remaining land shall be preserved as greenery or open space. The aim is to improve the efficiency of the land by introducing high-density commercial and business land use in the central area. Residential areas are expected to absorb the increasing population not only in the central area, but also in the adjacent vicinities. The reserved and agricultural areas are planned to be utilised as buffer areas, to achieve a balance between environmental preservation and economic social development (Table A.7).

Table A.7 Lilongwe population by land use category

Road class	Bitumen	Gravel	Earth	Total
Low density residential (LDR)	2,670	80,090	30	30
Middle density residential (MDR)	1,987	99,335	50	50
High density residential (HDR)	6,795	591,230	87	80-90
Quasi-residential	6,171	600,047	97	90-100
High-rise flat area	1,155	80,876	70	70
Commercial	1,611	48,308	30	30
High-rise commercial	219	6,580	30	30
Heavy / large scale industry	1,280	2,819	2	2
Light industry	616	12,311	20	20
Government	1,836	18,394	10	10
Airport	358	0	0	0
Nature sanctuary	137	0	0	0
Park and recreation	1,149	0	0	0
Greenery/natural open space	6,840	0	0	0
Agriculture	4,309	11,583	3	3
Forestry	9,564	28,427	3	3
Cemetery	701	0	0	0
Total	**47,400**	**1,580,000**		

Source: The Study on Urban Development Master Plan for Lilongwe, JICA, September 2010

There are some changes from the land use categories contained in the original Lilongwe Outline Zoning Scheme developed in 1986. The new zoning scheme as proposed in the 2030 land use plan is based on urban spatial development and the principles of spatial distribution of the population in 2030 (Figure 4.2).

A.2.4 **Population**

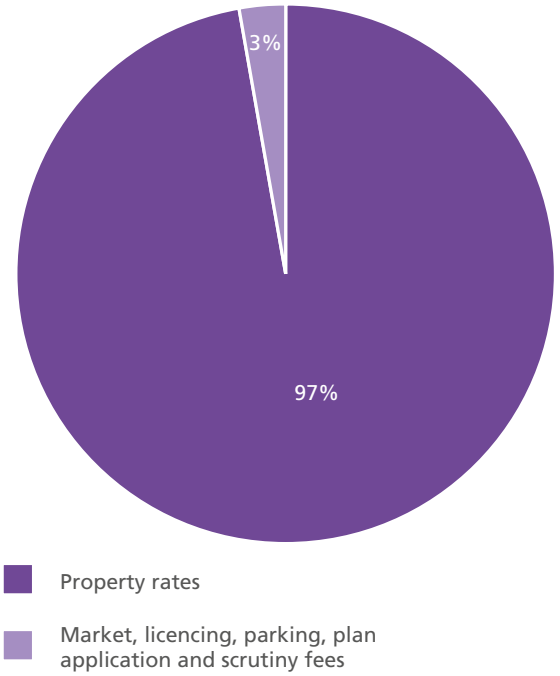
The city has witnessed rapid population growth since 1975 and about 76% of the population lives in informal settlements that take up about 12.2% of the total city land area. The population growth figures and projections are shown below (Figure 4.3).

The growing population of the city will increase demand on urban utilities including water supply, sanitation and solid waste management.

A.2.5 **Economy**

Since its inception, the city has mainly functioned as an administrative centre until 2005, when many head offices of institutions located in Blantyre moved to the city. The city's main revenue sources are shown in Figure A.11.

Figure A.11 Lilongwe City revenue sources



It is estimated that the city spends 18% of its revenue on personal emoluments while the remainder is allocated to the development of the city.

A.2.6 **Employment**

The movement of head offices of institutions from 2005 attracted more economic activities to the city which resulted in increased employment opportunities and population growth. Employment in the city comprises of the formal and the informal sectors. The formal employment sector is classified into the following:

- Manufacturing;
- Commercial;
- Government; and
- Agriculture.

Table A.8 below sets out estimated and forecast employment in the formal and informal sectors in the city.

It is estimated that 27% of the population is employed in the informal sector. However, the informal sector lacks adequate regulations and operates with minimal support from LCC. Lack of infrastructure such as markets and good roads and lack of access to credit to expand and improve businesses are major obstacles that hamper economic growth in the city.

The rapid urbanisation and inadequate employment opportunities in the city have resulted in high poverty rates in the urban areas, which are estimated to stand at 25% of the city's population, with 9% being considered ultra-poor. The poverty situation is exacerbated by a steady growth in the prices of basic goods and lack of access to basic urban services.

Table A.8 Estimated and forecast employment in Lilongwe City

		Year			
		2008	**2015**	**2020**	**2030**
Formal employment	Agriculture, mining	3,200	5,800	8,100	15,100
	Manufacturing	18,300	33,000	45,000	86,100
	Commercial	38,500	74,000	98,100	171,700
	Government	40,000	45,000	50,000	60,000
	Sub-total	100,000	157,800	202,000	332,900
Informal employment		110,000	161,100	212,000	307,000
Total		**210,000**	**318,900**	**414,200**	**639,900**

Source: The Study on Urban Development Master Plan for Lilongwe, JICA, September 2010

A.3 **Mzuzu**

A.3.1 **Land**

Lilongwe City, named after the Lilongwe River which runs through the city, became the official capital of the Malawi in 1975. The city's central position in the country played an instrumental role in it being designated Malawi's capital city.

The Mzuzu City Council (MCC) currently owns and manages 50% of all commercial land and 40% of all industrial estates in Mzuzu as well as the Traditional Housing Areas (THAs). MCC is confronted with the challenge of inadequate capacity to control development in the city, the absence of an updated land use map, lack of an up-to-date urban structure plan, and multiple layers in land administration such as:

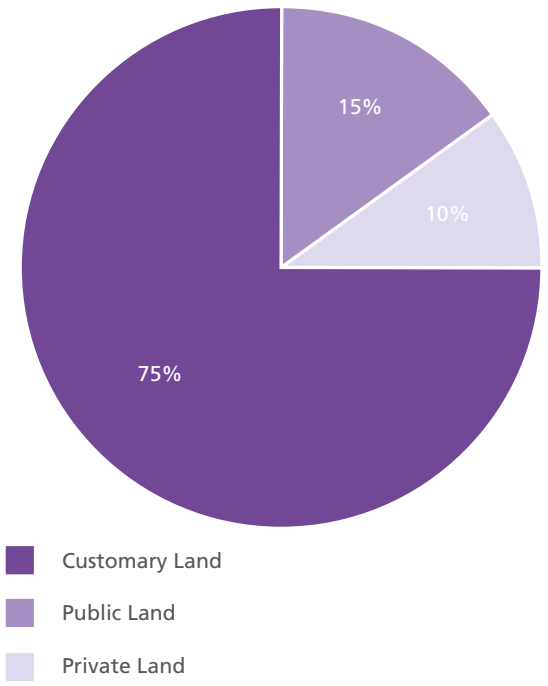
- MoLHUD;
- Malawi Housing Corporation (MHC);
- MCC; and
- Traditional Leaders.

In addition to the above, there is the Plot Allocation Committee (PAC) which carries out land allocation while the Town Planning Committee (TPC) manages physical development in the city. MCC is responsible for urban planning and development control functions in the city. The major land owners in the city are the above and:

- Agricultural Development and Marketing Corporation (ADMARC); and
- The Catholic Church.

Formal local council and government committees administer land and control developments, but they often have conflict with the local leaders who sometimes stop construction of approved developments and demand compensation for the land. Land ownership is shown in Figure A.12.

Figure A.12 Mzuzu City land ownership



The last urban structure plan covering a ten-year period expired in 2006 and there is an urgent need for a new one. The city has had no comprehensive urban management and local economic development plan. However, it should be noted that the city boundaries were extended from 48km^2 to 143km^2 and gazetted in 2010. The 1996 Urban Structure Plan designated land use zones comprising of:

- High density permanent areas – 120 hectares;
- Traditional housing areas – 791 hectares;
- Medium density housing areas – 51 hectares;
- Low density housing areas – 75 hectares; and
- Commercial areas – 180 hectares.

A.3.2 **Population**

There are 15 wards now, after re-demarcation of ward boundaries in the city, and about 75% of these have developed as unplanned settlements and have been upgraded by providing piped water, roads, market centres and plot demarcation. It is estimated that over 60% of the population live in unplanned settlements.

Table A.9 Population distribution in Mzuzu's 15 Wards

Ward	Population
Chibanja	10,384
Chibavi East	7,729
Chibavi West	8,076
Chiputula	6,825
Kaning'ina Msongwe	11,406
Katawa	6,944
Lupaso Nkhorongo	9,716
Luwinga	10,985
Masasa East	10,760
Masasa West	7,640
Mchengautuwa East	10,646
Mchengautuwa West	7,338
Mzilawaingwe	8,196
Zolozolo East	7,438
Zolozolo West	9,975

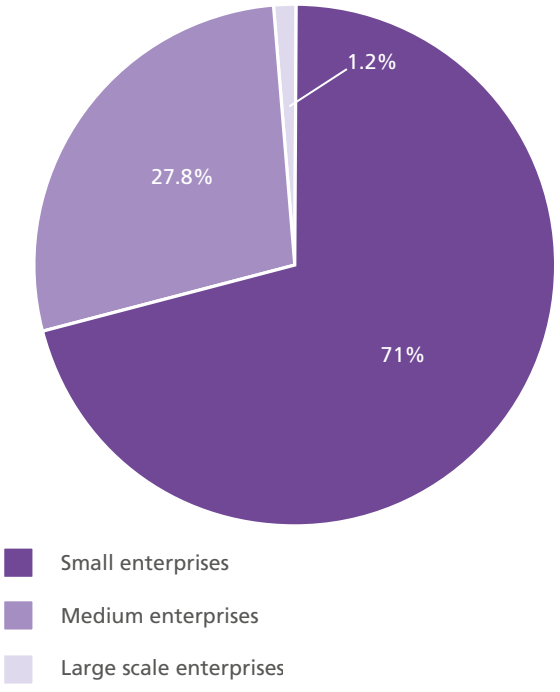
A.3.3 **Economy**

The City's economy is transforming rapidly from the mainly agricultural, administrative, service and distribution functions to manufacturing and production, high level services and commercial activities. Some of the economic activities taking place in the city include:

- Agriculture;
- Tobacco grading and sales;
- Transport services;
- Hospital services;
- Mining; and
- Food processing.

The Central Business District (CBD) is the hub of the most of the banking, retailing and distribution companies. The proportion of city economic activities by scale is shown in Figure A.13.

Figure A.13 Mzuzu city economic activities



In 2015, it was reported that the city had 4,500 registered vendors operating in the different markets, however those vendors operating outside the markets were not registered. Demand for improved business infrastructure and services is growing within neighbourhoods in the city.

A.3.4 **Employment**

The main employer in the city is the public sector, employing about 23% of the economically active population in the city. The private business institutions employ 19%, with private business individuals employing 16%. Self-employment stands at 20% while farming is at 22%. The agriculture and mining industries are the most vibrant, employing an estimated 27% of the population.

A.3.5 **Slums and shelter**

The rapid urbanisation in the city has led to the spread of unplanned settlements with a large percentage of poor quality housing, and with over 60% of the people living in these settlements. Housing tenure comprises 59% owner-occupied, 39% renting, 2.5% authorised dwellings and 0.8% employer provided housing, based on the National Statistical Office (NSO) Integrated Household Survey II 2004-2005. It is estimated that about 52% of the dwellings are permanent, with 20% being categorised as semi-permanent. Traditional or temporary dwellings are estimated to account for 18%.

The lack of services and poor sanitation has been attributed to the absence of an up-to-date urban structure plan to guide and allow for planned new site development, but also due to the lack of financial capacity for the MoLHUD and MCC to provide infrastructure in most residential areas, including the low-income areas. The Federation of the Rural and Urban Poor of Malawi (previously known as the Malawi Homeless People's Federation) is one of the institutions providing low cost housing to low income and poor groups, apart from the MCC. During 2006 to 2007, the federation built 83 houses in Mchengautua in Mzuzu.

A.3.6 **Water**

Northern Region Water Board (NRWB) supplies water in Mzuzu City and the whole northern region of Malawi. NRWB's water sources consist of surface and ground water. The cost of water is dependent on the distance from the nearest water mains and land use category. In planned and serviced areas, the cost of water is less than in the unplanned areas. The NRWB treatment plant has a maximum design capacity of 16,400m^3 per day, but the organisation supplies approximately 13,700m^3 of treated water to about 170,000 people daily (with the exclusion of Ekwendeni Township, which is 24km outside Mzuzu City). The total pipe network coverage is about 178km. There is a current project by the NRWB to construct a new treatment plant at Ekwendeni.

Current access to water by Mzuzu City residents by source is shown in Table A.10. It is expected that the water demand will be 70,855m^3 per day by 2020.

Table A.10 Access to water by Mzuzu City residents

Access	Percentage of population
Piped water into dwellings	18
Piped water on their yard or plot	43
Water kiosks	21
Unprotected sources (wells, springs, river, streams and dams)	16
Protected wells	2

NRWB completed Phase 1 of the Mzuzu Water Supply Project which includes the construction of the upgrading works of Mzuzu water supply system. The facilities that were upgraded included the water treatment plant, transmission pipelines, pump stations and storage tanks. The second phase of the project saw the installation of distribution pipelines from storage tanks to consumers. An additional 90km of pipeline was laid within the city, thereby enabling 3,000 families access to safe water.

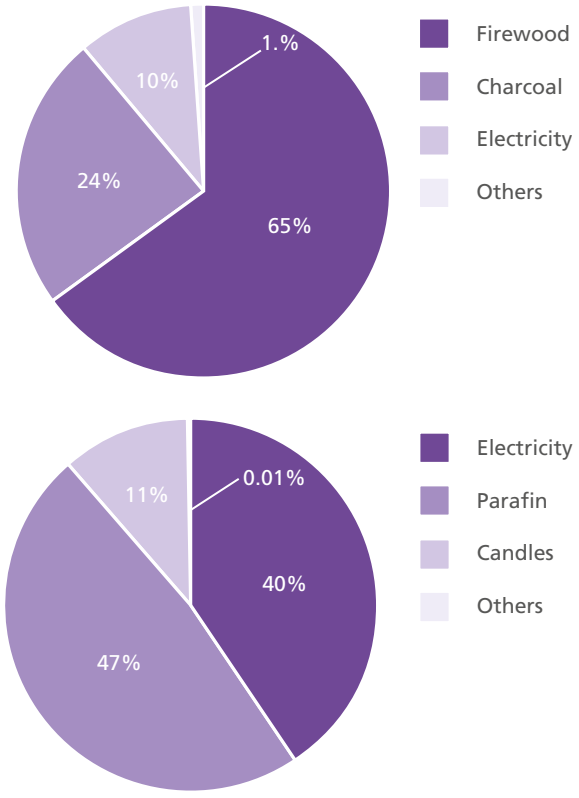
A.3.7 **Waste management**

MCC is responsible for the provision of sanitation services such as refuse removal and disposal services in the city. The planned and fully serviced areas are serviced at regular intervals while the unplanned areas manage waste themselves through rubbish pits, on road ways, river banks and in storm water drains. The city has no public sewage treatment facilities. Private waste treatment ponds exist at the army barracks, prison and Mzuzu Central Hospital, but these are not fully utilised and instead septic tanks are used. The majority of solid waste collected by MCC is dumped in the Mchengautuwa unplanned settlements.

A.3.8 **Energy**

As with the rest of the country, the major energy source for industries is electricity supplied by Electricity Supply Corporation of Malawi (ESCOM) in the city. The most common energy sources used by residents of the city are shown in Figure A.14. ESCOM supplies hydro power to the city from its hydro stations on the Shire River and small hydro station in the North.

Figure A.14 Common energy sources for Cooking and Lighting



A.3.9 **Health**

The city has one referral public hospital, one public health centre and several hospitals and clinics operated by religious and private individuals and institutions in the city. The current health facilities in the city are not evenly distributed and are inadequate for the current population, more specifically for those in the informal settlements. Malaria and upper respiratory infections are the most common diseases at 23.4% and 22.6% respectively. The Mzuzu Central Hospital provides 40% of the city's primary in-hospital health care services.

A.3.10 **Education**

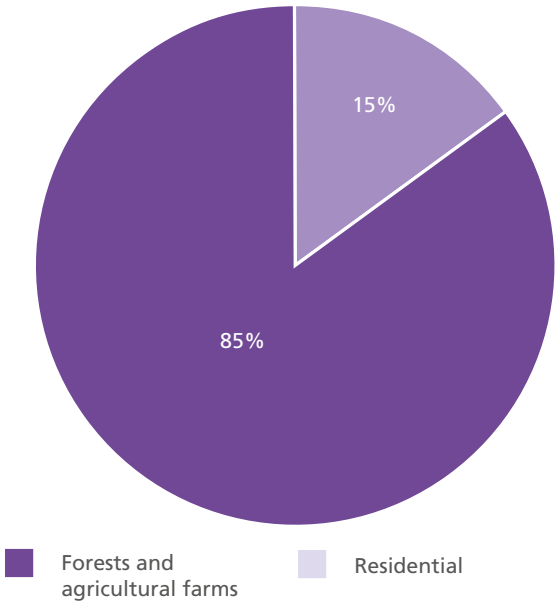
Education in the city is offered by both public and private institutions. There are 43 primary schools with a total of 375 classrooms. Apart from the several private tertiary and technical institutions, the city has one public university, Mzuzu University that was founded in 1999 and one technical college.

A.4 **Zomba**

A.4.1 **Land**

Zomba City covers an area of 39 km^2 and the Zomba City Council (ZCC) is responsible for all urban planning functions in the city. The major land owners include: MoLHUD; MHC; ZCC; and local chiefs. The city land use is shown in Figure A.15.

Figure A.15 Zomba City land use



In terms of land ownership, private land accounts for 56% of all land and public land accounts for 44%. However, a UN-HABITAT report in 2010 indicates that private land is only 0.5%, public land is 9% and 90.5% of the land is under customary practices.

Land is administered through the PAC and TPC. Challenges include the high number of illegal developments, lack of an up-to-date urban structure plan for the city and multiple layers in land administration. The distribution of Zomba's population by ward is shown in Table A.11.

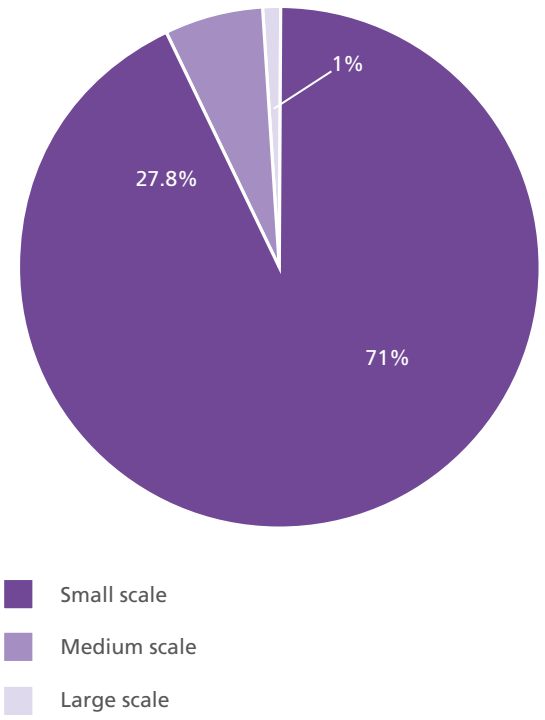
Table A.11 Population distribution in Zomba's 14 wards

Ward	Population
Chambo	6,072
Chikamveka	2,978
Chikamveka North	13,710
Chilunga	3,636
Chilunga East	6,960
Likangala Central	7,696
Likangala North	12,855
Likangala South	1,541
Masongola	872
Mbedza	4,207
Mtiya	9,688
Sadzi	9,103
Zakazaka	6,423
Zomba Central	2,573

A.4.2 **Economy**

Zomba's function is that of an administrative rather than commercial centre. It is a university town and centre of learning and public service delivery. This is reflected in the high share of employment in the government and related sectors. The ZCC is financed through local revenues, Government transfers and donor funding. Local revenue includes: property rates, market fees, rentals, planning fees, car parking fees, bus depot fees and other charges. The largest share of local revenue comes from property rates contributing about 80% of the total council revenue. The city also hosts tourists and related business as a result of the Zomba Mountain. There are numerous economic opportunities in the city especially in the agro-processing industry. The majority of economic activities in the city currently are small-scale activities as shown in Figure A.16.

Figure A.16 Economic activities in Zomba City



The most important and active economic activities include:

- Retail trade;
- Construction;
- Manufacturing;
- Transport;
- Marketing;
- Finance;
- Social services; and
- Public administration.

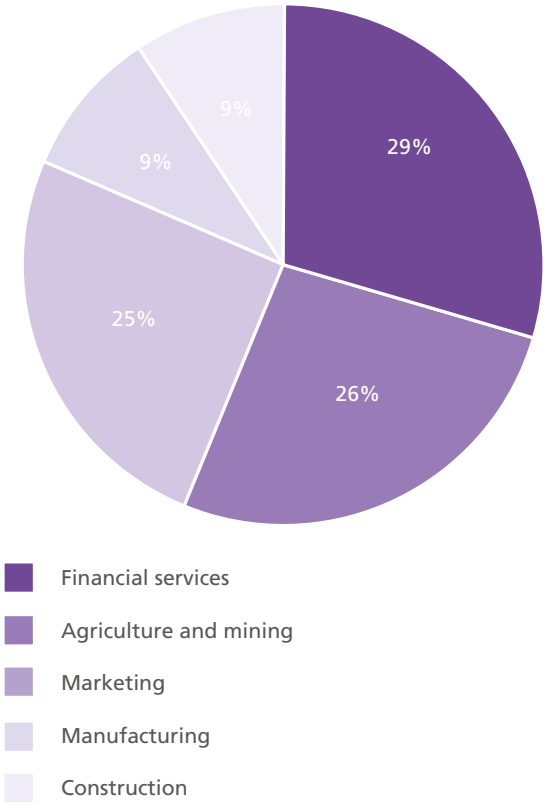
The Government of Malawi introduced the Local Development Fund (LDF) to support various economic development activities and several programmes to support access to micro finance by the poor. The following institutions are working with the ZCC and the Government of Malawi (GoM) to provide economic development opportunities in the city:

- Centre for Community Organisation and Development; and
- Micro-finance institutions such as the Malawi Rural Finance Company and the Malawi Rural Development Fund (MARDEF) offer basic training and provide loans for supporting small businesses.

A.4.3 **Employment**

Employment activities in the city are mainly in Public Administration, however other employers are from the agriculture, mining and quarrying, manufacturing, construction, marketing, finance and social services industries. Formal employment by sector is shown in Figure A.17.

Figure A.17 Formal employment by sector in Zomba City



A.4.4 **Slums and shelter**

The high-density areas are split into permanent and traditional housing areas and the informal settlements. The population in the informal settlements is rapidly growing due to the rapid increase in population and migration of people from the rural areas into the city in search of better economic opportunities. Housing in the informal settlements lacks the minimum requirements for low-income housing and has little or no access to the basic urban services or infrastructure.

Challenges facing the housing sector in the city include inadequate supply of serviced housing plots, the inadequate capacity of the ZCC to implement concrete slum upgrading programmes, and the involvement of chiefs in land administration in the city, which has led to increased incidences of illegal developments. There are several development organisations operating in Zomba that are involved in slum upgrading activities and these include:

- Centre for Community Organisation and Development (CCODE); and
- Habitat for Humanity Malawi (HfHM).

A.4.5 **Water**

Water is supplied by the Southern Region Water Board (SWRB), which supplies about 12,200m^3 of water per day through a gravity fed system from Mulunguzi Dam, which is located on the Zomba Plateau Forest Reserve. The current volume is adequate to supply a population of 145,000 people per day, which was the projected population expected in 2015. The majority of the city's residents who live in the informal settlements access their water through communal water points that are provided by SRWB.

A.4.6 **Waste management**

Waste management is a shared responsibility between the ZCC, MHC and the private sector. ZCC is responsible for maintaining the sewerage system, refuse collection and disposal, and maintaining good sanitation in the city. The formal, middle and high income areas receive regular waste management services. However, the informal settlements are neglected, with little or no access to waste management services. In the informal settlements, the majority of residents rely on communal rubbish pits for refuse disposal. Some refuse also ends up on roads, open spaces and in water bodies.

The gravity sewer system treatment plant serves about 20,000 people from the formal areas and the commercial and public institutions such as the army barracks, hospitals, Zomba Central prison and Chancellor College. Traditional pit latrines are the main means of disposal of human excreta in the informal settlements.

A.4.7 **Energy**

ESCOM supplies power to the city and approximately 63% of power is used in households, with industrial and commercial usage consuming 11.4% and 26.5% respectively. Aside from electricity, the most common sources of energy in the city are charcoal, firewood and petroleum fuels. At a very small scale, some households use solar power, gel oil, crop residues and gas for heating and lighting. The Government of Malawi has installed solar power in some newly constructed public facilities such as hospitals.

A.4.8 **Health**

The main provider of medical services in the city is the Zomba Central Hospital. The hospital functions as a tertiary referral centre, receiving patients from district hospitals in the Eastern Region of Malawi, health centres within Zomba and self-referrals. The hospital has a capacity of 500 beds.

Service roads provide some forms of parking facilities in Lilongw

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Malawi National Transport Master Plan

Appendix B Supplementary traffic signal design advice

Urban Transport Sub-Sectoral Plan

The following are options for traffic signal control:

1. **Vehicle actuated** – the timings of each phase/stage are varied between the pre-set minimum and maximum times, according to the demands indicated by the vehicle and pedestrian detection systems. It is possible to miss out or cut short certain phases/stages of the cycle if no demands are registered for these. Vehicle actuation offers significant benefits at stand-alone signal junctions. It adjusts the signal timings to suit the traffic flows at the time and if properly set up and maintained keeps overall vehicle delays to a minimum. All stand-alone signals should operate with vehicle actuation as their normal mode of operation.
2. **Fixed time** – the timings of each phase/stage and the overall cycle time are predetermined and activated by a time clock within the controller. A number of different time plans (for example am peak, pm peak, off-peak and overnight) can be programmed. No vehicle detection systems are required for this type of operation but demand dependant stages (for example pedestrian stages) can be incorporated into these. The main disadvantages of this method of operation are the longer delays to vehicles off-peak (most of the day) and that the plans can quickly become out of date as traffic flows change. Fixed time control should only be used where the signal installation is part of a network of linked signals or as a back-up when there is a fault with the vehicle actuation at stand-alone signals.
3. **Manual control** – The timings can be operated manually in special circumstances such as special events, usually by the Traffic Police. Traffic signals can also be controlled in a manner which co-ordinates their operation with adjacent signals.

The key components of a signalled junction are:

a. A controller – a microprocessor and other control equipment e.g. detector pack, power supply etc. normally contained within a 'large grey cabinet'. The equipment controls the operation of the signals. In particular, the phasing and staging of the junction and the time allocated to each are programmed and stored within the controller's memory;
b. Signal poles and heads – a number of primary, secondary and where necessary pedestrian and cycle signal heads, together with poles;
c. Detection equipment – vehicle, cycle and pedestrian detection equipment of various types (see section on detection systems);
d. Other street furniture such as traffic signs etc.; and
e. Road markings – including stop lines, lane markings and arrows.

At stand-alone sets of traffic signals the timings should be determined in a real-time method by detecting traffic approaching the junction (vehicle actuation). The minimum stage time is usually set at around 7 seconds (4 seconds for filter arrows) and is extended in units of around 1.5 seconds up to the pre-set maximum time. The maximum setting is pre-determined and programmed into the controller. When installing new traffic signals or updating timings, computer models can be used to assist in determining the most efficient settings. The timings can be fine-tuned after observing traffic conditions on site. Signal controllers can store a number of different maximum greens so that the timings can be set to suit traffic flows at different times of a day.

Intergreen times allow streams of traffic or pedestrians in a phase to clear the junction before a conflicting phase commences. The layout of the junction is examined to determine how long is required between each phase or stage change (the intergreen). The intergreen times can vary between 5 seconds for compact junctions and 10 seconds or more for junctions with a long distance between entries and exits. Particular care is needed when the pedestrian phase follows a traffic phase. In this case, the intergreen time should allow vehicles (including right-turning vehicles that will use the intergreen to complete their turn) to clear the crossing point before the pedestrian phase starts.

Detection systems are used to call or extend phases in the signal sequence. The main forms of detection in use are: inductive loop detectors are loops buried in slots cut into the road surface and connected to the controller. They work by detecting the passage or presence of vehicles over the loop.

Rear queue detection loops are positioned on important links to alert that the queue back from a junction has exceeded the desired maximum queue length.

Microwave vehicle detectors (MVDs) detect movement and are used in two main ways. The most common use is to detect traffic on the approaches (vehicle actuation). The other use of MVD's is at signalled pedestrian crossing points to detect pedestrians on the crossing. They are used to extend the crossing time for slow moving or large groups of pedestrians.

Infrared detectors (IRDs) detect presence rather than movement and are used in two main ways. The first is as kerb side detectors to detect the presence of pedestrians waiting to cross. The IRD is often used a supplement to a push button unit. If the pedestrian crosses before the pedestrian phase arrives then it will cancel the demand so that drivers are not delayed unnecessarily. The second use is as an additional detector at a stop line to ensure that slow moving vehicles such as cycles are detected and the required phase is called.

Push buttons are used to call pedestrian phases and can incorporate tactile indicators for blind or partially sighted people. Audible bleepers should be used where possible but only when there is a full pedestrian stage and all traffic is stopped. This avoids confusion for blind or partially sighted pedestrians who might hear a bleeper relating to a partial pedestrian stage elsewhere in the junction and step out into traffic.

Push button units should be located close to the point where pedestrians will cross (ideally 0.5m from the kerb and 0.5m from the edge of the crossing guidance lines). Push button units should be mounted at a height of 1m to the bottom of the push button unit. Two types of push-button unit are now commonly used: The first is a unit where the entire electronic front panel area acts as a push-button. A direction indicator on top of the unit should point in the direction of travel for the pedestrian. A vibrator is located under the direction indicator and allows blind or partially sighted pedestrians to know when to cross. The second type has a large push-button, a small flashing light and audible indicator. The audible indicator "ticks" slowly whilst a red pedestrian aspect shows. It then ticks more quickly and vibrates when a green pedestrian aspect shows.

Lanes on the approaches to traffic signals in an urban area should generally be 3m wide. This can be reduced to 2.4m in special circumstances. At simple junctions, local widening of the road can help to provide a length of right turning lane. The length should be equivalent to the expected peak hour queue lengths (this depends on signal timings) to avoid blocking of other movements. If this cannot be achieved a shorter length or narrower width may still be beneficial.

If speeds cannot be reduced through the use of narrow lanes and other measures, then high-friction surfaces should be considered for the approaches to traffic signal junctions. This minimises the risk of accidents involving skidding on a wet road surface. Accident studies in the UK have shown that the use of high-friction surfacing at traffic signals can reduce accidents by up to 68%. Where used, high-friction surfaces should be provided for a distance of at least 50m (on 50kph roads) back from the crossing walkway edge line (beyond the stop line). On faster roads, greater lengths of high-friction surfaces should be provided. Visibility of vehicles approaching the signals requires good visibility of the signal heads. The minimum visibility distance required in urban areas is 40m.

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