The Republic of Zambia
Ministry of Transport and Communications

National Transport Master Plan – 2037

Past and futuristic transport photos

To develop transport infrastructure and facilities in a coherent and coordinated manner enabling intermodalism for freight and passenger transport.

Foreword

Hon. Brian Mushimba, MP

Over the past decade the transport industry has witnessed a steady growth in both services and infrastructure. This has been due to increased regional trade, expansion of national economic activities and Zambia`s central geographical location. The Transport Sector has particularly played a critical role in facilitating the development process in all economic and social sectors. Since independence transport infrastructure provision has been steered mainly by the public sector and its development partners, while transport services have been largely provided by the private sector since 1991.

The NTMP 2037 aspires to bring a long-term, vitalizing and sustainable transport sector framework. It thus will shift the ideal transport planning approach of demand response by facilitating provisions of transport infrastructure in perceived needful economic areas and further facilitation transport services through the creation of Special Purpose Vehicles in needful services beyond the capabilities of the private sector.

This Master plan will be implemented over a horizon of 20 years from 2018 through 2037. In this regard, this document will trigger institutional and legal reforms to enable implementation of this plan. As the primarily Ministry responsible for transport, we shall, in collaboration with line Ministries, coordinate and support the implementation of the NTMP 2037 to enhance multi-sectoral national economic growth and improved livelihoods of our Zambian population by improving accessibility to markets for goods and services whilst reducing the trading costs. Incidents and accidents and fatalities from transport sector operations shall be significantly reduced by imposition of occupational health and safety standards for all modes of transport to be complemented by intelligent ICT solutions and other instruments.
This National Transport Policy shall be implemented with a dynamic approach to domestic, regional and international supply and demand factors so as to retain it

I would also like to thank the cooperating partners for the support rendered in developing the NTMP. I, therefore, encourage you all to utilize NTMP 2037 as modal in you planning and implementation activities.

……..

Honourable Brian Mushimba M.P.
MINISTER OF TRANSPORT AND COMMUNICATIONS

Preface

Eng. Misheck Lungu
Permanent Secretary

Earlier on the government of the republic of Zambia and transport sector cooperating partners realized the importance of Zambia to have a long term strategic document in transport planning. To this effect, the National Transport Master Plan (NTMP) has been developed to guide investment in the sector over a horizon of 20 years.

Consequently, the NTMP has been aligned to National Development Plans (NDP), Government's Medium Term Expenditure Framework (MTEF) and as well as the SADC Regional Infrastructure Master Plan.

In the formulation of the NTMP 2037 new emerging themes in the transport industry have been included to ensure that Zambia keeps pace with the changes and innovation taking place in the global transport industry. Some of the emerging concepts includes, but not limited to the following:

- National mobility;
- Regional connectivity;
- Road safety;
- Intermodalism;
- Inland Container Deports (ICD)

It is important to note that the NTMP 2037 is focused on national and regional mobility and accessibility. As such, specific urban and rural transport master plans will be developed to augment this plan.

The transport industry is a dynamic and vibrant industry. In this regard, the NTMP 2037 will be subject to periodical reviews and interventions to suite world best practices.

Eng. Misheck Lungu
PERMANENT SECRETARY
MINISTRY OF TRANSPORT AND COMMUNICATIONS

Acknowledgment

Nicholas Chikwenya
Director Transport

On behalf of the Government of the Republic of Zambia, the Ministry of Transport and Communications commits to providing efficient, safe and effective integrated transport infrastructure and services through collaborative implementation of the revised National Transport Policy of 2017.

The formulation of this Plan was undertaken through an elaborate consultative process facilitated by the Ministry of Transport and Communications.

In view of the above, we wish to acknowledge the guidance and support provided by officials from Cabinet Office, Ministry of Works and Supply (MWS), Ministry of Local Government (MLG), Ministry of Agriculture (MA), Ministry of Commerce and Trade (MCT) and other line ministries, transport authorities and agencies, Zambia Institute for Policy Analysis and Research (ZIPAR). We further wish to acknowledge, the private sector players who were consulted and more particularly, the members of the Technical Reference Group who dedicated their professional competencies and expertise to ensure and assure the realization of the NTMP 2037.

Nicholas Chikwenya
Director Transport
MINISTRY OF TRANSPORT AND COMMUNICATIONS

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List of Abbreviations and Acronyms

AfDB	African Development Bank
ADT	Average Daily Traffic
ATM	Air Traffic Management
CBA	Cost Benefit Analysis
REF	Project inventory entries which are ongoing or approved for implementation called Reference Projects
CSO	Central Statistical Office
EIA	Environmental Impact Assessment
ECM	Estimated. Cost in Millions of United States Dollars USD ($)
ECD	Estimated. Completion Date
EU	European Union
GIS	Geographic Information System
GPS	Global Positioning System
GRZ	Government of Zambia
IRR	Internal Rate of Return
ITS	Information and Telecommunication Systems
LRA	Local Roads Authority
LOS	Level of Service
MCA	Multi Criteria Analysis
MHA	Ministry of Home Affairs
MND	Mandatory Projects. Project inventory entries which are not yet approved but essential for the development of the sub sector and should be included in the master plan called Mandatory Projects
MoC	Ministry of Commerce
MoF	Ministry of Finance
MLG	Ministry of Local Government and Housing
MTC	Ministry of Transport and Communications
NCC	National Council for Construction
NMT	Non-Motorized Transport modes
NRFA	National Road Fund Agency
NTMP	National Transport Master Plan
O-D	Origin – Destination
PT	Public Transport
PPP	Public Private Partnerships
RDA	Road Development Agency
REF	Reference Projects
ROM	ROM Transportation Engineering Ltd.
R-SNDP	Revised- Sixth National Development Plan
RTSA	Road Transport and Safety Agency
SIA	Social Impact Analysis
TAZ	Trucker Association of Zambia
TAZARA	Tanzania Zambia Railways Authority
TDM	Travel Demand Model
ToR	Terms of Reference

UNQ	Unique Projects. Project inventory entries of potential future interventions which would benefit the transport sector greatly should budget and feasibility be available
USD	United States Dollars
UNZA	University of Zambia
VHT	Vehicle Hours Time – Sum of in vehicle time
VKMT	Vehicle Kilometers – Sum of all vehicle kilometers driven
ZACL	Zambia Airports Corporation Limited
ZASTI	Zambia Air Services Training Institute
ZCAA	Zambia Civil Aviation Authority
ZP	Zambia Police
ZRL	Zambia Railways Limited

List of Working Definitions

TERM	DESCRIPTION
Base Scenario	Scenario which includes all reference and mandatory projects for development. This scenario is common to all development scenarios
Deep screening	In railway construction and maintenance, deep screening of the ballast is done to ensure that a clean ballast cushion of the required depth is available below the lower half of the sleepers, which is necessary for providing the proper drainage and elasticity to the track.
Demographic Scenarios	Scenarios which simulate changes in factors which affect travel behavior such as population, employment and car ownership
Fast Passenger Rail	A mode of passenger rail which runs at high speeds (between 80-120 km/h) and provides a high level of service
Freight Trip Factors	Scenarios which simulate changes in factors which affect freight travel demand such as economic growth and changes in imports and exports
Full Fast Passenger Rail	A complete and comprehensive network of fast passenger rail services
Full Intermodal Cargo Rail	A complete and comprehensive network of high LOS Trunk/Main Roads
Greenfield Project	A new project built on undeveloped land
Infrastructure Maintenance	Periodical activities which repair and upkeep infrastructures in order to ensure their long term viability and ability to provide service
Infrastructure Rehabilitation	Projects which renew existing infrastructures from a dilapidated or under serving state to one which provides a cost effective, high level of service
IRR	Internal rate of return (IRR) is the interest rate at which the net present value of all the cash flows (both positive and negative) from a project or investment equal zero. Internal rate of return is used to evaluate the attractiveness of a project or investment. If the IRR of a new project exceeds a company's required rate of return, that project is desirable. If IRR falls below the required rate of return, the project should be rejected.
Multi Criteria Analysis	A decision making method that aims to compare different actions or solutions according to multiple criteria and policies.
Partial Fast Passenger Rail	Scenario of the highest performing investments from the full network
Partial Intermodal Cargo Rail	Scenario of the highest performing investments from the full network
Public Transport Scenario Code	A label given to scenarios for organization within the TDM and other databases
Transport Scenarios	Possible directions of development, in this case of transportation infrastructure and transportation policy. Scenarios group together various elements of development into a single package. There are many types of scenarios in transport planning, the main two are: Demand Scenarios: scenarios which test changes in demand for transport, for example the impact of population growth Supply Scenarios: scenarios which test changes in the supply of transport, such as the building of a new railway or road
Trip Distribution Factors	Factors which impact the distribution of passenger trips, mainly their distance

Executive Summary

The long term purpose of the National Transport Master Plan (NTMP) is to provide the Government of the Republic of Zambia through the Ministry of Transport and Communications (MTC) with an action plan for investments in transport infrastructure and services. A master plan for long term investments and reforms starts from the current situation and progresses toward the desired situation in 20 years.

Reports included in this project:

1. Inception report;
2. Field Survey;
3. Data Compilation and Statistical Analysis;
4. Development of Travel Demand Models;
5. Scenario Definition and Assessment; and
6. Final Report

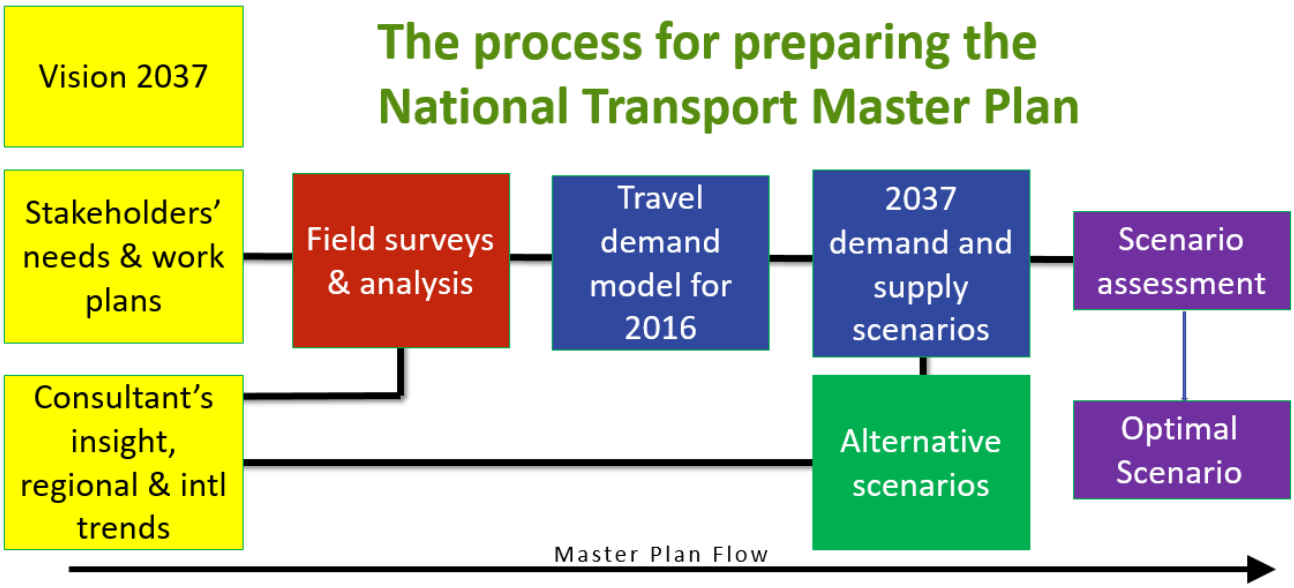


Figure 0.1 The master plan process

The master plan project represents a comprehensive evaluation of Zambia's transportation system. Beginning with transport surveys and supply and demand analysis, collection and analysis of existing sectoral and transport sub sector plans, and the establishment of a comprehensive project inventory. As a result of these activities it became clear that the de facto private vehicle oriented transport system which had guided development up to this point needed augmentation. The data gathered for the surveys and analysis was used to develop transport demand models, both for passenger and freight transportation. During this period, meetings with stakeholders and workshops were undertaken to compile a project inventory for each transport sector. The project inventory is a list of all the projects that are applicable to the master plan and are categorized as follows:

1. Reference Projects – Those projects which are committed or in progress per transportation sector;
2. Mandatory Projects – Projects which are essential to the future of the transportation sector; and
3. Unique Projects – Large scale investments which were evaluated in the TDM

Projects were packaged into various development scenarios with the objective to finding mix of projects and policy changes that provide the maximum positive impact for Zambia's transport system. Scenarios were evaluated using two methods. First the output of the TDM focused on transportation indicator changes resulting from changes in Zambia's transportation system. Important indicators include mode choice, vehicle travel time and kilometers traveled. Freight modeling showed the movement of tons of freight, and provided similar outputs to the passenger model. These quantitative measures were used to assess performance of transport projects for the horizon year 2037.

The TDM showed clearly that the mixed scenario, a unique scenario which took the highest performing infrastructure and policy projects from all possible projects, provided the maximum benefit for the transport system in terms of passengers. In terms of freight travel, it was found that only a limited intervention, in the form of intermodal rail operations and a single Greenfield project (Kafue to the Lion's Den via Chirundu border crossing), provided a worthwhile investment outside of the reference and mandatory projects.

Table 0-1: Summary scenario evaluation table, select transport indicators

Scenario	Car Trips	PT Trips	Car Mode Share	PT Mode Share	VHT	VKMT	Bus Passengers	Fast Train Passengers
2016 Base	68,088	42,792	36.0%	22.6%	222,859	13,094,871	42,792	-
2037 Base	250,273	78,530	45.5%	14.3%	909,733	55,208,413	78,530	-
2037a – Full Fast Train	226,831	123,685	41.3%	22.5%	859,309	51,930,991	66,895	67,565
2037b – Central Fast Train	236,927	104,119	43.1%	18.9%	879,417	53,067,722	71,361	36,172
2037c – Full Road Program	253,720	71,616	46.1%	13.0%	870,271	56,147,973	71,616	-
2037d – T2 Road Upgrade	252,341	77,220	45.9%	14.0%	909,771	55,899,177	77,220	-
2037e – PT improvement	241,606	95,316	43.9%	17.3%	889,710	54,517,846	95,316.86	-
2037f – Road Tolling Program	237,896	101,766	43.3%	18.5%	765,402	53,119,314	101,766.74	-
2037g – Mixed Passenger	196,106	189,749	35.7%	34.5%	847,734	43,783,907	158,863	36,172

While transport demand models are powerful tools, they rely solely on quantitative figures. In order to better asses these scenarios, a multi criteria analysis was undertaken. This analysis allows for the evaluation of scenarios based on both qualitative and quantitative factors and in the end provides a single score for each scenario. Factors included cost benefit ratios, level of support for impoverished populations, support for trade and economy, reduction in road accidents and finally reductions in pollutions.

The MCA supported the findings of the TDM in that the mixed passenger scenario is indeed the best option for the optimal scenario, it achieves a significantly higher scores than the single unique scenarios.

Table 0-2 Summary MCA table with weighted final scores

SCENARIO	WEIGHT	2037	2037b	2037d	2037e	2037f	2037g
Simplified Cost-Benefit Analysis	20%	5	7	7	12	13	20
Reduction of Accidents	15%	13	13	13	13	13	15
Level of Support to Impoverished Populations	30%	7	13	17	23	20	30
Level of Support to Trade and Commerce	25%	5	13	10	13	5	25
Environmental Impacts	10%	9	9	9	9	9	10
TOTAL	100%	38.1	54.3	55.6	70.2	60.0	100.0

The optimal scenario is the output of the scenario building process, it contains broad interventions in every transport sector with a focus on:

1. An acceptable cost – benefit ratio;
2. Reduction of road accidents;
3. Supporting underserved populations;
4. Supporting trade and commerce;
5. Decreasing transportations impact on the environment

The optimal scenario will help Zambia achieve these important goals by packaging together a number of essential projects and prioritizing their implementation. This report will focus on providing a detailed description of this scenario.

It is time for Zambia to step away from over dependency on road transport and develop a sustainable, integrated, and appropriate transport system that promotes the growth of socio-economic sectors of the country.

The main objective of this project is as follows:

To develop the country's national transport infrastructure master plan aligned to addressing the country's transport requirements in the short term, medium term and long term periods beyond 2030.

This master plan will achieve this objective by providing a futuristic comprehensive development framework up to the year 2037. This master plan provides short, medium and long term projects chosen to continuously improve Zambia's transportation system in an integrated manner. Further, the projects prioritized by this master plan will build a foundation of best practice and sustainable transport alternatives upon which Zambia will continue to build a better and more holistic transportation system. Finally, this master plan, in the form of the optimal scenario is based on the current and future needs of all Zambian's. The optimal scenario's broad approach to transport looks to improve the level of service of all sectors, across the whole of the country.

Chapter 1: Introduction

The purpose of the Zambia National Transport master plan is to provide the Government of Zambia with an action plan for investments in transport infrastructure and services as well as institutional reforms. A master plan for long term investments and reforms starts from the current situation and progress toward the desired situation in 20 years.

It is time for Zambia to step away from over dependency on road transport and develop a sustainable, integrated, and appropriate transport system that promotes the growth of socio-economic sectors of the country.

The main objective of the National Transportation Master Plan (NTMP) as defined by the original terms of reference is as follows:

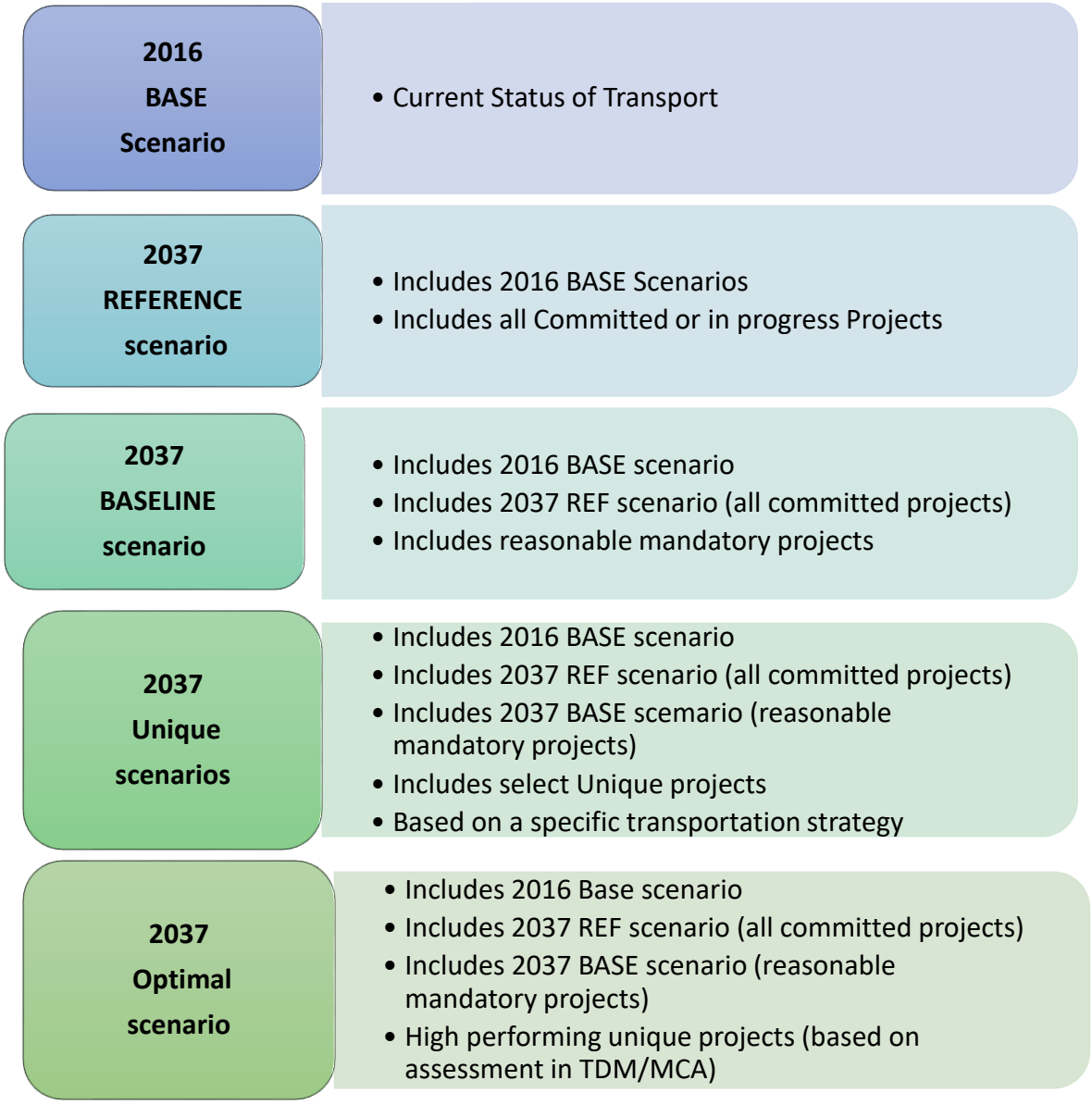
To develop the country's national transport infrastructure master plan aligned to addressing the country's transport requirements in the short term, medium term and long term periods beyond 2030.

This master plan provides short, medium and long term projects chosen to continuously improve Zambia's transportation system in an integrated manner. Further, the projects prioritized by this master plan will build a foundation of best practice and sustainable transport alternatives upon which Zambia can continue to build a better and more holistic transportation system. Finally, this master plan, in the form of the optimal scenario is based on the current and future needs of all Zambian's. The optimal scenario's broad approach to transport looks to improve the level of service of all sectors, across the whole of the country.

This final report represents a culmination of the work done up to this point on the master plan. While this report will focus on providing a detailed description of the optimal scenario defined for this project, it is built on the foundation of the reports previously submitted and the utilization of the transport demand models developed for this project. The process of scenario building was defined in the previous report however it will be reviewed here in brief. These reports and the current status of transportation in Zambia will be briefly reviewed in this report.

The scenario methodology packages a diverse variety of policy and infrastructure projects together in order to achieve the maximum benefit. The advantage of packaging diverse projects together is that the strategy of the master plan is robust and provides mobility alternatives no matter what the future holds. The master plan contains three types of projects, reference, mandatory and unique. Each project type was explained in detail in previous reports, these projects where then categorized into separate scenarios for 2037. The above figure illustrates the process of scenario buildings, every unique scenario tested using the TDM contained all of the reference and baseline scenario projects. The optimal scenario also contains these projects as well as a number of unique projects. Some of the unique projects were decreased in scope based on the findings of the TDM as well as based on time and budget constraints.

Figure 1.1: Scenario Building as a Process



The optimal scenario is the output of the scenario building process, it contains broad interventions in every transport sector with a focus on:

1. An acceptable cost – benefit ratio;
2. Reduction of road accidents;
3. Supporting impoverished populations;
4. Supporting trade and commerce;
5. Decreasing transportation's impact on the environment

The optimal scenario will help Zambia achieve these important goals by packaging together a number of essential projects and prioritizing their implementation. This report will focus on providing a detailed description of this scenario.

This report is divided into 3 sections

1. ***Section 2*** presents a brief review of the reports previously submitted in this project and their contribution to the overall master plan.;
2. ***Section 3*** will provide a brief overview of each transport sub sector based on previous reports and the action plan presented at the conclusion of this report. Each sub sector review will share a similar structure as follows:

   Sub Sector Final Review:

   - Background;
   - Present situation;
   - Condition of infrastructure;
   - Institutional organization;
   - Deficiencies and obstacles; and
   - Investment needs in the NTMP.
3. ***Section 4*** provides an explanation of the comprehensive scenario evaluation which was undertaken on each development scenario in this project. The section provides a comparison between the quantitative assessment which was the output of the transport demand model and that of the multi criteria analysis's mixed method approach.
4. ***Section 5*** describes in detail the optimal scenario which is the final product of the master plan. Each project is recorded and discussed. The connections between reference, mandatory and unique projects is well explained to illustrate the integrated and holistic approach of the master plan.
5. ***Section 6*** provides an action plan for the optimal scenario. This action plan is a road map for the successful implementation of the master plan within time, feasibility and budget constraints.

1.1 NTMP 2037 Formulation Methodology

The process to develop the NTMP included among others; undertaking of Field Surveys, Data Collection and Analysis, Development of Travel Demand Models, Scenario Definition and Assessment.

1.1.1 Field Survey Report

The purpose of the field survey report is to set the basis for understanding the current transport situation in Zambia for 2016. That is to understand the status que, where Zambia is coming from and where Zambia is heading to with respect to the transport sector. The specific objectives of this report were to:

1. General review of national development plans with specific focus on the transport sector
2. A detailed review of main characteristics of each sub-sector of the transport sector
3. A review of the four main economic sectors that significantly impact the transport sector, namely: mining, agriculture, tourism and commerce/manufacturing
4. Review of the specific field surveys conducted by the consultant in order to better understand the current situation

The first section of the report provides a comprehensive review of existing national and regional development plans providing the background information which defines the development path for Zambia. These plans touch on multiple subjects including transportation and its important place in the country's future. Important development plans include the Revised Sixth National Development Plan (RSNDP) as well as the Southern African Development Community (SADC) Regional Infrastructure Development Master Plan. In addition to development plans, this chapter provides an overview of key demographic figures and indicators including population, employment and households. These indicators are the context for transportation demand in Zambia from the perspective of individual travelers. Population growth trends provide the clearest example of how the demand for mobility and accessibility will continue to grow in Zambia, something which will be accounted for by the NTMP.

Secondly, the report provides a review of four economic sectors as agreed upon with the Ministry of Transportation and Communications. These sectors include agriculture, mining, tourism and the commerce and manufacturing sector, all of which have a significant impact on demand for Zambia's transportation infrastructures as well as the increase in that demand. The consultant met with representatives of each economic sector in order to understand their needs and challenges and collect up to date data. Zambia's GDP is growing. Fueled by increases in agricultural and mining production, these industries are dependent on transport infrastructure and services, mainly road and rail, to deliver production inputs and goods to the marketplace. Tourism is a diverse sector that has irregular requirements on aviation and road transportation infrastructures. Tourism in Zambia is also on the rise, and Zambia is one of the most popular destinations in Africa. Each sector review will provide the following information:

1. Total production, Annual growth over the past five years, expected future growth and trends;
2. Geographic distribution of the economic sector; and
3. Transport needs of the sector

Thirdly, a comprehensive review of the transportation sector as a whole and by sub sector in Zambia was carried out. High level analysis focuses on subjects such as the institutional makeup of the transport sector and the subject of road safety. Relevant sub sectors include: roads, railway, maritime and inland waterways, aviation, pipeline and public transport. The consultant spent significant time meeting with stakeholders from each sub-sector in order to

collect data and gain an understanding of the status, opportunities and challenges facing them. A large body of information was collected and reviewed. Each sub sector's current status is presented in a standardized format.

The purpose of these reviews is to ascertain the current status of each sub sector and define a number of benchmark indicators as well as an inventory of existing facilities, infrastructure and services. Sub sector develop plans provide information as to the future vision of each sector, plans which can be tested within the travel demand model in later steps of the NTMP. With this information the NTMP will consider future interventions to upgrade, improve and development the country's transportation system as a whole.

Fourth, a second part of the report presents the methodology and results of a survey program undertaken by the consultant in late 2015, surveys executed include a roadside origin destination survey for both private and freight vehicles and a traffic count survey. In addition, a short review of traffic count surveys regularly undertaken by the Road Development Agency (RDA) provides further indicators as to the growth and distribution of road demand across Zambia. The purpose of these surveys was to collect data both for the Field Survey report and for the travel demand model to be developed for the NTMP.

1.1.1.1 Main Conclusions

The broad review of the transport sector has developed a number of high level conclusions. These conclusions will be considered by the NTMP project and incorporated into the long term strategy developed for Zambia in the final report.

(a) Institutional Structure

Following the evolution of the transport sector in Zambia, through time there is need to realign the institutional framework and their respective mandates. Doing so will facilitate prompt and effective decision making and therefore improve the management of the transport sector. The current transport sector institutional setup is well elaborated in the National Transport Policy on Appendix B.

(b) Growth in Demand, Static Supply

Zambia has continued to record a sustained growth rate averaging 2.8% per annum. It is expected that from 2018 through 2037 the population growth rate is forecasted to increase to an average of 3.0% per annum. (The population growth momentum will exert increased pressure on existing transport infrastructure and services. As such, this plan is designed to provide adequate transport facilities for the anticipated economic and population growth rates. There been a sustained growth in the middle class as well as the Small and Medium Enterprises (SMEs) giving rise to a phenomenon which has contributed to passenger vehicle ownership rate. Table 2.1 below depicts the national and provincial pop. Growth rates 2005 through 2037.

Table 1-1 : National/Provincial population and growth rates up to 2035 (source:2010 Census, 2011-2035 Projections)

Province	2000 Census	2010 Census	2000-2010 Growth Rate (%)	2035 Projected***	2011-2035 Growth Rate (%)***
Zambia	**9,885,591**	**13,092,666**	**2.8**	**26,923,658**	**2.7**
Central	1,012,257	1,307,111	2.6	2,565,450	2.5
Copperbelt	1,581,221	1,972,317	2.2	3,823,642	2.2
Eastern**	1,231,283	1,592,661	2.6	3,001,152	2.4
Luapula	775,353	991,927	2.5	1,834,667	2.3
Lusaka	1,391,329	2,191,225	4.6	5,465,775	3.6
Muchinga*	524,186	711,657	3.1	1,879,642	3.9
Northern**	809,400	1,105,824	3.2	2,355,007	2.9
North Western	583,350	727,044	2.2	1,397,137	2.4
Southern	1,212,124	1,589,926	2.8	3,184,855	2.7
Western	765,088	902,974	1.7	1,416,331	1.5
Source: 2000 and 2010 Census of Population and Housing					
*Muchinga was created in 2011					
**Figures adjusted following the new Provincial Demarcations					
***Source Report: Population and Demographic Projection 2011-2035					

Inherently, population growth creates higher demand for transportation. The population in Zambia is consistently growing along with other indicators such as the percentage of population living in cities and the motorization rate as shown in table 2.2 below.. Rich RDA traffic count surveys have shown the increase in demand for the road network over the last decade, a growth that is not matched by official efforts to improve supply or provide mobility alternatives.

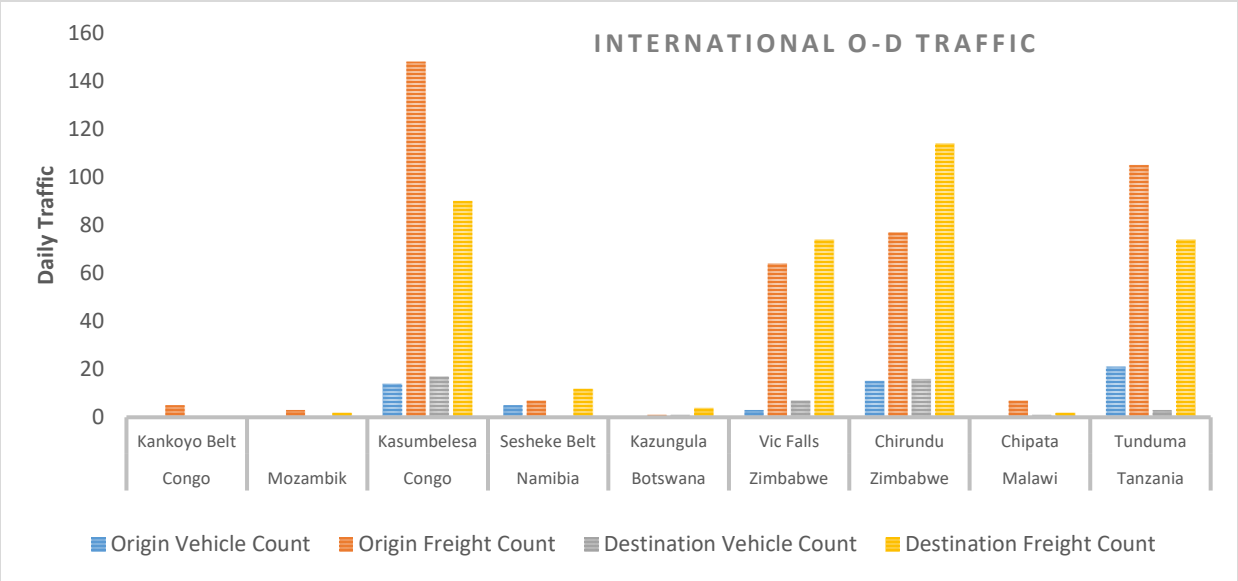
Table 1-2: Total households and average size for rural and urban with private vehicle ownership figures

	Total Households (HH)	Avg. HH size 2010*	Car/ Truck Ownership**
Zambia	**2,513,768**	**5.2**	**7%**
Rural	235,560 (59.5%)	5.3	2.5%
Urban	371,125 (40.5%)	5.1	13.2%
* source: 2010 Census – Housing and Household Characteristics Report (2014)			
* source: Demographic and Health Survey (2013) CSO			

The country has continued to record sustained economic growth with mining, tourism, manufacturing, energy and agriculture sectors contributing more to the GDP. This scenario continues to increase the demand for transport infrastructure and facilities.

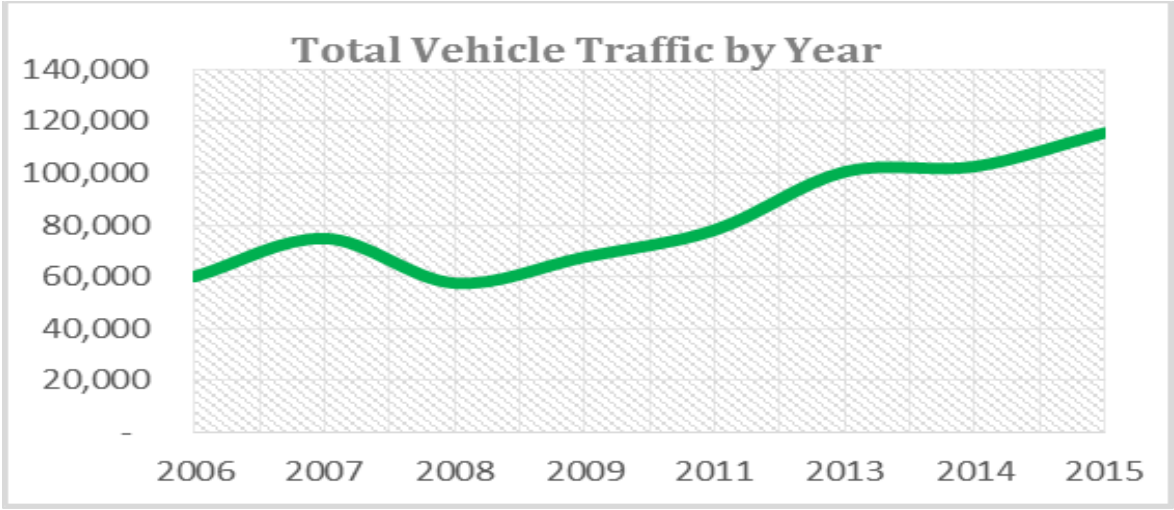
The field transport surveys identified the central corridor of the country's road network as the focal point of growing traffic and demand. Origin-Destination surveys show expected results that a majority of trips in Zambia originate and terminate along this corridor. The survey showed a growing trend of freight movement along these roads with an emphasis on international travel.

Figure 1.2: International trip origins and destinations (source: O-D Survey 2015)



Zambia is currently serving as a crossroad for heavy freight trucking carrying mainly valuable mining products. These trends show the increasing pressure being put on the country's road network by growing demand, acceptable solutions to this trend require sustainable approaches and alternative modes to truly streamline the transport sector.

Figure 1.5: Total vehicle traffic by year (source: RDA and Consultant traffic counts)



In the face of Zambia's rapid demographic and economic growth is a number of transportation supply projects have been implemented, for example a dual carriage way in the Copperbelt, a new road to Solwezi, and the upgrading of Kenneth Kaunda International Airport and more. However these interventions are not part of a larger and integrated Master Plan for Transport at a national level.

A reliable transportation strategy should focus on improving the quality of life for Zambia's citizens in the present and into the future, increasing economic efficiency and relieving poverty. This currently is not the case with the road sector which significantly dominates the transportation and budgetary discourse in Zambia presently. Accurate leadership will be challenged with resource allocation and the adoption of sustainable mobility and accessibility alternatives for the long term.

(c) Implications for NTMP Project

Clearly, the challenges facing Zambia's transportation system are significant. Overall, most transportation infrastructures with the exception of some trunk roads and Lusaka's international airport, are in some state of disrepair. Institutional complexity and a lack of a framework for prioritizing transport sector investments makes it difficult to efficiently apply resources and keep up with the country's rapid growth. This NTMP project will take these conclusions under close consideration and provide planning solutions and tools to help the relevant organizations improve and streamline the transportation sector in Zambia.

Up to the conclusion of the project period, The NTMP will work to create harmony in the transport sector. The high number of stakeholders involved makes communication and allocation a challenge but the NTMP can facilitate improved institutional clarity and redefined framework. This can be achieved in a number of ways:

1. Stakeholder meetings – routine meetings, even based on consultant deliverables force organizations to meet and discuss their problems, this should be a healthy and regular process;
2. Consultant-Stakeholder direct communication – with each meeting the consultant learns more about the needs and challenges of stakeholders creating a higher quality final strategy tool; and
3. Recommendations for sectoral streamlining – by the final report of the NTMP- the consultant will have an advanced understanding of the organizational environment in Zambia's transportation sector with a focus on efficiency and harmonization. This will be translated into the final conclusion and recommendations

A key issue which was understood by the consultant during the Field Survey exercise was a lack of strategic and tactical data regarding the transportation sector in Zambia. It is recommended that other sectors take after the RDA in completing regular data collection activities in their given arena of responsibility. Currently the Surveyor General in the Ministry of Lands is undertaking a nationwide project to create a GIS portal for government use with the highest level technology. It is recommended that the MTC also integrate its work into this system for long term data analysis. The NTMP has highlighted what data exists but also that which is lacking. Creation of this lacking data can help the MTC invest resources in the areas which need it most.

The conclusions of this report will be used in the upcoming steps of the NTMP as inputs in the development of various scenarios. Each scenario combines different policy and infrastructure

interventions to achieve the greatest benefit for the country within certain feasibility constraints. Development scenarios inherently prioritize potential projects, eliminating the risk of investing in unnecessary interventions. Scenarios are tailor made to address both supply deficits in all transport sub sectors as well as growing demand for mobility and accessibility.

Finally, the NTMP will provide the strategy which is clearly missing in Zambia's transportation sector. Transportation infrastructure projects are often resource intensive and often involve significant financial risk. In order to mitigate the chance that the "wrong" project will be chosen, the NTMP will develop a TDM to test the costs and benefits of different interventions. This model coupled with the qualitative understanding of the transportation sector as a whole will help the consultant provide strategic recommendations to harmonize the sector in the long term.

The results of this Field Survey report have shown that there are challenges in each transport sector, however these can be overcome with strategic planning and a harmonized and structured approach. The review of the transport and economic sectors in this report will act as the foundation for the consultants next steps leading up to the completion of this NTMP project.

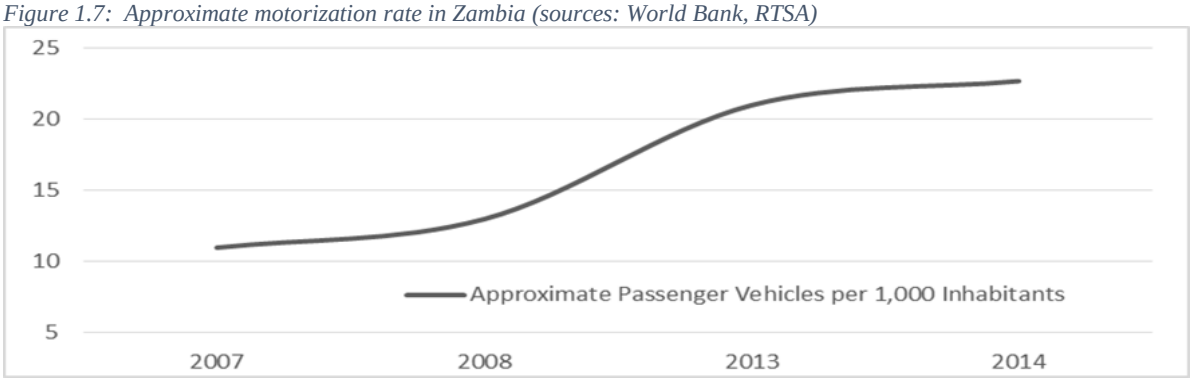
1.1.2 Data Compilation and Statistical Analysis Report

The purpose of this report was to provide a statistical understanding of the current situation of Zambia's transport system. The specific objectives of this report were to:

1. To provide international benchmarks regarding demographics, economy and transportation in order to shed light on the status of Zambia in relation to other countries both in and outside of the region;
2. A detailed statistical review of main characteristics of each sub-sector of the transport sector;
3. A statistical review of the four main economic sectors that significantly impact the transport sector, namely: mining, agriculture, manufacturing/trade and tourism; and
4. Results of the specific field surveys conducted by the consultant in order to better understand the current situation.

The data analysis illustrates the complexity of Zambia's transportation system. Over the last 20 years Zambia has operated under a de facto transportation policy which favours private vehicles and road development. This trend has caused increasing private car ownership and usage, increased use of the roadway for freight movement, the rapid dilapidation of railway systems and slowed sustainable transportation and public transportation development. This de facto policy is the source of a number of Zambia's current and future problems, for example road congestion. Road congestion is relatively low at present, with the exception of a few areas (Lusaka, the T2 Trunk Road and the Copperbelt) but increasing motorization rates mean that traffic will only increase. This coupled with very low levels of service in both railways and public transportation mean that the transfer to private vehicles will continue into the future.

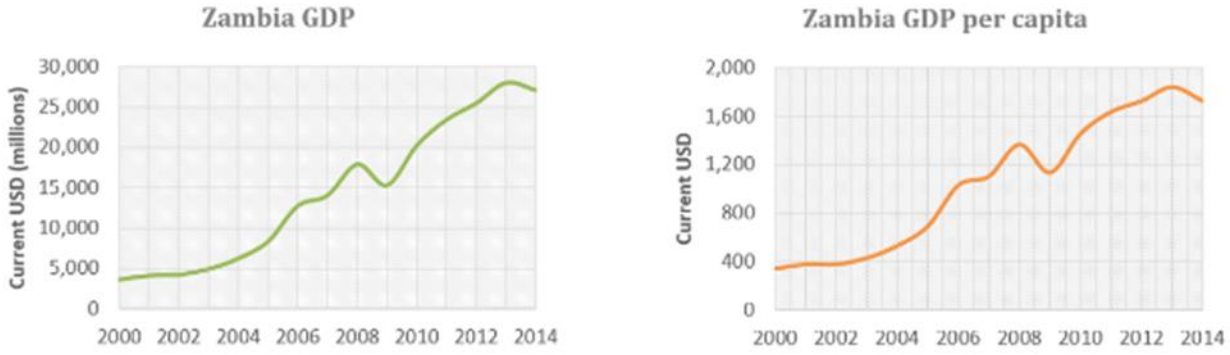
Figure 1.7: Approximate motorization rate in Zambia (sources: World Bank, RTSA)



Zambia's economy has continued to grow over the last ten years, a trend which is expected to continue into the future. Currently mining products, specifically copper, are the country's leading export and is driving growth in nation GDP. Other industries are also improving, such as tourism agricultural production and cross border trade with a focus on imports of consumer goods. As Zambia's economy continues to increase its performance, two major trends are to be expected.

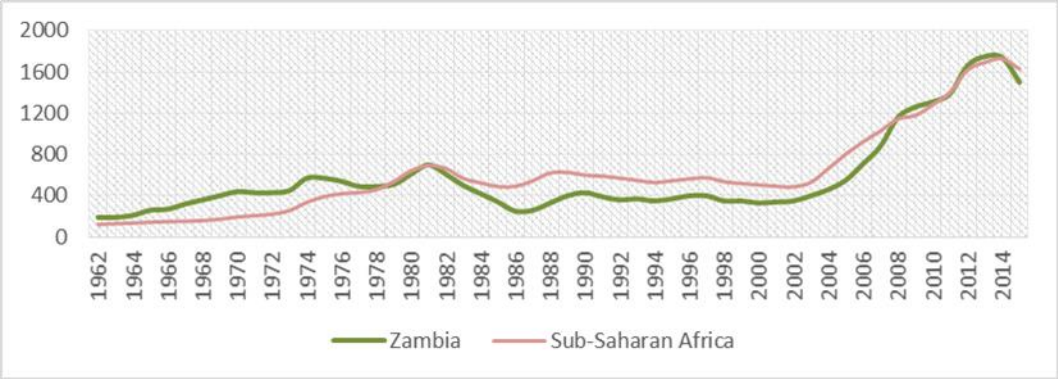
First, accelerated economic activity will increase production, imports, exports and cross border trade. The result of this is an increased demand for the movement of goods. At present a majority of this movement is accomplished by truck, such that increased economic activity is expected to increase the share of heavy trucks on the roads.

Figure 1.8: Zambia GDP and Per Capita GDP (Source; World Bank)



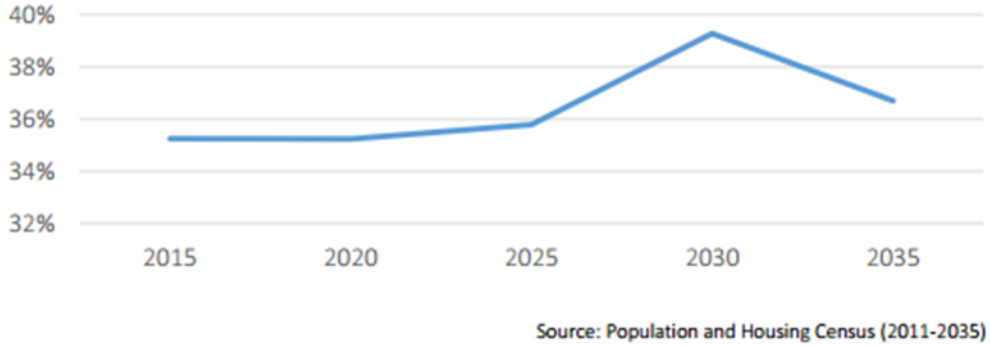
Second, increased economic activity leads to increased income which is highly correlated with private vehicle use; as the average income of Zambians increases, their usage of cars as their primary mode of transport will also increase.

Figure 1.9: Average income (GNI) (source: World Bank)



In addition to de facto transportation policies and increased economic activity, Zambia is undergoing a trend of urbanization which is quickly increasing urban populations. There is a high positive correlation between urban populations and increased travel behavior in comparison to rural populations. Residents of cities generally have higher average incomes than rural residents, this increased purchasing power is often used to buy private automobiles. The result of urbanization in terms of transportation are both increased travel demand and increased private vehicle usage.

Figure 1.10: Urban population share and projection 2015-2035 (source: population and Housing Census, COS)



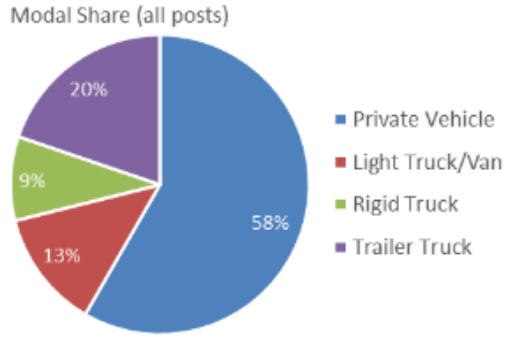
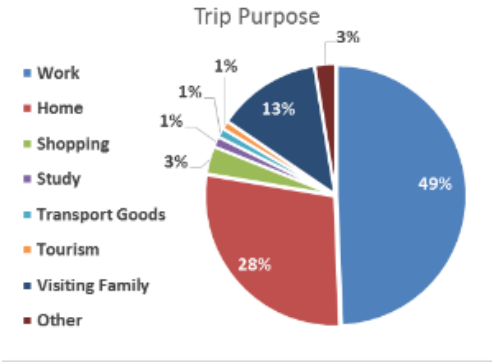
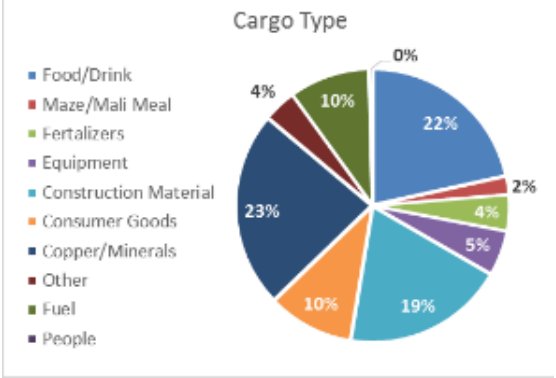
Transportation surveys were carried out in November of 2015 for the purpose of TDM calibration and overall data collection. These assignment included the following surveys as shown in table 1.3:

Table 1-3: Transportation survey objectives and methodology

Survey	Target population	Sample Size	Essential Attributes	Output
Traffic Count Survey	All Vehicles	• 14 survey posts • 43.5 total survey hours	• Location • Direction • Vehicle Class • Time • PT Fill Factor	Demand at select points on the road network classified by vehicle type and time
Private Vehicle O-D	All vehicles	• 14 survey posts • 1,399 vehicles	• Location • Direction • Vehicle Type • Time • Origin-Destination	O-D Matrix distributed appropriately between TAZ with mode share

			• Trip Purpose • Vehicle Fill Factor	
Freight Vehicle O-D	All commercial vehicles	• 14 survey posts • 1,446 vehicles	• Location • Direction • Vehicle Type • Time • Origin-Destination • Frequency of Trip • Cargo Type • Vehicle Fill Factor	O-D Matrix distributed appropriately between TAZ, Cargo by Type with mode share, frequency of trip

Table 1-4: Key survey output figures

Key Survey Output	Description
	• Classified traffic count output • A majority of the vehicles on Zambia's roads are private vehicles • Large cargo vehicles and trucks make up a large portion of the traffic on Zambia's roads, a combined 33% • Public transport vehicles are a relatively small portion of traffic
	• Passenger trip purpose • The main trip purpose in Zambia is for work, this is an expected answer and is nearly always the case • Other strong trip purposes are visiting family, funerals and moving goods to the market • This graph is very different than what would be expected in an urban survey
	• Freight vehicle cargo type survey • Cargo types are widely distributed on Zambia's roads • The leading cargo types being moved by road are mining materials, food and drink and construction materials

1.1.2.1 Transport Survey Conclusions

- Vehicle O-D surveys show that most traffic is located along the country's central corridor;
- Vehicle O-D surveys ascertain that most trips are for the purpose of work;
- The average private vehicle is traveling with more than 2 passengers in addition to the driver;
- The most popular private vehicle trips are between Lusaka and Kabwe or the Copperbelt, this explains why the average trip length is approximately 325 km;
- Freight O-D surveys show that a majority of the traffic moves along the T2 road, through the country's central corridor;
- The most popular cargo types are mining products, agricultural products, food/beverages and petrol;
- Most freight trips originate or end outside of Zambia, most common destinations are Tanzania, DR Congo and Zimbabwe/S. Africa, these trips are responsible for the relatively high average trip length for freight vehicles; and
- As expected, heavy freight vehicles are most often loaded

1.1.2.2 Summary of main findings of the statistical report:

- De facto transport policy supports private vehicle use and road development;
- Increasing economic activity equates to increased private and freight vehicle use;
- Rapid urbanization increases road demand in urban areas and the country in general

These main findings illustrate the lack of focus on sustainable travel options both in Zambia's transportation policies as well as its allocation of resources. This is something which must be augmented in the future in order to continue the country's strong economic growth, which in turn improves the quality of life for its citizens. A number of recommendations can be made in this effect, the recommendations will be aggregated into various development scenarios in the following steps of this project and assessed using transport demand models. This report supports the following recommendations:

- Making sustainable transportation a policy and development priority;
- Aggressively investing in the rationalization and improvement of public transportation, both for urban and intercity services;
- Investing in the rehabilitation of Zambia's railway system for freight and passenger service; any rehabilitation must be aware of and consider the conclusions of the 2011 ZIPAR report;
- Ensure proper organizations for each transportation sector in order to regulate and rationalize resource allocation to maximize levels of service;
- Continue to collect transportation oriented data across all sub-sectors of Zambia's transportation system in order to support future development and policy changes;
- Looking to the long term, transportation planning today must focus on the long term implications of any infrastructure development projects.

Transportation surveys were carried out in November of 2015 for the purpose of TDM calibration and overall data collection. These assignment included the following surveys:

1.1.3 Model Verification Report

The purpose of this report is to present the development, methodology and rationale of the transport demand models for the Zambia National Transport master plan assignment. Transport models are computer based models that simulate travel supply and demand on a national level. The model can be used to provide forecasts for demand for various projects and groupings of projects, called scenarios, for defined horizon years.

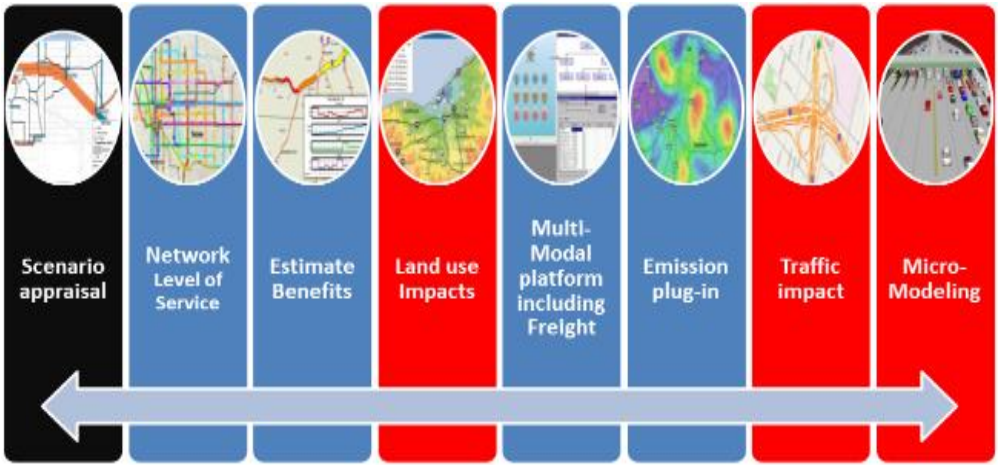
The model in this assignment is used for the following purposes:

- To assist in selecting an optimal and agreed upon transport development strategy for the horizon year 2037;
- To prioritize the investment and implementation of various potential projects;
- To evaluate the benefits of potential projects; and
- To calculate the environmental and social impacts of each project.

The models in question are national strategic models which produce daily forecasts. These models are not intended to provide supply and demand data for urban areas which would require peak hour modelling. Two models were created for this assignment:

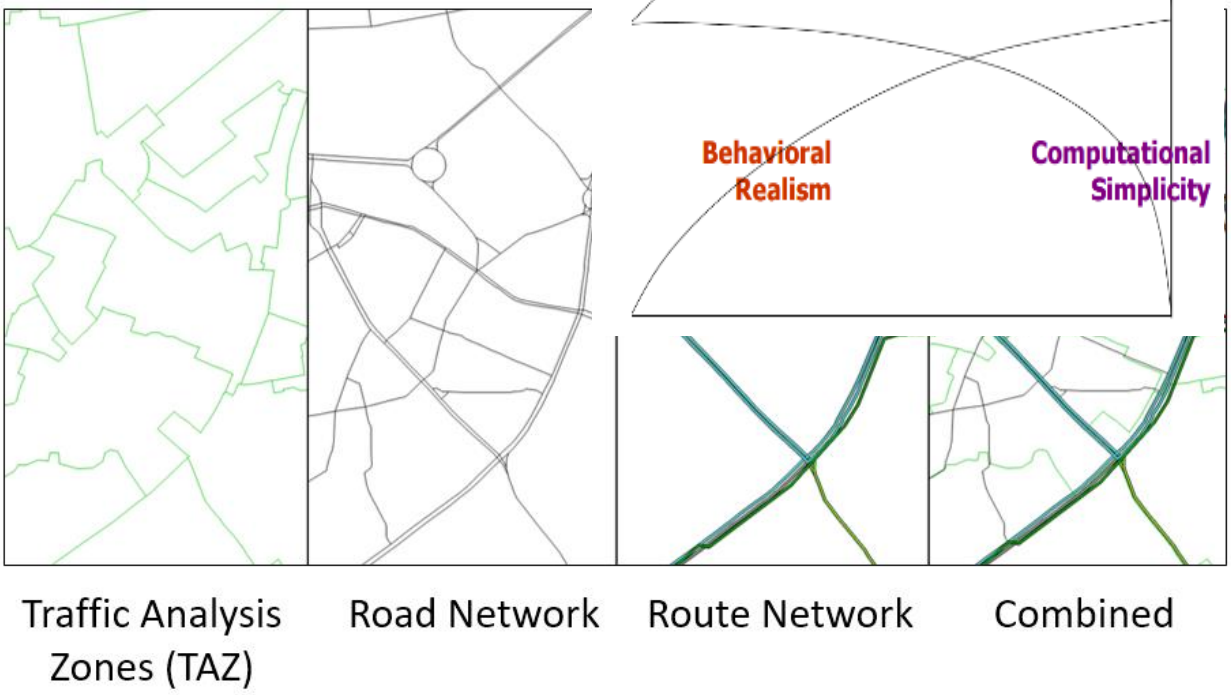
- The first is a classic passenger model which simulates national passenger trips either as a car passenger, car driver, bus passenger or train passenger; and
- The second model simulates freight movement across Zambia either via truck, rail, plane or pipeline.

Figure 1.11: Factors and structures of transport demand modelling



Traffic demand models are tools and not the focus of any project, it is important state this point. The TDM is used as a tool for assessing new projects, future scenarios and policy changes, its outputs are to be used in conjunction with other data and qualitative information. This for example is the basis for Multi Criteria Analysis where in the TDM is joined with other factors such as environmental impact and cost in order to assess future projects.

Figure 1.12: Essential spatial elements of TDM



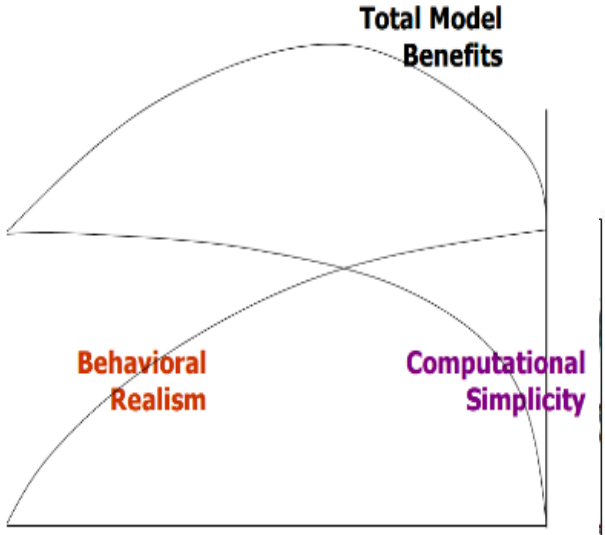


Figure 1.13: Model benefits between realism and simplicity

The models developed for this assignment attempt to bridge the gap between complexity in the model while also being useful, adaptable and easily understood. Overly complex models become difficult to understand, predict and finally take seriously. Instead less complex but more intuitive models provide useful assessment of future projects which can be explained and adapted to the needs of the project. The following points illustrate some of the design features of the model which make it reliable but also understandable and useful for the purposes of the National Master Plan.

- The current TDM is based on input data collected by the consultant from relevant stakeholders, for a complete list see Report 2: Field Survey of this assignment;
- The models focus on intercity transport only;
- Both models are daily as not significant traffic peaks are found in Zambia outside of Lusaka;

- Models were calibrated using RDA and consultant traffic surveys as well as border crossing data from the Zambia Revenue Authority;
- Model outputs in this report are for the current status of 2016-2017;
- Models based on the framework presented in this report were created to simulate travel demand for the horizon year 2037;
- Land use data are based on Zambia COS projections;
- Many inputs for both trip/cargo generation and mode choice are based on land use such that the model is responsive to horizon years development;
- All modeling tasks were completed either in Microsoft Excel or TransCAD to ensure clarity and simplicity

Finally, this report has been written in a way that it not only provides technical data regarding both models but also explains the process of development and validation in a way which is accessible to interested readers who do not come from a modeling background.

1.1.4 Scenario Definition and Assessment Report

The purpose of this report is to present the definition and assessment of future development scenarios for Zambia's transportation sector for the year 2037. Scenarios are essentially packages of ongoing and future infrastructure projects and policy changes which when combined provide certain benefits to the country's transportation system. Scenario assessment is the process of evaluating scenarios based on their benefit to society. This benefit is expressed through a number of indicators such as modal split, in vehicle time and total vehicle kilometers traveled. Sustainability is a key objective of the ZNTMP and as such modal shift which moves trip choice to public transportation is seen as an important benefit to any scenario.

Scenarios allow for planning in an uncertain environment. Because it is difficult to accurately forecast changes in passenger demand, freight demand and land use, scenarios are used to allow for broad strategic changes to the transport system which can cope with the unexpected changes of the future. Scenarios do this by taking advantage of diversified investments.

The goal of this report is an optimal scenario for the development of Zambia's transportation system.

Table 1-5: Scenarios Considered in this Report

Scenario	Description
Demand Scenarios	
Demographic Scenarios	Scenarios which simulate changes in factors which affect travel behavior such as population, employment and car ownership
Trip Distribution Factors	Urbanization and growth of urban areas
Freight Trip Factors	Scenarios which simulate changes in factors which affect freight travel demand such as economic growth and changes in imports and exports
Supply Scenarios	
Base Scenario	Scenario which includes all reference and mandatory projects for development. This scenario is common to all development scenarios
Full Fast Passenger Rail	A complete and comprehensive network of fast passenger rail services
Partial Fast Passenger Rail	Scenario of the highest performing investments from the full network
Full Road Network Upgrade	A complete and comprehensive network of high LOS Trunk/Main Roads

Scenario	Description
Partial Road Network Upgrade	Scenario of the highest performing investments from the full network
Intercity PT Improvement Program	Scenario of low cost and short term PT upgrades
Road Tolls Program	Scenario of complete toll way establishment on main roads
Full Intermodal Cargo Rail Network	A full network of improved cargo rail and intermodal hubs across the country
Partial Intermodal Cargo Rail Network	Scenario of the highest performing investments from the full network
Mixed Scenario	Scenario which incorporates relevant scenarios from the above development scenarios to achieve maximum benefits

Table 1-6: Summary table of passenger scenarios, select indicators (all data is for daily travel)

Scenario	Car Trips	PT Trips	Car Mode Share	PT Mode Share	VHT	VKMT	Bus Passengers	Fast Train Passengers
2016 Base	68,088	42,792	36.0%	22.6%	222,859	13,094,871	42,792	-
2037 Base	250,273	78,530	45.5%	14.3%	909,733	55,208,413	78,530	-
2037a – Full Fast Train	226,831	123,685	41.3%	22.5%	859,309	51,930,991	66,895	67,565
2037b – Central Fast Train	236,927	104,119	43.1%	18.9%	879,417	53,067,722	71,361	36,172
2037c – Full Road Program	253,720	71,616	46.1%	13.0%	870,271	56,147,973	71,616	-
2037d – T2 Road Upgrade	252,341	77,220	45.9%	14.0%	909,771	55,899,177	77,220	-
2037e – PT improvement	241,606	95,316	43.9%	17.3%	889,710	54,517,846	95,316.86	-
2037f – Road Tolling Program	237,896	101,766	43.3%	18.5%	765,402	53,119,314	101,766.74	-
2037g – Mixed Passenger	196,106	189,749	35.7%	34.5%	847,734	43,783,907	158,863	36,172

1.1.4.1 2037g – Mixed Passenger Transport Scenario

This comprehensive scenario is a collection of the successful scenarios presented in this report. This scenario provides significant modal shift toward sustainable transport as well as economic savings for Zambia's economy. The key to the success of this package is the mix between push policies which make private vehicle use less attractive and pull policies which provide high quality alternatives to the private car such as upgraded passenger railways.

Scenarios included in the comprehensive scenario:

- Scenario 2037b – Central corridor fast passenger train;
- Scenario 2037d – T2 Road Lusaka-Ndola dual carriageway and Lusaka bypass;
- Scenario 2037e – PT improvement program;

- Scenario 2037f – Road tolls program;

Estimate Economy Data	2016 – BASE	2037-BASE	2037g – Comprehensive Passenger Scenario
VHT	188,864	909,734	847,734
VKMT	11,097,349	55,208,413	41,181,896
Annual Economy Savings (USD)			**Time Value Savings: 30 mil annually** **Toll Revenue Annually: 250 mil annually**

1.1.4.2 Scenario Conclusions

1.1.4.2.1 General Conclusions

- Scenario 2037g provides an integrated mix of push and pull measures to allow for sustainable transport in Zambia;
- The scenario incorporates a number of PT focused interventions, both in the form of policy and in the form of infrastructure improvements;
- Modal shift from this scenario is significant, shifting nearly 100,000 travelers to PT, this equates to an increase in overall mode share of 20%

1.1.4.2.2 Fast train conclusions

- The central corridor fast train project has been shown to answer the demand for travel north and south of Lusaka and between the Copperbelt and Lusaka;
- The new stations included in this project provide improved accessibility for large populations;
- The project in scenario 2037g is projected to serve over 30,000 passengers per day, this is over 75% of its possible potential;
- A preliminary operational scheme shows that two routes are needed to serve this infrastructure, a commuter rail serving Kabwe – Lusaka – Kafue and a long distance route connecting Lusaka and the Copperbelt;
- Conservative estimates show that from an operational point of view, with 30,000 passengers per day, the fast train can sustain itself financially with a yearend revenue of over 4 million USD.

1.1.4.2.3 T2 Road Upgrade and Lusaka Bypass Conclusions

- Road improvement is important along this central corridor as it will continue to be the focal point of traffic in Zambia;
- Road improvement is important for mitigating traffic accidents which are currently a regular occurrence on this road corridor;
- In scenario 2037g, car flow is much reduced on the T2 road as a result of the substantial modal shift to sustainable modes of transportation; and

- The Lusaka bypass road continues to remove a significant amount of traffic from Lusaka's city center, these benefits will increase when consider freight traffic movements

1.1.4.2.4 Road Toll Program Conclusions

- In scenario 2037g the road toll program is expected to collect 820,155 USD per day, or approximately 250 million USD per year;
- This number is reduced from scenario 2037d because of the reduction in car usage in scenario 2037g;
- This revenue figure is calculated where PT vehicles are exempt from road toll charges

1.1.4.2.5 PT Improvement Program

- The measures in the PT improvement program should be undertaken as they best serve low income populations, providing improved access to daily basic necessities.

1.1.5 2037 h – Full Integrated Cargo Rail

The freight TDM was used to test the impact of improved cargo railway infrastructures as well as the impact of intermodal hubs on freight traffic in Zambia. Before summarizing this scenario, it is important to look at the changes in mode choice from the year 2016 to the year 2037. As was shown in the demand scenario chapter of this report, production of goods including imports and exports is expected to more than double by 2037. This is based on GDP growth and projected sectoral growth rates from the Vision 2030 document. I the 2037 Baseline scenario, these production figures have been increased as detailed, while the supply of transport in the form of infrastructure has stayed similar. This equates to an increase in car utilization for the increased trip generation for the following reasons:

- Trucks remain the least expensive mode for cargo transport per ton for short and medium distance trips;
- Railway infrastructure remain very slow in this baseline scenario and are hard pressed to compete with truck transport, this explains why train mode share decreases;
- Air cargo is not projected to rapidly increase to 2037 as demand for cargo services has grown slowly in Zambia;
- The pipeline connecting Dar es Salaam to Zambia is projected to continue to operate at capacity, growing with the growth in demand and continuing to hold a similar market share as in 2030

In an effort to transfer freight cargo traffic to railways, the scenario of intermodal railway transport was tested in the model. The strategy of the scenario is to allow for intermodal trips to take advantage of the low costs of short distance trips on trucks and the low cost of long distance trips via railways. For example 35 tons of copper being transferred from the Solwezi mine, via the Ndola intermodal hub, and continuing their journey to the Port of Durban in South Africa. The changes made in this scenario are as follows:

1.1.5.1 Upgraded Cargo Rail

- Numerous greenfield infrastructures adding new international and national connectivity;

- Increased operating speeds to 80 km/h from 30 kn/h in 2016.
    - Speeds are increased as a result of infrastructure overhauls, re-sleepering of rails, improved signaling and new rolling stock

1.1.5.2 Integrated Transport Hubs

- Sites where transfer of cargo between transport modes is facilitated at a reasonable cost;
- Points where rail infrastructure meets the core road network in Zambia;
- Enable utilization of rail travel for long distance origin-destination combinations

Table 1-7: Modal share of freight traffic: Scenario 2037h

Mode	2016	2037 Baseline	2037h
Truck	117,009	226,035	192,377.424
Train	13,139	15,062	48,719.126
Pipeline	273	506	506
Airplane	132	323	323
Total	**130,554**	**241,925**	**241,925**
Truck	89.63%	93.43%	79.52%
Train	10.06%	6.23%	20.14%
Pipeline	0.21%	0.21%	0.21%
Airplane	0.10%	0.13%	0.13%

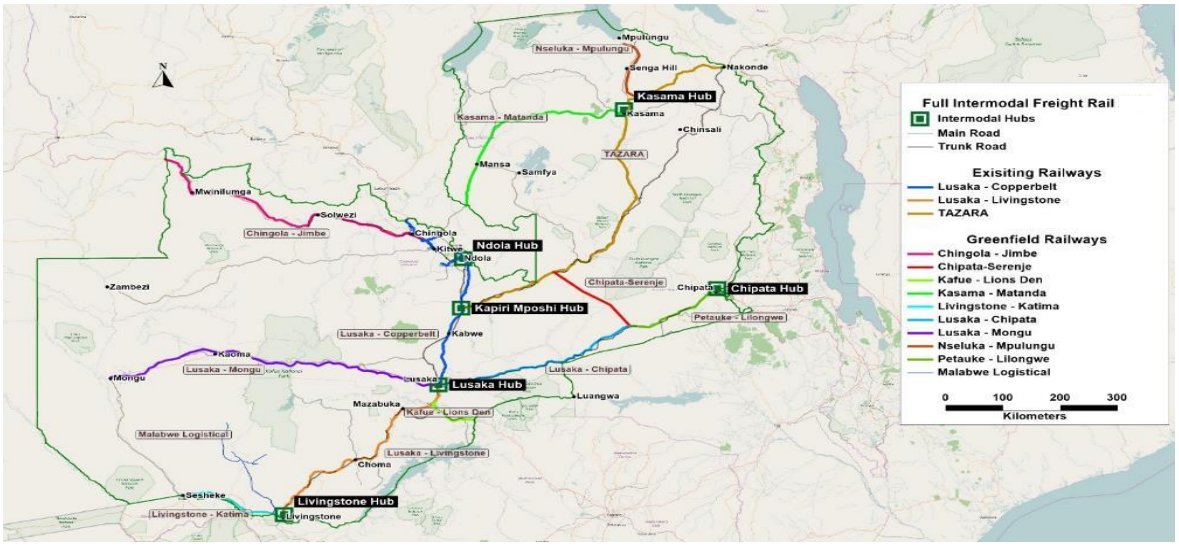
The methodology of the Freight is completely explained in Report 4: TDM development. In short the model looks for the lowest cost method of shipment. Train travel has a lower cost at longer distance. In scenario 2037h, trains are moving at 80 km/h and the new routes allow them to compete with trucks. Where the train was found to be more attractive, it was allocated a larger share of the overall cargo traffic. Within that allocation, which for scenario 2037h was a total of 48,719 tons per day, a majority was transported along the existing railways, specifically along the country's main corridor between Lusaka and the Copperbelt. Greenfield projects received less traffic except for the Kafue – Lion's Den Greenfield project and the committed project between Serenje and Chipata.

Table 1-8: Freight Railways and Share of Daily Rail Cargo

Freight Railway	Length	Daily Ton Flow	Share of Daily Flow
Existing Railway			
Lusaka - Copperbelt	556	14,863.46	36.0%
Lusaka - Livingstone	463	6,605.98	16.0%
TAZARA	848	4,128.74	10.0%
Greenfield Railway			
Kafue - Lion's Den	104	7,844.60	19.0%
Chipata - Serenje	175	2,890.12	7.0%
Livingstone - Katima	192	1,651.50	4.0%

Chingola - Jimbe	561	1,238.62	3.0%
Petauke - Lilongwe	200	1,238.62	3.0%
Kasama - Matanda	433	412.87	1.0%
Lusaka - Chipata	375	206.44	0.5%
Lusaka - Mongu	609	123.86	0.3%
Nseluka - Mpulungu	152	82.57	0.2%
Total	**4,668.00**	**41,287.39**	**100.0%**

Figure 1.14: Map; Full intermodal freight network and intermodal hubs



1.1.5.3 Scenario Conclusion

- Improved freight railway network significantly increases usage of freight rail
  - Increased speeds allow rail to compete with truck traffic; and
  - Freight rail is more efficient and cheaper than truck borne freight on long haul trips
- Intermodal hubs support the transfer of goods between modes at key location
  - Increased catchment areas for the meeting between road and rail traffic increase the likelihood of intermodal trips
  - Decreased loading and unloading fees at intermodal hubs reduces the cost of freight traffic

1. Overall decrease in road traffic
   - Relieve congestion in city centres
   - Increase road safety by decreasing trucks from the roadway

Infrastructures for inclusion in optimal scenario:

- **Railways**
  - **Existing railways**
  - **Kafue - Lion's Den Railway**
  - **Serenje – Petauke Railway**

  Chingola – Solwezi Railway
- **Intermodal Hubs**
  - **Ndola**
  - **Lusaka**
  - **Kapiri Mposhi**
  - **Livingstone**
  - **Chingola**
  - **Kafue**

Chapter 2: Transport Sector Final Review

This chapter will review each transport sub-sector based on the availability of data collected during the master plan project. The narrative writing style used in this report was chosen to show the integrated aspect of Zambia's transportation system and it is important to keep this point in mind throughout this review. While the chapter will review each transport sub-sector in turn, they do not exist separate from the whole of the transport system.

Each transport sub-sector will be reviewed in a uniform structure as follows:

1. Sector Introduction;
2. Sector Field Survey;
3. Sector Challenges and Opportunities;
4. Sector Key Development Projects;
5. Sector Impact of the Master Plan; and
6. Sector Conclusions

2.1 Road Sub-sector

2.1.1 Introduction

The road sector is presently the most important network of infrastructure in the country. It serves as the main foundation of mobility and accessibility for a vast majority of the trips in the country. The road network serves private vehicles, public transport, freight trucking and all types of non-motorized transportation. Its impact on the spatial and economic growth of the country is obvious as along these roads move the products of Zambia's economic sectors. This section presents an overview of the road sector and covers a brief background of the road sector reforms, the various road sector policies and programs, details of the road network and the key players in the road sector in Zambia.

The importance of the road network in Zambia and its de facto primary position in the country's transportation hierarchy have led to a number of strategic and development plans concerning the road infrastructure development and maintenance. A majority of these plans came as a result of the Transport Policy 2002 document which defined the road network as an essential component of Zambia's economic development. Key Programmes and projects which have resulted from this policy includes the two Road SIP programmes, the Link Zambia 8000 programme and the recently completely Road Sector Capacity Building Project 2015-2016 sponsored by the EU among several others.

These large programmess and projecst have considered and defined for Zambia all of the relevant aspects of the road sector including planning, construction, maintenance and financing. As such, the master plan does not recommend stopping of the committed developmental road projects, however it recommends that the focus be shifted from this infrastructure to those which provide mobility for all populations such as public transport,

those which provide increased sustainability such as rail while still preserving the vision of economic development for Zambia.

The road sector has a complex institutional set up which combines Road sector institutions (RDA, NRFA, RTSA and LRAs) and Government line Ministries (MLG, MHID, MOF and MTC)with other supporting institutions either providing input on the road sector or assisting in the cooperation between the major institutions. All policy issues in the Road sector are coordinated and formulated by MTC. Implementation of all road infrastructure projects is undertaken by RDA under MHID and LRAs under MLG. Financing of the road sector is coordinated and administered by MoF through NRFA.

2.1.2 Field Survey

2.1.2.1 The Road Network

Zambia has a total classified network of 67,671km of public roads comprising trunk, main, district, primary, secondary and tertiary feeder, urban and park roads. For the purpose of management of the public roads network, the RDA has delegated some responsibility to LRA in line with the Public Roads Act No. 12 of 2002.

Table 2-1: Road characteristics by type (source: RDA Reclassification Study, 2014)

Road Class	Responsibility	Total Estimated Network (km)
Core Roads		
Trunk (T)	RDA	3,088
Main (M)	RDA	3,691
District (D)	RDA	13,707
Urban (U)	LRAs	5,294
Primary Feeder (PF)	LRAs	15,800
Primary Tourist (TR)	ZAWA/LRAs	-
Non-core roads		
Secondary Feeder (SF)	LRAs	10,060
Tertiary Feeder (TF)	LRAs	4,424
Park Roads	ZAWA	6,607
Community Roads	LRAs	5,000
Unclassified roads		
Unclassified roads (UC)	LRAs	10,000
Total		77,671

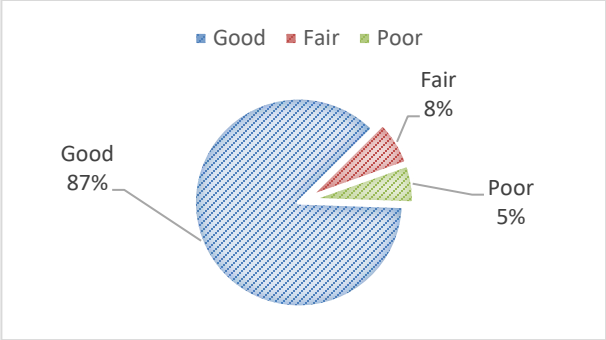
In 2016 road demand was concentrated along a central corridor from the Copperbelt toward Botswana and Zimbabwe via Lusaka. This main corridor not only serves a majority of the intercity private vehicle travel but also that of public transport and heavy freight traffic. A number of issues that result from the high travel demand on the main road corridor are:

- Focal point of road traffic accidents;
- Focal point of congestion in Zambia;
- Roadway in major need of periodic maintenance because of high traffic;
- Impact from pollution and traffic accidents on populations living along roadway; and
- Increased congestion in city centers as central corridor does not divert around urban areas.

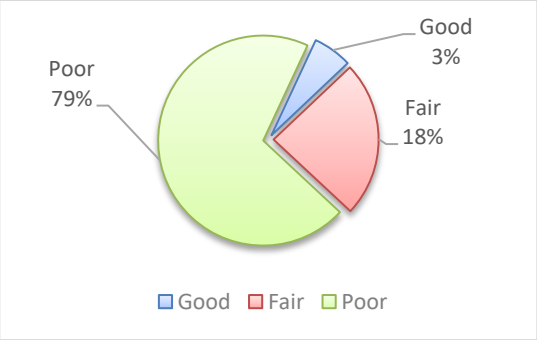
2.1.2.2 National Road Network Condition

Zambia is ideally located to be a hub for transportation of goods and people. According to recent RDA survey on the Trunk-Main-District (TMD) road network in 2015 RDA Condition Report, 87% of the paved TMD network was in good condition, while 8% and 5% in fair and poor condition, respectively. Similarly, for the unpaved TMD network, 3% was in good condition while 18% and 79% was in fair and poor condition respectively.

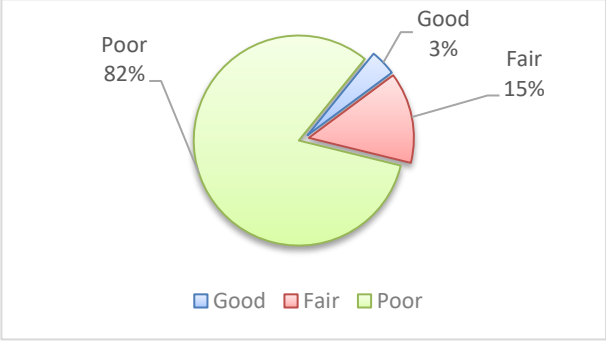
Figure 2.1: Summary of current road network conditions (RDA 2014)



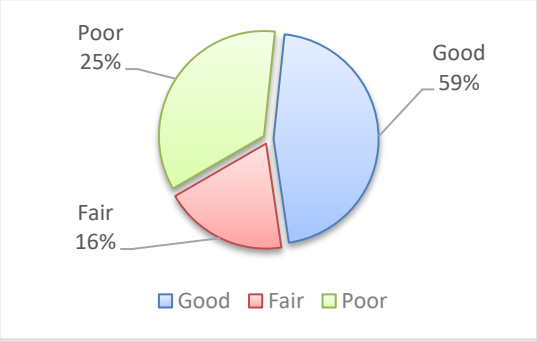
Paved TMD Condition



Unpaved TMD Condition



Unpaved Primary Feeder Condition



Paved Urban Road Condition

- On the paved TMD road network a significant improvement in the road network condition has been achieved especially during the period 2011 to 2015.;
- The unpaved TMDs have generally been in poor condition from 2006 to 2015, the deterioration is mainly due to the high traffic volume and lack of continuous maintenance. This portion of the network requires upgrading taking into account the traffic volume and classification.;

- The condition of the urban paved roads have generally been improving with 75% of the network in good and fair condition in 2015 compared to the 21% in 2009;
- There has been an alarming deterioration in the unpaved urban network condition, most likely related to the significantly increased volumes of traffic in the urban areas. The section in good/fair condition stood at 50% in 2009 and reduced significantly to only 10% by 2015. The unpaved urban roads must therefore be given high priority, for upgrading to paved condition or intensive and sustained maintenance;
- The PFR network (>15,000km) accounts for close to one third of the total CRN. However this category of the network has been deteriorating with a significant portion remaining in poor condition.

In terms of condition of the Core Road Network as a whole, 60% requires major rehabilitation and 40% is in a maintainable condition. It is hoped that some of the major rehabilitation, upgrading and maintenance programmes planned for 2015 onwards will improve the overall network condition to create an enabling environment for movement of people, goods and services.

2.1.2.3 Challenges and Opportunities

(a) Challenges

The following challenges have been identified in the road sector:

i) High Social and political demand for road infrastructure;
ii) Huge financial investment requirements for undertaking road works;
iii) Huge backlog of road works especially on the unpaved road network;
iv) Congestion on the road network in the urban setup and particularly along the central corridor of the country ;
v) Frequent occurrence of traffic accidents; and
vi) Resources mainly focused on high level roads (TMDs) neglecting other important lower level roads (feeder and community roads)

(b) Opportunities

The following opportunities have been identified in the road sector:

i) The country is well served by the three main road Agencies with well-defined cooperation between them which will help save the people of Zambia;
ii) Available road condition data will assist the sector in determining Investment requirements for rehabilitation and maintenance of road networks;
iii) Capacity built in the road sector with support from the EU will enable the road sector institutions provide effective management of the road sector;
iv) Improved road network has potential to increase the revenue for road maintenance through tolling; and

v) Improved road network will support social economic growth through enhanced accessibility to agriculture, mining and tourism communities and other social amenities.

2.1.3 Key sector development projects

Table 2-2: Road Sector Key Development Projects

Project	Description	Status
RDA annual maintenance	Annual maintenance projects for the RDA	Ongoing
Link Zambia 8000	Strategic road improvement project for all of Zambia	In Progress
LSK 400	Strategic road improvement project for Lusaka	In Progress
CB 400	Strategic road improvement project for Copperbelt	In Progress
Urban Roads Program	40 projects for 700 km upgrading local road networks	In Progress
	Design and Construction of 42.92km of urban roads in Ndola City	In Progress
	Zambia Urban Township Roads	In Progress
Pave Zambia 2000	Urban road project utilizing cost effective materials to improve urban roads across Zambia	In Progress
Lusaka Decongestion Project	Lusaka Traffic Decongestion Project Implementation	In Progress
Feeder Roads Program	Improved Rural Connectivity Project	In Progress
	20 projects for 650 km of rural access roads	In Progress
City Bypass Road Program	Bypass roads at major urban areas to remove through traffic from urban centers • Lusaka • Kabwe •Kapiri Mposhi •Kitwe •Chingola •Choma •Mazabuka • Livingstone	Planning
T2 Road Upgrade	Upgrade of T2 road to dual carriageway between Lusaka to Ndola (approx. 350 km)	Procurement
Toll Roads Program	Comprehensive toll gates program including operations	In Progress
PPP Projects	Kasomeno Mwenda PPP Project	In Progress
T1 Road Rehabilitation	Rehabilitation of the Turnpike to Monze Road	Planning
T2 Rehabilitation	Rehabiltation of the Serenge to Nakonde	Planning
T 5 Rehabilitation	Rehabilitation of Chingola to Solwezi Road	In progress

2.1.4 Impact of the NTMP

The master plan main focus for the road network is to develop road infrastructure essential for the economic growth of the country as well as projects which will improve public transportation and enhance road safety. The inland road toll programme has become a major asset for Zambia and it is envisaged that the funds generated will be channelled towards the maintenance of the road infrastructure.

The NTMP will not stop any committed road projects and assumes that the projects included in the Road Sector Annual Work plan are essential for the good of Zambia. The master plan includes a number of specialty projects, such as access roads to industrial areas, in order to enhance economic growth.

2.1.5 Sector Conclusions

- Road is the most used mode of transport in Zambia;

- A lot of funds are required for the rehabilitation and maintenance of the Core road network;
- Investments have improved the paved level of service for the core road networks while more investment is required to improve the service levels of the unpaved core road network.;
- Zambia's road network is well distributed to handle future economic development;
- Road network provides enough capacity as congestion is limited to a few areas;
- Increased vehicular population in Lusaka coupled with limited road network capacity has resulted in increased traffic Congestion;
- The country needs to improve the connectivity to the rural areas to improve access to the agriculture areas**.**

2.2 Road Safety

2.2.1 Introduction

The Road Transport and Safety Agency (RTSA) was enacted through the Road Traffic No. 11 of 2002 as the lead agency in charge of road transport, road safety and traffic management and became fully operational in 2006. The Agency's approach to improve road safety in Zambia is in line with the United Nations Decade of Action for Road Safety 2011 -2020 and the African Road Safety Action Plan. It is based on five pillars: road safety management, safer roads and mobility, safer vehicles, safer road users, and post-crash care. The challenge for road safety in general is the increasing motorization rates which despite contributing to mobility and access to economic and social facilities has come at a cost as deaths from road crashes have been on the increase.

A number of strategies are currently at work in Zambia and Africa as a whole, with a common goal of reducing road accidents and fatalities. The UN Decade of Action for Road Safety 2011-2020 plan set out a bold goal to reduce fatalities by 50% by 2020 and Zambia intends to meet its commitment to the goal of the Decade.

The Agency through the Ministry of Transport and Communications through stakeholder collaboration has drafted a National Road Safety Policy, Strategy and Action Plan which recognizes the need for a wider stakeholder collaboration and involvement in order to improve the country's road safety profile. In addition to Zambia Police and RTSA, there is a growing presence of NGO's and the private sector who are focused on road safety. These alternative organizations are essential for improving road safety in Zambia.

The following section will show key data of road safety in Zambia followed by an analysis of the challenges and opportunities facing the sub-sector.

2.2.2 Field Survey

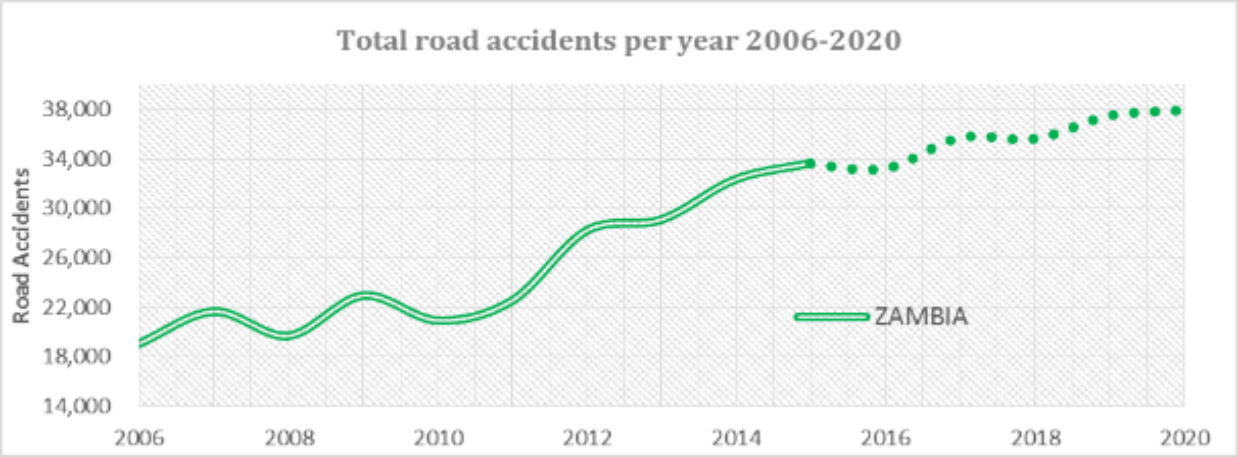
In 2016 a total of 32,350 road traffic accidents in Zambia were recorded, out of all road traffic accidents Lusaka accounted for 53.5% which the Copperbelt having 17.19%. The high density of both population and motor vehicles maybe the explanation for the high numbers surrounding

the capital city and Copperbelt. A majority of the traffic is along the T2 and T3 road connecting Lusaka, Copperbelt and Muchinga Provinces, a single carriageway with relatively high speeds In addition this is the main international freight artery through the country connecting Tanzania and DRC to South Africa by road. The mix between different road users including heavy trucks, private vehicles, public transport vehicles, bicycles and pedestrians create traffic conflicts. This corridor is of particular interest to the NTMP.

Table 2-3: Traffic accidents by Province 2006-2016 (source: Zambia Police Service)

YEAR	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Lusaka	10,513	10,889	11,180	11,430	11,055	11,498	13,687	15,435	17,028	17,661	17,317
C/belt	4,105	5,400	3,442	6,137	4,371	4,742	6,196	5,277	5,868	5,808	5,561
Central	1,047	1,382	1,311	1,339	1,402	1,384	1,763	1,882	2,362	2,547	2251
Southern	1,279	1,431	1,234	1,074	1,128	1,335	1,674	2,034	2,004	2,051	1757
Eastern	632	693	469	769	787	941	1,273	1,075	1,220	1,431	1600
Northern	443	569	493	605	581	678	429	409	532	533	542
Luapula	185	190	246	213	304	251	273	229	292	553	684
N/ western	549	735	882	1,017	863	1,109	1,527	1,533	1,525	1,464	1326
Western	342	401	470	394	471	632	781	664	896	906	689
Muchinga	-		-	-	-	-	644	580	665	718	623
Zambia	**19,095**	**21,690**	**19,727**	**22,978**	**20,962**	**22,570**	**28,247**	**29,118**	**32,392**	**33,672**	**32,350**

Figure 2.2: Total road accidents per year 2006-2020(source: Zambia Police (traffic), RTSA)



The trend from 19,095 total accidents in 2006 to 33,672 in 2015 shows overall increase in accidents of 76%. RTSA forecasts show a steady increase in this trend with a further increase in total traffic accidents of 12% from 2015 to 2020. The most significant trend can be seen in the Lusaka province with an increase of 168% in just under ten years. Again the impact of

increasing motorization rates in the country's most populated city is correlated with increasing traffic accidents.

In the 2015 Accident Report published by RTSA, statistical analysis shows a high correlation between the total number of registered motor vehicles and total number of traffic accidents. The statistically significant conclusion of the test shows that car registration increases explain approximately 95% of the increase in traffic accidents. This result paired with the increase in traffic accidents in the Lusaka region illustrates one of the challenges for road safety in Zambia in the short and long term.

Despite efforts by RTSA, Zambia Police Service and other stakeholders, in line with the United Nations goal to stabilize and reduce road crash fatalities by the year 2020, there is still a clear year to year increase. From 2006 to 2016, annual road accident fatalities have increased from 1,176 in 2006 to 2,206 in 2016; figure 3-4 illustrates this trend. Clearly fatal accidents are still of major concern in the immediate and long term. The major contributory factors to the accidents and fatalities are speeding, fatigue, driving under the influence of alcohol and other intoxicating substances and the non-use of seatbelts and child restraints.

Figure 2.3 Total road fatalities per year 2006-2020 (source: Zambia Police Service)

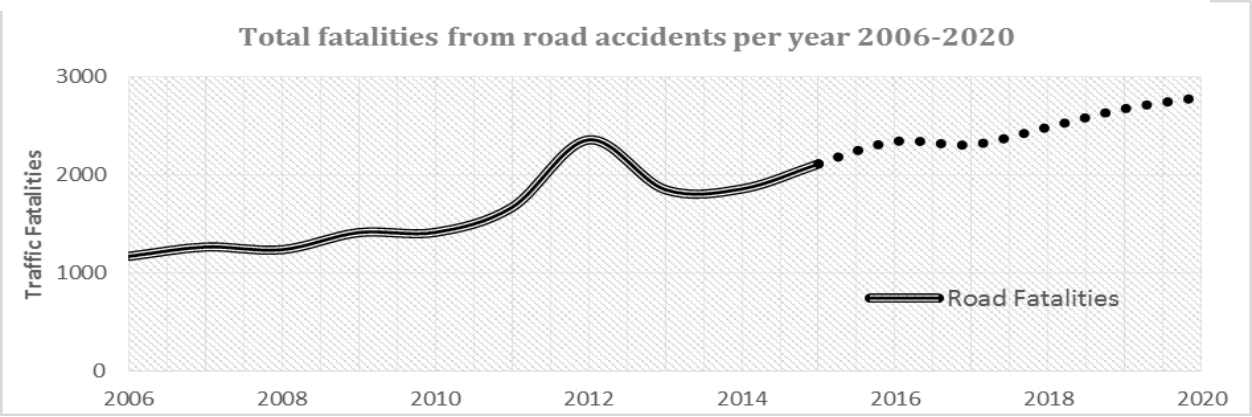


Figure 2.4: Total road fatalities per year 2006-2016 (source: Zambia Police Service)

Overall Zambia has relatively safe roads in comparison with other countries in the region but clearly there is much to improve (WHO 2014). This section has shown that total accidents in Zambia has continued and is expected to increase up to 2020, the trend for fatalities caused by road accidents is similar. Pedestrians are shown to be the most vulnerable road users in Zambia with a high measure of fatalities in 2016 accounting for 42.5%.Motor vehicle passengers ranked high in term of serious injuries in the same year representing 50% of the serious injuries. Finally, the main transportation corridor covering the Copperbelt, Central and Lusaka provinces is the location for a large majority of the country's road accidents.

2.2.3 Key Sector Development Projects

Table 2-4 Road safety sector key development projects

Project	Description	Status
Design, Installation and Implementation of an Intelligent Transport System (ITS)	Major highways are facing road traffic challenges in terms of congestion and increased road crashes. To apply information and Communication Technology in road transport infrastructure for traffic surveillance, traffic and mobility management	Phase 1 establishment
Construction of Motor Vehicle Inspection Centers	Upgrading infrastructure for motor vehicle inspection.	Pre Planning
Mechanized Motor Vehicle Testing equipment	Currently most of the motor vehicle inspection is conducted manually and hence subjective, There is need to mechanize motor vehicle inspection of the Zambian Motor Vehicle population in order to improve road safety.	Pre Planning
Accident Information System (AIS)	Utililisation of a computer based accident recording	Pilot phase
Road Traffic Signing	New road traffic signing across Zambia	Planning

2.2.4 Impact of the NTMP

The NTMP takes road safety as a very serious issue. For this reason it is one of the key indicators in the multi criteria analysis included in this project. All road safety projects are highly recommended within the master plan with a special emphasis on the use of a computerized Accident Information System. This advent will allow the Zambia Police Service and RTSA to ascertain the geographic location of road accidents and apply resources to decrease these through appropriate countermeasures.

2.2.5 Sector Conclusions

RTSA offer a number of conclusions in their 2015 annual accident report and they are as follows:

- Increase the number of officers in Enforcement and Education and publicity units. Education awareness campaigns are more effective they are supported by enforcement activities;
- Engage and bring on board stakeholders to fight the scourge on road carnage;
- Roll out of accident information system (AIS) so that accurate and timely accident information is collected for appropriate interventions and policy formulation;

- Invest in Intelligence Transport System (ITS) to monitor road user behavior especially motor vehicle drivers. ITS will supplement the efforts of enforcement officers whose numbers should be increased. ITS will also save as a data capturing tool.

This is a good list of recommendations and the lack of high resolution geographical location of accidents is a serious limitation to the relevant road safety institutions ability to decrease total accidents. Establishment of a method for mapping the location of road accidents on a national level is very critical as this will allow RTSA, Zambia Police and the RDA to determine those problem areas in the road network that contribute to road accidents. Location information can be recorded by hand and geocoded or logged on site using GPS data loggers. This is an essential dataset to ascertain those roads and intersections which are most dangerous so that infrastructure and policy improvements can solve them in a focused manner.

2.3 Railway Sector

2.3.1 Introduction

Even though, historically Zambia's development has occurred largely along the line of rail, currently, the share of rail transport for both passengers and freight, has continuously been diminishing, in favour of road transport. It is estimated that at independence (1964), the share of rail in goods movement was approximately 70% of the total, whereas today it is only 10-15%.

Over the last decades, rail has experienced a vicious cycle of continuous decline: Poor maintenance and lack of reinvestment, leading to poor quality of service and long travel time, and thus to declining demand and revenues. Insufficient revenues lead to further decline in quality of service and further deterioration of railway infrastructure. It seems that the biggest single setback suffered by the rail mode against road, in terms of competing for the market share is the low average speeds of rail transport, resulting from the poor state of the rail track, inadequate rolling stock, and signalling and telecommunications system. The same can be said for human resources in the sector as the sector skills for succession and sustainability are lacking. Re-skilling and capacity building will need to be part of the reformation and transformation of the railway sub-sector.

Investments in the railway sub-sector have been minimal compared to the road subsector. This discrepancy in the investment levels has made road transport to be much faster and more reliable and consequently leading to declining market share by rail and ever-increasing market-share by road. This market-share switch has occurred in spite of the fact that international experience has clearly shown that rail has a significant cost advantage (per ton-km) particularly for heavy and bulk haulage. In Zambia, a large share of both exports (i.e. copper, other minerals and agricultural product) and imports (i.e. fertilizers, construction materials and oil products) are bulk and heavy products. In order to systematically implement railway projects that have been identified and prioritised in this document, MTC will develop a Railway Sector Investment Programme (RailSIP) that will incorporate various projects and the required financing mechanisms. Zambia, being a land linked country lies in the centre of the Southern

African Region, and as such relies heavily on her neighbours for vital surface and sea routes to various import and export destinations. The current surface transport routes are to Dar es Salaam, Walvis Bay, Lobito Bay, Durban, Beira, Nacala and Mpulungu Port.

SADC Development Corridors, which are largely rail routes provide accessibility to the eastern and western coasts of Africa, the Great Lakes Region, and others. Currently, Zambia relies most heavily on the East African Indian Ocean ports for its international trade. The development of Greenfield Railway Projects to link important entry and exit points is not only vital for facilitating smooth access to the outside world, but also for the overall boosting of trade in the African sub-region and making Zambia a competitive country for doing business.

Thus, railway routes in Zambia are not a stand-alone entity for serving internal demand, but rather part of a regional network serving international trade. Rehabilitation, upgrading and development of Greenfield railway projects will enhance the linking of the Zambian railway network to all the trade corridors in the sub-region.

There two major railway operators in Zambia are ZRL and TAZARA. Zambia Railways Limited (ZRL) is wholly owned by the Government of the Republic of Zambia, and is mandated under the Railways Act to operate both rail passenger and freight trains. The total ZRL rail network is 1,248 km. At present, ZRL has a total staff of nearly 1,000 with offices dotted throughout the railway network. The TAZARA railway network stretches from the port of Dar-es-Salaam on the East coast of Tanzania to Kapiri Mposhi in Central Zambia. It covers a distance of 1,860 km and connects with Zambia Rail way Limited (ZRL) at Kapiri Mposhi. The TAZARA railway infrastructure was built from 1970 to 1975, as a turnkey project, financed and supported by the Government of the People's Republic of China. At the time of its completion (two years ahead of schedule), the TAZARA was the single longest railway in sub-Saharan Africa. At the cost of, then, US$ 500 million to build, the TAZARA was the largest single foreign aid project undertaken by China.

2.3.2 Field Survey

2.3.2.1 Zambia Railways Limited infrastructure

The current ZRL total route length is 1,248 km, of 1,067 mm gauge, single track, and is made up of the following main routes:

Table 2-5: ZRL Existing Line in Kilometers

ZRL – Existing Rail Line	Length (Km)
Mainline – Victoria Falls Bridge to Kitwe	848
Various Branch Lines	149
Choma – Masuku Line	65
Mulobezi Line	162
Chipata – Mchinji Line	24
Total	**1,248**

The current average train speed is 30km/h and 40km/h for freight and passenger trains respectively. In order to increase train speeds further ZRL has to complete ballasting, tamping and welding of the track. Sleepering and other maintenance projects have lagged behind

because of lacking funds and continuously falling revenues. Significant investment for the rehabilitation and upgrade of the railway infrastructure is required in order to fully resuscitate the operations of ZRL.

Table 2-6: ZRL track rehabilitation progress as of December 2014 (source: ZRL 2014)

Activity	Rehabilitated Track (Km)
Re- Sleepering Involving 442 Km of the Track	137
Deep Screening Involving 524 Km of the Track	478
Tamping and aligning of the track 966Km	211
Ballasting of 966 Km of the Track	79

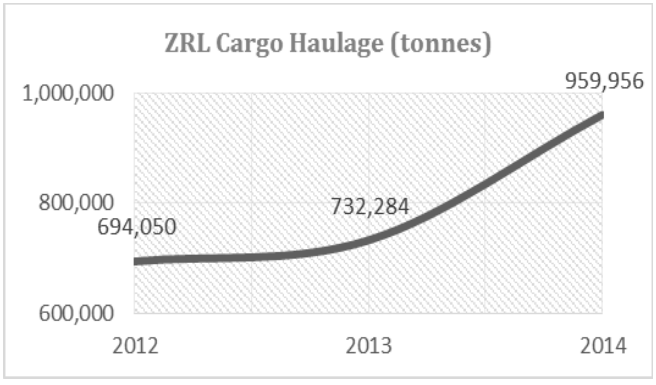
Regarding rolling stock, the company is also in a state of disrepair and requires funds for refurbishment of existing equipment and the purchase of new equipment. ZRL has a total of 37 diesel electric locomotives out of which 25 are operational and 12 are defective and extensively cannibalized. The company has 2,094 wagons of various types out of which 1,351 are operational, 93 are scrap and the rest 650 are defective. ZRL has a total holding of 56 passenger coaches of various types and it offers passenger services on the following routes:

- Ordinary train between Livingstone and Kitwe (Kafue Train);
- Ordinary train between Livingstone and Mulobezi (Mulobezi Train);
- Ordinary train between Kapiri Mposhi and Nakonde (Chambeshi Train);
- Express train between Lusaka and Livingstone (The Golden Jubilee Michael Chilufya Sata Express Train)

2.3.2.2 Zambia Railways Limited Service Performance

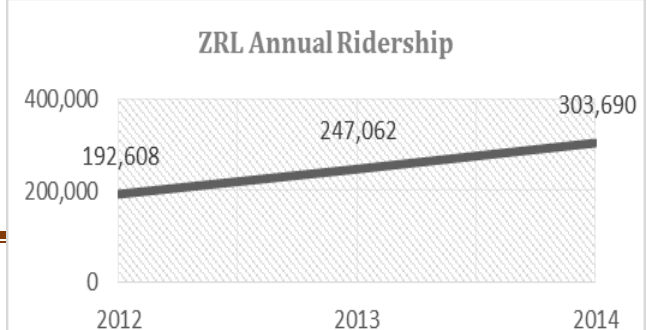
The performance of ZRL has continued to improve from 2012 when the Government took over the management of the company from Railway Systems of Zambia. Annual cargo traffic has increased from approximately 600,000 tonnes in 2012, to 730,000 in 2013, and close to 1.0 million tonnes in 2014.

Figure 2.5: ZRL Cargo Haulage 2012-2014 (source ZRL: 2015)



Total cargo hauled in 2015 was approximately 900,000tons. Of which, 25% were imports, 36% exports, and 34% local. Inter-mine accounted for only 1% of total, and 4% transit (from other countries, via Zambia).

Figure 2.6: ZRL Annual Ridership 2012-2014 (source: ZRL 2015)



Since the cancellation of the concession in 2012, performance in terms of the number of

passengers moved by train has continued to improve, annual passenger travel by ZRL increased from below 200,000 in 2012 to over 300,000 in 2014.

2.3.2.3 TAZARA infrastructure

The TAZARA stretches from the port of Dar-es-Salaam on the East coast of the United Republic of Tanzania to New Kapiri Mposhi in Central Zambia. It is a single track with 45 kg/m steel rail. Track gauge is 1,067 mm. TAZARA route covers a distance of 1,860km and connects with Zambia Railway Line (ZRL) at New Kapiri Mposhi. According to TAZARA Management, the average travel time for the entire route is 48 hours.

TAZARA has also suffered over the years from underfunding, something which has negatively impacted the railway infrastructure and rolling stock. The TAZARA passes through a number of difficult sections in both Zambia and Tanzania. In Zambia the portion of the network between Kasama and Nakonde is the most difficult and accident prone section. Railway maintenance activities are being undertaken to resuscitate these section. As a result of the low track capacity and insufficient rolling stock, it has been extremely difficult for TAZARA to compete with road transport leading to reduced market share of freight haulage over the years.

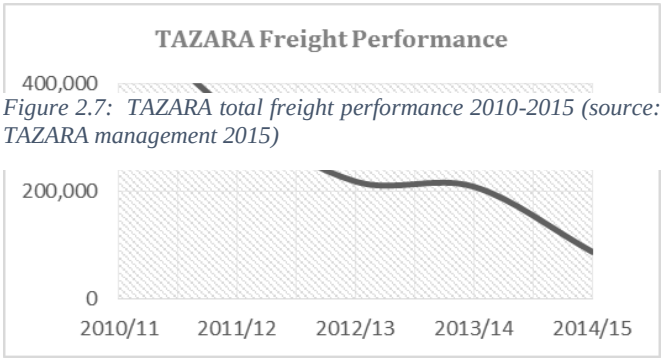


Figure 2.7: TAZARA total freight performance 2010-2015 (source: TAZARA management 2015)

2.3.2.4 TAZARA Service Provision

TAZARA freight performance by commodity, 2010/11 to 2014/15 has been in decline. While in 2010/11 TAZARA carried over 500,000 tonnes total, in 2014/15 it carried less than 100,000 tonnes. The largest share of commodities carried in 2014/5 are: Fertilizers 22% and Maize 27%. Copper accounted for only 12% and cement 11%. Loaded containers accounted for only 8%.

Table 2-7: TAZARA Freight Performance 2010/11 to 2014/15 (tonnes) (source: TAZARA management 2015)

Commodity	2010/11	2011/12	2012/13	2013/14	2014/15
Total	533,974	339,094	218,285	208,538	87,860

Total Freight Revenues have fallen from over US$ 27 million in 2011/12 to less than US$ 6 million (4.5 times reduction) in 2014/15; while total operating cost were reduced from approximately 40 million to approximately 28 million, due to reduced train operations. In 2014/15, total revenues of passenger and freight was US$ 9.9 million, and total operating costs 27.9 million, resulting in total operating loss of US$ 18 million.

Table 2-8 Key performance indicators including revenue and expenditures (source: TAZARA management 2015)

Key performance indicators	2011/2012 (Actual)	2012/2013 (Actual)	2013/2014 (Actual)	2014/ 2015 (Actual)

Total traffic freight (ton-km in millions)	484	258.3	239.8	100
Total passenger traffic (passenger-km in millions)	288	84.2	203	130
Locomotive utilization (km/loco/day)	159.5	292	176	197
Wagon turn-around time (days)	28.9	37.9	48.5	105
Track speed restriction (km)	106.5	118.5	129	126.3
Total Revenue - freight (US$ million)	27.29	16.2	16.7	5.8
Total revenue – pass. (US$ million)	5.09	4.5	4.2	4.1
Total operating cost (US$ million)	**39.83**	**32.6**	**42.5**	**27.9**

2.3.3 Challenges and opportunities

2.3.3.1 ZRL Challenges and Opportunities

The ZRL, Strategic Business Plan, 2013 indicates the following weaknesses and threats to ZRL, in the period 2014-2018:

1. Poor State of the Railway Infrastructure – Due to current condition of the rail track, freight and passenger trains move at an average speed of only 35 Km/hr. This has resulted in long transit time, and to the overall inefficiency of the train service;
2. Lack of Reliable and Adequate Rolling Stock – The current rolling stock (wagons and locomotives) are also in a deplorable state and, therefore, cannot fully support the transportation of both freight and passengers in a sustainable manner.;
3. Problems In Contiguous Rail Administrations – Being a land locked country, ZRL is linked to neighbouring railway administrations and, therefore, the performance of these rail entities have a great impact on ZRL as over-border traffic must be hauled through other countries to different ports, such as, Durban and Dar-E-Salaam;
4. Land Encroachments and rampant vandalism- The people of Zambia have continued to illegally occupy the ZRL railway reserve land and causing damage to the railway infrastructure and rolling stock;
5. Inadequate real time monitoring of trains- ZRL lacks a signaling system and ICT infrastructure/ systems to facilitate real time monitoring of train operations.
6. Inadequate connectivity to new industries and production centers for various commodities- ZRL is faced with the challenge of lack of funds to enhance its connectivity.

Following these challenges, the market share of the rail sub-sector has been continuously declining. ZRL reported that in 2013, the average freight market share (mainly with roads) was only 12% and in passengers trips only 8% and10% (2013 and 2014 respectively). The mining, agriculture, energy and manufacturing industries are the largest users of rail transport. ZRL's market share goals for 2013 and 2014 for passenger ridership were exceeded. ZRL's passenger market share was at 7% in 2012. The company projected to increase the freight market share to 8% in 2013 but achieved 9%. A total of 247,062 passengers were moved by

rail against the projection of 211,000; and in 2014, a total of 303,690 passengers were moved against the projection of 280,000.

***Increase Freight Traffic Market Share*.** The total Zambian freight traffic market size (by all modes), was estimated at about 10.0 Million metric tons in 2014, and was projected to grow to almost 12.0 million metric tons in by 2018. ZRL's corporate goal, as stated in the Strategic Plan, is "to begin to move 5 million metric tons per year from 2018". This is quite an ambitious plan, which implies reaching about 42% market-share of freight traffic.

Table 2-9: Cargo Traffic 2012-2014 and projections to 2018 (tonnes) (source: ZRL Strategic Plan 2014)

Segment	2014	2015	2016	2017	2018	Projected Growth 2014-2018
Total	1,000,000	1,600,000	3,044,000	4,400,000	5,000,000	500%

ZRL Strategic Pan, 2013, estimated that in order to achieve its goals and attain the projected profit levels (not shown here), it needs an investment of US$ 379 million (2013 prices). These funds are expected to be sourced with the help of the Government and other cooperating business partners, including through Public Private Partnerships (PPP). The capital needs are mainly in rolling stock, where ZRL intends to procure 2,600 wagons and 13 new GT locomotives. Furthermore, operations will be boosted with the introduction of the latest technology in rail transport which will eventually result in a safer railway network.

ZRL maintenance. The most critical issue facing ZRL is its inability to compete with road transportation. This is largely attributed to low service levels which is a direct product of inadequate track and rolling stock maintenance. Up to 2017 the annual maintenance budget of ZRL is only 5 million USD which is not nearly high enough to provide an acceptable level of service. International best practice recommends a conservative maintenance rate of 2% of the total value of the infrastructure per year. The consultant estimated that the total value of ZRL infrastructure s at approximately 2 billion USD, meaning that the annual maintenance budget should be 40 million USD. This application of resources is essential for improving the poor state of the railways and has been considered in the action of this master plan.

2.3.3.2 TAZARA Challenges and Opportunities

As in the case of ZRL, TAZARA is facing similar problems, namely:

1. Poor State of the Railway Infrastructure – Due to current condition of the rail track, freight and passenger trains move low operational speeds, this has resulted in long transit time, and to the overall inefficiency of the train service;
2. Lack of Reliable and Adequate Rolling Stock – The current rolling stock (wagons and locomotives) are also in a deplorable state and, therefore, cannot fully support the transportation of both freight and passengers in a sustainable manner;
3. Problems In Contiguous Rail Administrations – Being a land locked country, ZRL is linked to neighbouring railway administrations and, therefore, the performance of these rail entities have a great impact on TAZARA as over-border traffic must be hauled through other countries to different ports, such as, Durban and Dar-E-Salaam;

4. Diminishing TAZARA Market Share to Almost Zero – The TAZARA management reported that it is estimated that out of the cargo through the Dar-es-Salaam, Port destined to places where the railway serves, only about one percent is currently moved by the railway. While the Dar-es-Salaam Port handles increased freight volumes per annum, the volumes transported by the railways are diminishing.

2.3.3.3 Cross Cutting Opportunities in the Rail Sub-sector

1. Availability of training institutions offering technical programmes that can be used to offer railway tailored programmes.
2. Existing railway operators have already established training centres that can be revamped to offer specialized training;
3. Exponential growth in the mining, agriculture and manufacturing industries;
4. Favourable legal framework to support the railway sector.
5. Introduction of road tolling.
6. Planned construction of green filed railway projects by the GRZ.

2.3.4 Key sector development projects

Table 2-10: Rail Sector Key Development Projects

Project	Description	Status
TAZARA - Kasama-Nakonde Rerouting	Rerouting and upgrade of rail section for safety and speed	Concept Development Stage
TAZARA - Kapiri-Nakonde track rehabilitation	Rehabilitation of railway infrastructure	Awaits conclusion on the business cooperation model
ZRL – annual maintenance	Maintenance of all aspects of ZRL infrastructure	Ongoing
ZRL – Comprehensive rehabilitation and upgrade	Rehabilitation and upgrade of railway infrastructure and acquisition of rolling stock	Procurement Stage
ZRL – Mainline signaling	2 Phase project implementing signaling systems on ZRL mainline	Awaiting funds
Serenje-Chipata greenfield railway	388 km of track providing connection to the port of Nacala, Mozambique	Mobilization of funds by the contractor
Kafue – Lion's Den	304 km of track providing connection to the port of Beira, Mozambique	Concept paper and TORs prepared
Chingola-Solwezi-Jimbe	600 km of track connecting Chingola to Jimbe via Solwezi.	Awaits conclusion of the
Nseluka- Mpulungu	192 km of track to connect TAZARA to the port of Mpulungu and the Great Lakes Region	Feasibility studies, preliminary and detailed engineering designs completed.
Livingstone-Kazungula-Sesheke	200km of track to connect ZRL network to the Namibian Rail network and the Port of Walvis Bay	Feasibility studies and preliminary designs completed.
Fast passenger rail	Upgraded passenger rail between Livingstone – Chingola	Pre Planning

2.3.5 Impact of the NTMP

A strategic shift to increased rail utilization for both passenger and freight transport is a major subject of the NTMP and the GRZ. Rail has been shown to be expensive and difficult to manage in Zambia and most African countries with an almost tragic history of investment and

wastage. There is no reason for this trend to continue in Zambia's future and properly planned and controlled investment in the sector can promote competitiveness and cost efficiency in the long term.

One of the key issues in the rail sector's inability to compete with road borne transport for both passenger and freight transport is a inadequate track and rolling stock capacity and maintenance. Maintenance is a difficult concept which neither wins elections or new development contracts, however it is the lifeblood of the transport system. The RDA has wholeheartedly accepted the importance of maintenance as a significant portion of its annual road sector budget. ZRL has acknowledged the importance of maintenance however significant backlogging of essential upkeep has made rehabilitation the focus of the company's efforts. Maintenance must be made the highest priority of the rail sector.

This master plan completely supports all project for both ZRL and TAZARA which are aimed at rehabilitating and improving existing infrastructures. The rationale for this support being that the provision of a high quality, core service with a reasonable operating speed and frequency will allow the rail sector to become competitive in some measure and begin growing its market share. This positive trend will lead to sector development in the future as well as modal shift toward the more sustainable mode. The extreme case of this core network focus is the upgrading of passenger services along the country's central corridor. This high quality service is projected to cause modal shift, reduce road accidents and spur economic development by providing accessible mobility for a broader population than that served by private vehicles. These unique projects are described in detail along with recommended Greenfield freight rail projects later in this report.

The master plan is cautious however, when considering Greenfield freight rail projects. There is no precedent in these projects which will guarantee the people of Zambia responsible management of such expensive and intensive projects. The debt which may be incurred by the State of Zambia when committing to these larger projects may very well outweigh the benefits when considering the difficult part of the rail sector in the country and its difficulty to compete with road transport.

To conclude, the master plan is supportive of rehabilitating the sector with a focus on existing railway infrastructure and establishing acceptable market shares through the utilization of intermodal hubs and reasonable operating speeds and frequencies prior to the commitment of larger Greenfield freight rail projects.

2.3.6 Sector Conclusions

1. Zambia's rail sub-sector is in a state of disrepair resulting from low revenue and investment
2. Railway performance continues to decline because of significant maintenance backlogs and a lack of investment in new infrastructure and rolling stock

3. Market share for both passenger and freight traffic have declined significantly; the railways cannot compete with road transport
4. Development plans and rehabilitation are very expensive and time intensive
5. ZIPAR report warns against significant investment of public funds in the sub-sector citing the high risk of financial loss and market failure
6. Direct comparison between road and rail transport reveals a complex story with no one mode better than the other
7. Rail transport for freight can be sustainable and cause sustainable mobility practices such as intermodal transport
8. Investment will need to be carefully considered to ensure:
    - Cost efficiency
    - Competition
    - Sustainability

2.4 Maritime and Inland Waterways

2.4.1 Introduction

Zambia's Inland water transport (IWT) is one of the oldest economically and environmentally sustainable modes of transportation for people and goods, particularly in those areas where the means of mobility and accessibility is by canals and waterways (rivers, swamps and lakes). This is the case in some stretches of the Zambezi flood plain, Kafue flood plains, Chambeshi and the Luapula Rivers, and the larger waterways of Lakes Kariba, Bangweulu, Mweru, Mweruwantipa and Tanganyika.

In order to strengthen the management of water transport, the MTC has embarked on an ambitious process of establishing a Maritime and Inland Waterways Authority by introducing a piece of legislation in Parliament. According to the findings of the experts from the International Maritime Organization (IMO), who conducted a needs assessment mission in 2014, both the Inland Waterways Act Cap 466 and the Merchant Shipping Act Cap 468 of the laws of Zambia are out dated and require total repeal and new legislations passed. In this regard, the department is working on drafting a new piece of legislation to replace the outdated ones.

The Zambia Government policies on transport as a whole and Maritime and inland waterways in particular are contained in several policy statements including the Transport Policy 2002, the Revised Six National Development Plan 2011-2015 and Zambia Vision 2030. As derived from the " *the Transport Policy of 2002"*The goals of the policy on maritime and inland waterways is to attain a developed, safe, efficient and sustainable maritime and inland waterways transport system in order to promote national economic development and regional co-operation. The SNDP document provides a number of objectives, strategies and programmes for Maritime and Inland waterways as follows:

Table 2-11: Objectives, strategies and programmes for the Maritime and Inland Waterway sector (source: SNDP

Objectives	Strategies	Programmes
To bring the core canal network to navigable condition in order	Develop a rehabilitation and maintenance plan for canals;	Canals and Waterways Rehabilitation and

to improve water transport facilities	Secure financial resources for labor based methods; and Procure dredging equipment.	Maintenance in all Provinces
To build capacity in the sector and Produce qualified and skilled personnel.	Develop a training school master plan; Encourage PPP in maritime training; Secure technical assistance from the International Maritime Organization (IMO)	Establish Marine Training Schools.
To enhance safety of navigation in order to save lives and property on waterways	Secure financial resources and procure equipment; Undertake capacity building; and Construct Light House and Navigation Aids.	Navigation Aids/radio communications
To facilitate efficient and effective clearing of goods at major ports in order to decongest the border posts	Secure land; and Encourage PPP in the development and management of the facility,	Establish Inland dry Ports, Sea Ports, Dry Port and terminal Port Facilities
To facilitate the efficient and effective means of construction of canals and waterways	Secure financial resources; and Build capacity of end users dredging equipment.	Procurement of Dredging equipment
To provide transport to communities for social economic sustenance	Secure financial resources; and Encourage private participation in water transport service provision	Procurement of vessels

The Department of Maritime and Inland Waterways was established in the Ministry of Communications and Transport by a Ministerial Administrative Directive in 1994 without any legal instrument. The Department is responsible for all matters relating to the Inland Water Transport, ports and shipping.

The Department is charged with the following functions:

1. Maritime (Ports and Shipping);
2. Survey and Registration of Vessels;
3. Boat crew testing and Licensing;
4. Regulatory and Enforcement of the Act;
5. Management of the inland Waterways Navigation;
6. Development and Maintenance of Canals and Waterways (Dredging) and Infrastructure such as port terminals, quays warehouses etc;
7. Licensing and Registration of Vessels and Motorised Boats;
8. Enforcement of Legislative measures aimed at promoting Safety of Navigation , Search and Rescue and Environment Protection;
9. Regulate Harbours and Ports operations;
10. Promoting private sector participation in shipping services;

2.4.2 Field Survey

2.4.2.1 Present Situation of Canals and Waterways

MTC survey: "*Report on the preliminary survey of canals and waterways in Central, Copperbelt, Muchinga, Northern, Luapula, Northwestern and Western Provinces*" presents the physical and hydrological status of waterways in various provinces of Zambia as updated under the survey conducted from October to November, 2013. In addition, the report analyses the

socio-economic status of communities dependent on water as the source of livelihood in the respective provinces.

The conclusions of the 2013 survey are as follows, Zambia has approximately 2,700km network of navigational canals and waterways. However, the water transport mode has not been utilized to a significant degree due to the lack of maintenance of inland waterways and canals. Most of the Canal maintenance has hardly been carried out as a result the canals and waterways are blocked by weeds, floating islands, sand dunes and sand banks thus making maneuverability of marine vessels difficult. The overall consequences of the situation are the isolation of the numerous remote and underprivileged communities.

2.4.2.2 Status of the Harbors

Apart from Mulamba harbour in Mongu and at Mpulungu Harbour which provides regional shipping on Lake Tanganyika, all the inland harbours visited during the consultant survey, require very urgent repairs as they suffer from the common problems arising from many years of neglect. There is a lack of Infrastructure facilities existent on all waterways, jetties are non-existent, and lack of transit warehouses; cargo-handling equipment and landing bays/platforms are none existent, lack of harbour administration. In addition to these problems and due to their remote locations, most of the harbours which were under government responsibility were privatised and have been turned into fishing companies, timber processing or in some cases abandoned completely.

However the government has realised the need to develop and modernize the inland harbours and therefore the problems are being addressed through various National development plans. According to the MTC Report "*Brief on the operations of the Department of Maritime and Inland Waterways, The Challenges and the way Forward"* The process has commenced and The department proposes to establish and strengthen harbour administration across the country and is proposing to increase the staffing levels.

2.4.2.3 Maritime Operations, Dry Ports and Port Terminal Facilities

The government of Zambia through the Ministry of Communications and Transport issued in November, 2007 a request for proposal on tender basis for "The establishment of air cargo hubs and dry ports in Zambia." The result of this was the planning of a number of dry ports and inland container depots. Unfortunately many of these projects never left the planning phase and those that exist are underused or plagued by bureaucratic difficulties. These ports will be included in the master plan as facilitators of trade for the Zambian economy.

Benefits to be gained by different stakeholders can be grouped as:

1. Economy of Zambia would benefit by having a facility that adds-value to the activities of its members, promoting increased levels of inter-regional and international trade.
2. Well-run and efficient dry port leads to reduced costs for importers, while increasing the potential competitiveness of exports, through the various trade corridors to overseas markets.

3. Allows transport companies to improve turnaround of vehicles, increasing asset usage.
4. Allows rail operator to run block trainloads to the dry port facility, discharged quickly with managed wagon turnaround, increasing asset usage.
5. Shipping lines have an opportunity to streamline their supply chain from the origin to the ultimate destination of the journey, Zambia
6. Allows logistics service providers such as freight forwarders, warehouse providers and handling agents to receive and consign cargoes from anywhere in the world.

Establishment of dry ports in Zambia is meant to fulfill the need within the Zambian economy to provide cost effective and efficient logistics services to all the players in the movement of foreign trade in Zambia and the nearby region. The dry port will be the core of a logistics activity zone and become one of the cornerstones upon which Zambian foreign trade could be developed. This initiative will in itself also form a major catalyst and contributing factor to the overall economic development of not only Zambia but the SADC region and will culminate into bringing about reduction of poverty and a better way of life for the people of the region.

The lack of efficient operations at sea ports in the region such as Dar es Salaam and the land transport to them has posed major challenges to the smooth flow of trade between Zambia and the world market. This situation has caused congestion in the ports leading to slowed movement of cargo and penalties for Zambia importers. Limited transit period for cargo destined for Zambia leads to accumulation of storage charges. This situation therefore necessitated the need for the Zambian Government to establish facilities at ports:

i) Mukuba Depot - a Port Terminal Facility at Kurasini Area near the port of Dar es Salaam in Tanzania to facilitate the quick movement of freight traffic from the Port of Dar es Salaam into the hinterland of Zambia.
ii) Walvis Bay Dry Port/Port terminal Facility - which is a Zambian controlled area inside the main Port of Walvis Bay. The port of Walvis Bay provides the shortest trade route between Europe, The Americas and the SADC Region.
iii) Zambia copper yard port terminal facility at the Port of Mombasa - this was a Zambian controlled area within the Port of Mombasa. The facility was abandoned after the privatization of the Zambia Consolidated Copper Mines (ZCCM). The Government is keen to reclaim the facility.

These facilities require the government to continuously review the corridor transport strategy to constantly provide cost effective and efficient logistics services to all the players in the movement of foreign trade in Zambia, and the nearby region.

2.4.3 Challenges and Opportunities

2.4.3.1 Challenges for Water Transport Sector

(a) Data deficiencies

Deriving from the survey conducted by the consultant, little or no data exists on usage of waterways by people living along them. The review of developments in inland water transport

by ROM found a lack of data to adequately assess the role of inland water transport in passenger transportation. As a result of data deficiencies, it is difficult to quantify the economic importance of the sector or establish trends on which to base the policy.

(b) Prevailing Perceptions

The lack of accurate data as detailed above, reflects a lack of official interest in the sector. As a result, even where inland water transport enjoys favorable conditions, the sector is often ignored by existing government transport regulations and investments are markedly lower than its market share. It is important to note that significant populations are completely dependent on water travel for their daily basic needs.

(c) Funding Constraints

Table 2-12: Yearly Finding Requirement (USD) for the Transport Sector 2013-2016 (source: R-SNDP)

Sector	2013	2014	2015	2016	Total
Roads	4,254,494	7,694,155	11,444,202	8,359,32	31,752,171
Railway	812,765	432,865	142,560	135,450	1,523,640
Water	18,176	21,900	25,125	27,867	93,068

The sector is the least funded of Zambia's modes of transport based on the R-SNDP. It is hoped that this will be reconsidered in future development plans as a result of the clear need for investment in the sector.

(d) Limitations in speed and geographical reach

By its nature, the inland water transport network is limited. To function, it depends on an interface with land transport, which further slows down the process and increases its overall cost. A lack of public investment in docking facilities at a particular harbor increases the inefficiency, as much time may be wasted loading and off-loading passengers and cargo.

(e) High dependence on environmental conditions

Inland water transportation also suffers from the pronounced influence of current hydro-meteorological conditions, as navigable waterways dramatically reduce in many parts of Zambia during the dry season making many rivers and canals un-navigable.

(f) Safety

Safety is often compromised because RWT tends to be ignored by existing government transport regulations and environmental safety standards.

(g) Institutional bias

The institutional environment is often biased against the sector, as hidden subsidies disguise the costs of road transport and create the illusion of water transport as unviable alternative. Moreover, waterways users and operators lack the organizational and lobbying power to influence government decisions.

(h) Environmental concerns

Certain environmental problems and risks associated with water transport include canalization and dredging (reactivation of polluted sediments into surface waters); shipping operations (pollution through oil spills; noise pollution; risks of accidents with dangerous cargoes); and

import of invasive species: (bacteria and other microbes, small invertebrates and the eggs, cysts and larvae of various species): the introduction of invasive species into new aquatic environments by ships (through the ship's ballast water, attached to ships' hulls and via other vectors). An example on Lake Tanganyika, ship's polluted ballast water from ports of Burundi is discharged into clean environment of the port of Mpulungu.

(i) Lack of coordination in planning

Land transport interventions are often planned without consideration of their impact on traditional waterways (ie. bridges built without determining required height and hydro-power dams without by-passes for navigations). Eg. The construction of the Kafue Bridge across the Kafue River was done without a required height.

(j) Lack of Infrastructure at Harbors and Ports

Landing Jetties are non-existent, even transit warehouses, cargo-handling equipment and landing bays/platforms are none existent. Passengers have to wade through waters while boarding or alighting the vessels.

(k) Lack of Navigation Aids

Navigation aids are totally absent. There are no channel markings, beacon lights or other indicators, leaving operators at the mercy of navigational hazards.

(l) Lack of Workshop Facilities

Government workshop facilities are non-existent. When repairs are needed, the engines have to be dismantled and carried to distant places mainly in Lusaka and the Copperbelt. Availability of spare parts is another problem. This means that once vessels develop even minor problems, they will remain out of operational for long periods.

2.4.3.2 Opportunities for the Water Transport Sector

(a) Navigability

As Zambia's Waterways suffer from serious bottlenecks on account of physical impediments like siltation, weeds, mud, sandbanks etc. it is absolutely essential to arrange for the removal of these obstacles. The Government through the Ministry of Transport and Communications DMIW has put up measures to ensure that canals and waterways are navigable. The National Dredging Management plan for the year 2014 has been put in place for the whole country. In some shallow waterways especially during the dry season, use of long tail boats in use in Bangkok, Thailand is recommended

(b) Infrastructure

Highest priority should be given to strengthen such facilities at Mpulungu Port as it handles international traffic, which is vital to the region. At Lake Bangweulu, Mweru and Kariba and the Mongu-Kalabo waterways, minimum facilities like proper landing Jetties, small sheds and storage facilities must be provided to facilitate passenger and cargo traffic.

(c) Private Sector Participation

This should be encouraged in the operation of water transport services in line with the Transport policy of 2002. Experience with the functioning of the three parastatal organizations, namely, Bangweulu Water Transport, Mweru Water Transport and Post boat has shown total incompetence and inefficiency of parastatal corporations to handle water transport services. These agencies have failed to meet traffic demand, to maintain the vessels fit for operation and make operations viable as they survive on Government subsidies and support.

(d) Facilities

These should be promoted and developed in a manner that at least minor repairs and routine maintenance can be undertaken near the place of operation without much difficulty.

(e) Vessel Design

These should be developed to suit the conditions prevailing on Zambian waterways especially with reference to the physical impediments. The design should aim at providing safety and comfort of passengers and cargo.

(f) Human Resource

This is of vital importance of the efficient operation of water transport service. Possibilities should be explored to provide the required training facilities at suitable institutions or training centers abroad.

(g) Dry Ports

Establishment of dry port facilities and the streamlining of operations at existing depots to ensure minimization of costs to Zambia's economy.

2.4.4 Key Sector Development Projects

Table 2-13: Maritime and inland waterways sector key development projects

Project	Description	Status
Mpulungu Harbor Modernization	Complete modernization of Mpulungu Harbor on Lake Tanganyika	In Progress
Port Terminal Facilities (ICD) Rehabilitation Program	Dar es Salaam – Mukuba Depot Mombasa Copper Yard Walvis Bay ICD (privately financed)	In Progress
Harbor rehabilitation projects	Projects distributed across Zambia for harbor rehabilitation: • Lake Tanganyika • Lake Mweru • Lake Bangweulu • Lake Kariba • Zambezi River • Kafue River • Chambeshi River	In Progress
Canal Rehabilitation projects	Provincial canal projects distributed across Zambia including a limited number of large scale canal projects	In Progress
Inland Waterways Master Plan	Long term strategy and prioritization of investments	Conceptual

2.4.5 Impact of the NTMP

A majority of the projects supported by the NTMP for the maritime and inland waterways sector are in progress projects which have been defined in the past as essential. The focus of the master plan is to allocate resources for the successful completion of these stalled and backlogged projects as they will provide the essential accessibility along the waterways which is necessary for the populations who rely on the sector for their basic daily needs.

2.4.6 Sector Conclusions

1. Significant populations are dependent on water transport for their most basic needs
2. The Department of Maritime and Inland Waterways does not have the capacity to collect the statistics it requires to assess the current situation of the sector and appropriately apply resources to make a difference
3. Port and harbor facilities are in disrepair throughout the waterway system
4. Canal rehabilitation is greatly slowed by limited funding and dredging equipment
5. Dry ports provide numerous positive gains for Zambia, expansion may be financially beneficial however progress has not been made over numerous years to implement these facilities
6. The creation of a governing authority for the maritime and inland waterway sub-sector will have important benefits for the management and maintenance of Zambia's waterways

2.5 Aviation Sub-sector

2.5.1 Introduction

The aviation sector in Zambia is under the responsibility of three institutions, namely ZCAA, ZACL and ZASTI. The aviation sub sector is regulated by the Zambian Civil Aviation Authority which is under the Ministry of Transport and Communications. Since its formation in 2015, the ZCAA has worked to upgrade Zambia's rating in all the key parameters of compliance in line with ICAO Standards and Recommended Practices (SARPs). The ZCAA has worked to improve Zambia's Effective Implementation (EI) rating from an average of 46.7% to 62.4%, which is above the world average of 60%. This is not a small achievement considering the short period of time within which this has been achieved.

The upgrading of the status of the civil aviation sector in this regard widens the scope of opportunities for sectors such as tourism and international business, whose growth and development is reliant on an efficient and competitive air transport environment.

ZACL is currently responsible for management of four International airports across Zambia, namely, Kenneth Kaunda International Airport (KKIA) in Lusaka, Simon Mwansa Kapwepwe International Airport (SMKIA) in Ndola, Harry Mwaanga Nkumbula International Airport (HMNIA) in Livingstone and Mfuwe international airport (MFU). There is a proposal to

extend the mandate of ZACL to management of Provincial Aerodromes in Zambia while the district aerodromes will be managed by the Local District Authorities. It is therefore imperative to build capacity for the local authorities to run and manage the district aerodromes in line with standards to prescribe by the ZCAA.

ZACL has provided data which shows that air transport demand is increasing in recent years driven by tourism and international business travel. ZACL reported positive annual growth of 2.25% between 2015 and 2016 while there is a 4.34% increase between the first quarter of 2016 and the first quarter of 2017. This positive outlook for the aviation sector in Zambia has necessitated the Government of the Republic of Zambia to invest in the aviation sector to position regional hub for aviation.

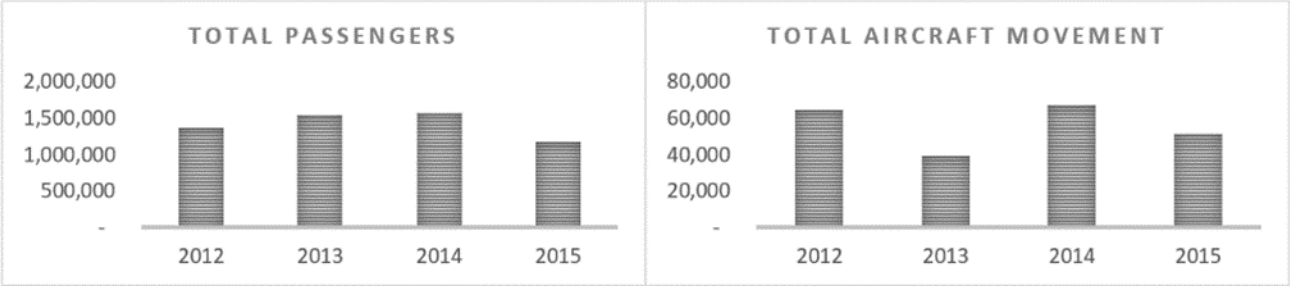
2.5.2 Field Survey

Zambia has four international airports; (i) Kenneth Kaunda International Airport, (ii) Harry Mwaanga Nkumbula International Airport, (iii) Simon Mwansa Kapwepwe International Airport and (iv) Mfuwe International Airport; four provincial and XX district aerodromes serve international and domestic flights. The four major (international) airports are managed by the Zambia Airports Corporation Limited (ZACL). ZACL is a major player in the Zambian aviation in that it provides airport infrastructure and services in the only four international airports that Zambia has.

Table 2-14: Passenger and Aircraft movement Data at International Airports, 2016(source: ZACL)

		Lusaka	Ndola	Livingstone	Mfuwe	Total
International Passengers	ARR	493,322	91,085	82,420	898	667,725
	DEP	496,677	91,927	90,242	1,348	680,194
	Total	989,999	183,012	172,662	2,246	1,347,919
Domestic Passengers	ARR	80,152	27,218	17,859	12,968	138,197
	DEP	77,271	27,154	18,959	12,763	136,147
	Total	157,423	54,372	36,818	25,731	274,344
Total PAX		**1,147,422**	**237,384**	**209,480**	**27,977**	**1,622,263**
Aircraft Movements	INT	17,518	4,668	4,386	811	27,383
	DOM	18,584	4,815	5,599	2,044	31,042
	Total	36,102	9,483	9,985	2,855	58,425

Figure 2.8: Left: Total passengers at international airports 2012-2015 Right: Total aircraft movements at international airports 2012-2015 (source: ZACL)



In addition to the major international airports, there are some 96 other registered aerodromes in the country, most are labelled as unserviceable which means that maintenance and upgrades are a challenge. The most common surface types for these facilities is either grass or gravel, which limits the type of aircraft which can land on these runways. These airstrips are used mainly by tourists, provincial medical services and light cargo delivery. There is little financial incentive to invest in small scale air fields such as these but it is important to preserve basic requirements in order to preserve a measure of safety.

Kenneth Kaunda International Airport in Lusaka is a chief port for air freight in Zambia. In 2014 approximately 20 million kilograms of cargo of all types passed through the airport. Nearly 98% of all cargo is international cargo meaning that domestic goods are mostly being transferred by road and not by air. Nearly 60% of international cargo is unloaded at the airport. This shows that Zambia is importing more goods than are being exported, at least by air. It is important to note that Zambia produces mainly mining products and agriculture goods, products which are generally not transported by air. In short it is important to consider the import/export situation of the country as a whole before making conclusions based on air cargo data.

In 2011, the Jacobs Consultancy prepared for the then National Airports Corporation limited a "Feasibility Study for the Zambia Airport Master Plan". The Study includes detailed feasibility study for each of the four International Airports.

Each report contains:

- Passenger and cargo demand forecast
- Demand/Capacity analysis and development of facility equipment
- Long-term development plan
- Assessment and potential Environmental Impact
- Capital Cost and investment requirements
- Financial Analysis and plan
- Public-Private partnership strategy
- Development impact considerations
- Identification of US suppliers

The four International Airports serve the principal business and tourism centres in Zambia, including Lusaka, the capital city and principal business centre; Ndola, a major city in the Copperbelt copper mining region; Livingstone, the location of Victoria Falls and the country's largest tourism attraction in terms of visitors; and Mfuwe, a tourism destination which serves the South and North Luangwa National Parks and also acts as an international gateway to Eastern Zambia. Other significant airports serving Zambia, such as those serving Chipata, Kasaba Bay, Lusaka (City) and Solwezi, are operated as domestic airports under the MTC. The Government is currently in the process of assigning all of these aerodromes to ZACL.

The Zambia Air Services Training Institute (ZASTI) is the key institution in Zambia which prepares Zambians to work in all branches of the aviation sub sector in Zambia. Presently the institution is striving to redefine itself as a regional centre of aviation training with courses teaching engineering, ground operations and piloting. Capacity building is required however to allow ZASTI to apply and receive the necessary ATO and ICAO Train Air Plus certifications and to procure simulators and other technologies to allow for world class training.

Zambia has no national airline but maintains an open sky policy by which multiple carriers utilize Zambia's airports. Thus, for international and regional air transport Zambia is heavily dependent on foreign carriers. Major connections are through Johannesburg, South-Africa, with other connections through Dar-es -Salaam, Tanzania; Nairobi, Kenya; and Addis Ababa, Ethiopia.

2.5.3 Challenges and Opportunities

At present the aviation sector in Zambia is in a favourable position. Its institutions are working well together to progress the sector in terms of service provision and infrastructure upgrade. Extensive work has gone into bringing Zambia's aviation industry too slightly above the world average of implementing ICAO SARPs. Significant resources have been committed to upgrading, rehabilitating and even constructing a new international airport. Finally, the upgrading of the terminal facilities at Kenneth Kaunda International Airport in Lusaka underlines Zambia's rise in the subject of air transport.

2.5.4 Key Sector Development Projects

Table 2-15: Aviation sector key development projects

Project	Description	Status
Kenneth Kaunda International Airport Upgrade Project	This airport will serve the Lusaka province in carrying both passengers and goods.	In Progress
Copperbelt International Airport	This airport will serve the Copperbelt and Northwestern provinces in carrying both passengers and goods.	In Progress
Mfuwe International Airport	This airport will serve the Eastern and Muchinga Provinces in carrying both passengers and goods	Financing/Negotiation
Provincial Aerodrome Program	10 key provincial airports for rehabilitation, organized into Lots 1, 2 and 3	In Progress
CAA Expansion and Capacity Building	There is need for capacity building of technical personnel, especially with regard to Economic	Pre Planning

	Regulation, Approved Training Organization (ATO) Certification, General Surveillance and Resolution of Safety Concerns. There is need to construct, furnish and equip the new CAA Head Office in order to accommodate the entire establishment in bespoke accommodation.	
ZASTI Capacity Building	4 projects focused on bringing ZASTI up to international standards as a center of excellence for aviation training in the region	In Progress
Nationwide adaptation or design of road portions as emergency landing areas to facilitate for the Zambia Aeronautical Search and Rescue Organisation (ZASARO)	There is need for nationwide adaptation or design of road portions as emergency landing areas for aircraft in distress or search and rescue missions. The Road Development Agency (RDA) should be mandated to spearhead this project. 20 Units	Pre Planning

2.5.5 Impact of NTMP

The master plan supports the continued development of Zambia's aviation sector. The sector doing much to progress aviation in Zambia, further development recommendations include capacity building for the regulator and better maintenance of aviation facilities. The ZCAA should increase its ability to ensure the safety and efficiency of the country's aviation facilities and operations. Maintenance, as in all transport sectors is important and should become the focus of the sector as so many infrastructures are currently undergoing upgrades or new construction.

2.5.6 Sector Conclusions

1. Aviation demand in the form of passengers and aircraft movements has remained relatively steady since 2012. Zambia's air transport capacity is growing;
2. Key airport facilities are either under construction or being upgraded; and
3. The establishment of the CAA has improved the regulation and development of the sub-sector.

2.6 Public Transport Sector

2.6.1 Introduction

Public transport is the means of movement for all peoples, it is available to the general public and clearly different from other modes like private cars or taxis. Public transport in Zambia is mainly by road, making passenger transportation by buses a very important player in the sector. Other methods of public transportation include rail, water and air however these modes transport relatively few passengers when compared with road transport. Historically the public transport sector was dominated by the public sector with most buses being run by a state owned Bus Company called United Bus Company of Zambia (UBZ). Through policy changes, and after liquidation of the state owned UBZ, the sector has become predominantly private sector driven.

This chapter deals with intercity public transportation in order to provide an overall review of that sector. A lack of clear administration at high levels means that data for this sector is rare with most knowledge being held in various informal formats at local municipalities. The consultant spent field time interviewing and surveying these actors but this process is not complete.

The highest mobility is experienced between Lusaka, the capital and the Copperbelt cities of Ndola and Kitwe, these routes are served mainly by bus transport. There is also some demand along the whole of the ZRL railway from Livingstone to the Copperbelt. Other highly travelled routes include the great East road into Chipata, Great North road leading to Central, Muchinga and Northern Provinces and Mongu route to western Province. As new roads are being created and improved there is a possibility of creating more travel demand in areas that once were considered remote and difficult to access.

The quality of this service can be measured from a number of criteria some of which are:

1. Comfort to the passenger, which is affected by the quality of vehicles they travel in and the quality of the roads that connect any two places being travelled;
2. Road safety:- Incidents of accidents may lead to loss of lives as well as property and livelihoods; and
3. Frequency of travel on each route

Today there is no official organization or agency regulating and advancing public transportation. The Ministry of Transport and Communications is responsible for this branch of transport in Zambia but in truth the most influential actors in the sector are local or private. Local actors include municipalities and bus station managers while private companies include different types of bus operators. Municipalities working under guidelines from the RTSA are charged with regulating and advancing public transportation. This system has is advantageous in that local municipalities have the best knowledge as to the needs of their citizens and can therefore define the most accurate service supply. This system, however has two major disadvantages, first, municipalities are limited in their ability to plan public transportation at a national level leading to lopsided supply and second, municipalities may not collect and transfer data at the necessary efficiency. This creates a public transport system which favors local decision making. The NTMP will work to define a larger scale strategy for improving and rationalizing the public transport system in Zambia.

2.6.2 Field Survey

2.6.2.1 Bus Service Provision

In areas where roads are congested, of low quality or non-existent, public transport will fail to provide a high level of service to the people. Where public transport is lacking, people will be less able to access employment and other basic services, this can cause an increase in private vehicle usage as well as a decrease in economic activity.

Bus operators choose routes based on profitability, this means that buses run based on the individual companies' rational. From the customer perspective this makes for an unreliable, unpredictable and infrequent service. This is an important point and one that has a negative correlation with use of public transportation, as level of service declines, ridership and use of public transportation also declines. This relationship causes a dangerous cycle where operators lose profitability and cease to provide service at all.

RDA traffic count surveys and consultant site visits show that the current situation in the public transport sector is chaotic. The main route for buses in the country is from the Copperbelt to Lusaka and buses are shown to be nearly always full. On the negative side data is not being collected consistently for this sector such that it is impossible to say based on data where service is lacking.

2.6.2.2 Bus Stations

Intercity bus stations are the focal point for intercity public transport. These stations are run by local municipalities and collect data regarding bus companies, passengers and bus departures. This data is not necessarily used to improve public transportation but more accurately as a method of charging a fee from the bus operators for using the bus stations.

Bus stations are not organized by any regulator, instead they are set up based on the logic of the market with different operators working out of various spaces in the bus station. Some stations such as Lusaka have a separation of buses based on destination, this set up actually increase healthy competition between buses as the customer can choose the service based on comfort, price and other variables.

Bus stations are centers of activity in any city and this is the case in Zambia. Buses are used not only to transport people bus also to informally transport goods, this use of vehicles for cargo provides another way from bus operators to profit and stay in business.

2.6.2.3 Rail Public Transport

Both railways systems provide limited passenger services. These services and their frequency are outlined in Chapter 4.5 of this report. ZRL provide services from the Copperbelt to Lusaka and from Lusaka to Livingstone in the south, train frequency is relatively low with service once every two days. TAZARA provides service between Dar es Salaam and Kapiri Mposhi one a week approximately. Passenger ridership data shows that the market share of both of these systems for passenger travel is very low.

2.6.2.4 Water Public Transport

Water transport is an important mode of travel in Zambia, the current status of this sub sector is outlined in chapter 4.6 of this report. Most movement is done informally on small boats which can traverse the variable water conditions. Limited transport options exit from Samfya, Mpulungu and Lake Kariba. Data on this mode of travel is limited at this time however plans to establish a Maritime Authority which will work to measure and improve water borne public transport.

2.6.2.5 Aviation Public Transport

While intercity aviation does exist in Zambia, it is very expensive and mainly reserved for tourists or special trips such as medical cargo. A chapter outlining the current status of this sub s3ector is outlined in chapter 4.7.

2.6.3 Challenges and Opportunities

There is no explicit mention of public transport in the Revised Sixth National Development Plan. The plan only discusses briefly the road sector, and then only deals with infrastructure development and not the operation of public transport. In addition the R-SNDP it only says that at the culmination of the plan period, the [transport] sector would have contributed to increased efficiency in the delivery of services in agriculture, health, education and other key sectors of the economy. It is also expected that there will be increased connectivity to tourist destination and productive sectors of the economy thereby contributing to economic growth. Regular maintenance and rehabilitation will also help reduce the cost of managing the Sector.

Zambia is a developing country and while the per capita GDP is increasing, a number of people still require public transportation for their daily needs. This is an extremely important revelation in the review of the sector's current status and further marginalization of the sector will only increase private vehicle use and degrade the economic potential of Zambia's citizens.

The newly completed transport policy has summed up some of the challenges of the road passenger transport in Zambia as follows:-

1. High public transport costs. On average, spending on public transport services accounted for 26% of all household expenses, with up to 40% for low-income households. This is a figure hi enough to deter people from taking the journey to work because of the cost of transport.
2. Lack of coordination and planning. There is a lack of coordination among different institutions and agencies that are responsible for public transport, especially in the Lusaka region. Most intercity public transport only serves the profitable lines, i.e., with many passengers, and hence some districts in Zambia are poorly served.
3. Inefficient, unsafe minibuses. The use of small capacity vehicles (mini-buses) in poor technical condition for public transport is inefficient, and this contributes to traffic congestion, air pollution, noise and accidents, especially in big cities. All these aspects adversely affect the reliability and safety of public transport.
4. Licensing. The passenger market is basically a free-for-all one and operators can choose to run services where they expect most profit.
5. Congestion. Especially in Lusaka is becoming a serious problem, negatively influencing productivity.

These observations are more specific to urban centres though similar conclusions can be drawn nationwide. It has been shown that that rural areas are characterized by poor road conditions, or generally lack of roads, as a result there are fewer and fewer vehicles in rural areas as motorists risk their vehicles being damaged on a constant basis. This in turn makes travel and

transportation expensive, making farming and other economic activities uncompetitive on the wider market. Public transport vehicles are even more sensitive to low quality roads because of their size and weight, these vehicles are not specifically designed to deal with such difficult conditions. Low quality roads also decrease speeds of buses and damage them, this has a negative impact on both bus operator's profit margin and the public's perception of public transport in general.

Like in urban areas, rural areas are not spared when it comes to provision of facilities of non-motorized transport. Little or no facilities exist for pedestrians, cyclists and even animal drawn carts on major trunk roads linking different regions, yet these are the most available forms of transportation.

Being a large but poor country, Zambia will continue to depend on road transport. There are two major challenges associated with this, however. Firstly, the country's extensive road infrastructure is in need of rehabilitation and maintenance. Zambia intends to continue putting greatest priority on rehabilitating and maintaining its entire road network from feeder to trunk roads. This is important for the following reasons:

- Delay in maintenance and rehabilitation increases costs eventually
- Economic growth and poverty reduction require that the roads and other transport systems are efficient and cost-effective
- Efficient delivery of services including emergency relief requires good roads
- Road rehabilitation creates jobs and business opportunities, often at the lower end of the labor market and this has direct impact on reducing income poverty

2.6.4 Key sector development projects

Table 2-16: Public Transport Sector Key Development Project

Project	Description	Status
Bus Station Program	7 new/upgraded intercity bus stations and 1 international bus station	In Progress
Intercity PT Improvement Program	Comprehensive improvements to Zambia's intercity PT system • Improved passenger information • Rationalization of service provision • Establishment of PT organization at MTC • Improved LOS across the board	Conceptual

2.6.5 Impact of NTMP

The master plan has shown that public transport requires increased attention as the main mode of transportation for lower income population throughout the country. The regulatory situation of the sector is a significant obstacle as the de facto policy of on road competition for between buses inherently provides a discontinuous and unreliable service for the public. The MTC unfortunately does not have a specific authority for dealing with this transport sector and it has continually been ignored in national development plans and transport policy documents. The master plan has in its vision the provision of sustainable mobility for all populations in order to continue the economic development of Zambia. In that light the master plan proposes a comprehensive intercity PT improvement program which will lay the framework for a long term and responsible public transport system for Zambia.

Passenger rail is also a form of public transport and is heavily assessed within the master plan. The plan recommends the establishment of high quality, high speed passenger rail along the country's main corridors to provide accessible mobility for all populations, reduce private car use and continue economic development.

Both the intercity PT improvement program and high speed passenger rail as assessed as part of the unique projects in this report. TDM analysis and MCA assessment both show these public transport projects to have significant positive benefits for Zambia and should be made a priority.

2.6.6 Sector Conclusions

1. Public transport is not a high priority in Zambia
2. There is no direct managing organization for public transportation in Zambia, this results in a low LOS
3. Public transportation is still the main mode of travel in Zambia; demand for public transportation is increases faster than supply
4. Sustainable mobility must become a priority in Zambia; and
5. There are many potential benefits to increased investment and improvement of public transportation for the quality of life of all Zambians as well as the national economy.

Chapter 3: Scenario Evaluation

3.1 Introduction

This chapter will outline the methodology used to assess the positive and negative impacts of the various development scenarios considered in this project. In the report: Scenario Development and Assessment, of this project, these scenarios were presented in their entirety. In that report, supply scenarios were compared using transport indicators only. Transport indicators include vehicle time, kilometres travelled and modal shift. However a transport focused, qualitative approach often does not tell the whole story of a scenarios impact. In this chapter a second method of assessment is utilized, that of MCA.

Table 3-1: All Scenarios Considered in the National Master Plan Project; Supply and Demand

Scenario	Description
Demand Scenarios	
Demographic Scenarios	Scenarios which simulate changes in factors which affect travel behavior such as population, employment and car ownership
Trip Distribution Factors	Urbanization and growth of urban areas
Freight Trip Factors	Scenarios which simulate changes in factors which affect freight travel demand such as economic growth and changes in imports and exports
Supply Scenarios	
Base Scenario	Scenario which includes all reference and mandatory projects for development. This scenario is common to all development scenarios
Full Fast Passenger Rail	A complete and comprehensive network of fast passenger rail services
Partial Fast Passenger Rail	Scenario of the highest performing investments from the full network
Full Road Network Upgrade	A complete and comprehensive network of high LOS Trunk/Main Roads
Partial Road Network Upgrade	Scenario of the highest performing investments from the full network
Intercity PT Improvement Program	Scenario of low cost and short term PT upgrades
Road Tolls Program	Scenario of complete toll way establishment on main roads
Full Intermodal Cargo Rail Network	A full network of improved cargo rail and intermodal hubs across the country
Partial Intermodal Cargo Rail Network	Scenario of the highest performing investments from the full network
Mixed Scenario	Scenario which incorporates relevant scenarios from the above development scenarios to achieve maximum benefits

Table 3-2: Summary Table of Unique Transport Development Scenarios and Methodology

Scenario	Scenario Code	Description	Infrastructure Changes	Method
Improved Passenger Rail	**2037a 2037b**	Improvements in Mainline Railway from Lusaka – Copperbelt with a focus on Passenger services	• Additional improved corridors: o Lusaka – Victoria Fall o Lusaka – Chirundu o Lusaka – Chipata o TAZARA	• improved operational speed • Improved attractiveness to transport users • New Railway Stations
Dual Carriageway Lusaka-Ndola and Lusaka Bypass Road	**2037c 2037d**	Increase T2 Road from 2 lanes to 4 and Lusaka Bypass Road	• Road LOS increase • Bypass roads: o Lusaka	• Increased speeds on improved infrastructures
Overall Intercity Road PT Improvement	**2037e**	Improvements in frequency and LOS of bus public transportation	• Construction of intercity bus terminals • Reallocated rights of way in order to provide PT priority	• Frequency improvements which equate to time savings for passengers • Reduced wait times • Improved Passenger Information
Road Tolls Program	**2037f**	Toll collection across the country's road network	• 9 border entry points • 3 2017 inland toll gates • 39 planned inland toll gates	• Calculation of value of time • Mapping of toll collection points • Calculation of time penalty for drivers • Calculation of revenue for State
Combined Passenger Scenario	**2037g**	All beneficial passenger scenarios		• Scenario 2037b • Scenario 2037d • Scenario 2037e • Scenario 2037f
Full Integrated Cargo Rail Network	**2037h**	Improvements in mainline freight rail infrastructure to allow for better operations and speed	• Multiple greenfield railway infrastructures • Multiple intermodal hubs	• Expansion of railway-road feeder network surrounding intermodal hubs • Increased freight rail operating speeds • Decreased freight handling costs for transfer cargo at intermodal hubs

The previous table summarizes the development scenarios which were evaluated in the previous report and the following table presents a summary of the transport indicator output for the development scenarios for 2037. The table shows indicators such as modal shift and changes in travel behavior at a macro level. However, these figures do not show how a scenario helps low income families, reduces traffic accidents or benefits Zambia's economy. Based only on transport behaviors, scenario 2037g – mixed passenger scenario, provides the most benefit in terms of transport indicators.

Table 3-3 Unique project scenario comparison: transport indicators

Scenario	Car Trips	PT Trips	Car Mode Share	PT Mode Share	VHT	VKMT	Bus Passengers	Fast Train Passengers
2016 Base	68,088	42,792	36.0%	22.6%	222,859	13,094,871	42,792	-
2037 Base	250,273	78,530	45.5%	14.3%	909,733	55,208,413	78,530	-
2037a – Full Fast Train	226,831	123,685	41.3%	22.5%	859,309	51,930,991	66,895	67,565
2037b – Central Fast Train	236,927	104,119	43.1%	18.9%	879,417	53,067,722	71,361	36,172
2037c – Full Road Program	253,720	71,616	46.1%	13.0%	870,271	56,147,973	71,616	-
2037d – T2 Road Upgrade	252,341	77,220	45.9%	14.0%	909,771	55,899,177	77,220	-
2037e – PT improvement	241,606	95,316	43.9%	17.3%	889,710	54,517,846	95,316.86	-
2037f – Road Tolling Program	237,896	101,766	43.3%	18.5%	765,402	53,119,314	101,766.74	-
2037g – Mixed Passenger	**196,106**	**189,749**	**35.7%**	**34.5%**	**847,734**	**43,783,907**	**158,863**	**36,172**

3.2 Multi-Criteria Analysis (MCA) Methodology

MCA stands for Multi Criteria Analysis and is a well-accepted method of assessing complex options which cannot be expressed using only a single indicator. In addition, the MCA method allows for the use of both qualitative and quantitative indicators to provide a more complete and rounded measure of a scenarios positive and negative impacts.

The MCA methodology progresses in the following manner:

1. Evaluation factors are chosen based on the strategic goals of the project,
2. Each scenario is assessed for each factor, each factor score is calculated in a unique manner using both qualitative and quantitative methods
3. Scenarios are given an overall final score which is a weighted sum of performance in the evaluation factors, some factors are deemed more import within the MCA than others and as such are given lower or higher weights based on the projects goals
4. Scenario comparison, the final scores are compared to ascertain which scenario provided the most performance

Table 3-4 Multi Criteria Analysis factors and methodology

Factor	Description and Methodology
Simplified Cost-Benefit Analysis	Balance between investment/operation costs and macro level economic savings. A project with a high benefit cost ratio is one that reduces time and resource wasting, has the ability to repay its investment costs in a reasonable amount of time and provides savings to the overall economy. • This factor is calculated based on vehicle time and kilometers traveled savings.

Factor	Description and Methodology
Reduction of Accidents	Projects which improve traffic safety for both motorists and vulnerable road users receive a high score in this factor. Reduction of accidents, especially those ending with fatalities, is also an important consideration in this factor. • Calculation based on reduction in private vehicle usage • Calculation based on road LOS, dual carriageways for example reduce the occurrences of head on collisions which often result in fatalities
Level of Support to Impoverished Populations	Projects which improve accessibility to affordable mobility options such as PT improvements and urban transport. Projects which serve private vehicle travel receive low scores in this factor. • Score is based on qualitative evaluation of the project's impact on impoverished populations
Level of Support to Trade and Commerce	This factor measure provides a qualitative scorings of how well a project supports freight traffic. A project which enables more efficient and more sustainable movement of goods- Infrastructures which support freight traffic such as intermodal hubs, the feeder road network and freight railways -will receive a high score in this factor. • Score is based on qualitative evaluation of the project's impact on Trade and Commerce
Environmental Impacts	This factor scores the project's ability to reduce the impact on the environment. Generally projects which reduce private automobile usage and heavy trucks for freight trips will receive higher scores in this factor. • Factor calculation based on modal shift to sustainable modes of transport • Factor calculation based on savings of vehicle time and vehicle kilometers travelled

3.3 MCA Output

The MCA output is split into three tables:

1. MCA units of measure per scenario – this table shows the absolute figures for each evaluation factor as well as a comparative benchmark based on 2016 observed data;
2. MCA percentage of maximum score – a simple method is utilized to provide a "winning" scenario for each indicator. The scenario with the best score for a given factor receives 100%, the subsequent scenarios receive a percentages based on their proportion to the maximum score;
3. MCA factor scores, weighted sum and final comparison – this final table provides the calculated final scores for each factor per scenario. The weights provide priority to those scenarios which provide more for impoverished populations and support trade and commerce.

Table 3-5: MCA units of measure per scenario

SCENARIO	UNITS	2016	2037	2037b	2037d	2037e	2037f	2037g
Simplified Cost-Benefit Analysis	IRR		3%	5%	5%	8%	9%	14%
Reduction of Accidents	Annual Fatalities	2,113	4,205	4,276	4,215	4,152	4,046	3,610
Level of Support to Impoverished Populations	(1-LOW/5-HIGH)	2.0	1.0	2.0	2.5	3.5	3.0	4.5
Level of Support to Trade and Commerce	(1-LOW/5-HIGH)	1.5	1.0	2.5	2.0	2.5	1.0	5.0
Environmental Impacts	100 = 2016 environmental impact values	100%	199%	202%	201%	192%	191%	173%

Table 3-6 MCA percentage of maximum score per scenario

SCENARIO	2037	2037b	2037d	2037e	2037f	2037g
Simplified Cost-Benefit Analysis	24%	37%	37%	62%	63%	100%
Reduction of Accidents	86%	84%	86%	87%	89%	100%
Level of Support to Impoverished Populations	22%	44%	56%	78%	67%	100%
Level of Support to Trade and Commerce	20%	50%	40%	50%	20%	100%
Environmental Impacts	87%	85%	86%	90%	90%	100%

Table 3-7 MCA factor scores, weighted sum and final comparison

SCENARIO	WEIGHT	2037	2037b	2037d	2037e	2037f	2037g
Simplified Cost-Benefit Analysis	20%	**5**	**7**	**7**	**12**	**13**	**20**
Reduction of Accidents	15%	**13**	**13**	**13**	**13**	**13**	**15**
Level of Support to Impoverished Pop.	30%	**7**	**13**	**17**	**23**	**20**	**30**
Level of Support to Trade and Com.	25%	**5**	**13**	**10**	**13**	**5**	**25**
Environmental Impacts	10%	**9**	**9**	**9**	**9**	**9**	**10**
TOTAL	100%	**38.1**	**54.3**	**55.6**	**70.2**	**60.0**	**100.0**

3.4 MCA Conclusions

In the NTMP – 2037, the MCA supports the conclusions of the transport indicator evaluation, in that scenario 2037g provides the greatest benefit to Zambia's transportation system and residents for the year 2037. This is not a surprise as this scenario contains the positive and highest performing aspects from each previous scenario.

- Simplified Cost Benefit Analysis
    - Scenarios which provide a high economic benefit to the state while requiring acceptable investments receive a higher score for this factor.
    - Scenario 2037e, PT improvement is relatively simple to implement but can have a significant impact on the economy by allowing people to access basic needs and work
    - Scenario 2037f, Road tolls program is a scenario where the state makes money, such that the IRR is very high
    - Scenarios 2037b and 2037d provide more limited scores as they require significant sunk costs in terms of infrastructure, these high costs reduce the overall positive impact on the economy
- Reduction of accidents
    - Generally speaking, every scenario which reduces the use of private vehicles will reduce the number of accidents caused in the MCA. This is a result of fewer cars on the road, traveling fewer kilometers, thus lowering the probability of an accident
    - Scenario 2037d however is an interesting case in that it is a roads project but one which improves road safety. While the scenario causes modal shift toward private vehicle usage, the improved LOS on the road (multiple lanes and segregation between directions) reduces the probability of road accidents and accidents which lead to fatalities
- Level of Support to Impoverished Populations
    - Scenarios which provide improve public transportation generally assist impoverished populations by providing access to basic needs such as food, water, health services, schools and jobs
    - Scenario 2037e provides the best version of PT for this indicator in that it focuses on bus PT. Bus PT has a wider distribution of service, is often less expensive than train transport and provides shorter distance and flexible trips
    - Scenario 2037b provides improved PT in the form of a fast train, however it is generally found to assist low income population less as their demand for long distance trips is much less than their need for immediate short distance trips. Short distance trips are better served by bus PT
    - Scenario 2037f, the toll program has a high measure in this based on the hope that some of the money collected will go to improving basic and essential social services

- Level of Support to Trade and Commerce
    - Scenarios which allow for more efficient and cost effective movement of freight goods receive high scores for this factor. In addition scenarios which benefit the economy by allowing access to employment also receive medium scores
    - The scenarios in the MCA are mainly passenger supply scenarios and as such support this less than freight scenarios (see next section)
    - Scenario 2037b will provide an upgraded rail mainline in the country's central corridor. This upgrade will improve freight transport in this corridor
    - Scenarios 2037b and 2037e both improve PT which is seen as a prerequisite to job growth. These methods allow populations which do not own a private vehicle to access employment, something which will drive the economy forward
- Environmental Impacts
    - Scenario which reduce pollution of all kinds receive a high score in this factor
    - In general any mode shift toward PT is seen as a positive element in reducing pollution, mainly greenhouse gas emissions
- Total
    - Clearly the mixed passenger scenario of 2037g provides the maximum benefit for all MCA factors
    - This is to be expected as it is a combination of high performing scenarios
    - Based on this MCA, the optimal scenario is defined as 2037g

3.5 Freight Scenario Evaluation

The freight scenarios are not part of the MCA and are evaluated solely based on their transport indicators. In the previous report: Scenario Definition and Assessment, it was concluded that the following infrastructures be part of the optimal scenario:

Table 3-8 Summary of freight scenario projects and rational for inclusion in NTMP

Category	Project	Description	Rational for inclusion in NTMP
Greenfield freight railway	Kafue – Lion's Den	Freight rail connection between Zambia to the port of Beira in Mozambique via Zimbabwe	• High performance in TDM • Provision of alternative rail connection for Zambia in addition to Nacala and Dar es Salaam
Greenfield freight railway	Serenje – Petauke	Freight rail connection between Zambia and the port of Nacala in Mozambique	• Project already confirmed and soon to be in construction phase
Greenfield freight railway	Chingola - Solwezi	Freight connection between expanding Copperbelt and ZRL mainline	• Required based on projected increases in mining production
Intermodal Hubs based on performance in the TDM			

Intermodal Hubs	Ndola Hub	Intermodal Hub at Ndola	• High performance in TDM • Freight interchange for Copperbelt
Intermodal Hubs	Kapiri Hub	Intermodal Hub at Kapiri	• High performance in TDM • Freight interchange between ZRL and TAZARA
Intermodal Hubs	Lusaka Hub	Intermodal Hub at Lusaka	• High performance in TDM • National level freight interchange for all types of cargo
Intermodal Hubs based on alternative indicators			
Intermodal Hubs	Livingstone Hub	Intermodal Hub at Livingstone	• Provides important freight interchange for international freight from Botswana, Namibia and southern Zambia
Intermodal Hubs	Chingola Hub	Intermodal Hub at Chingola	• Provides freight interchange for the northern Copperbelt and North Western Province • Provides important freight interchange for international freight from the DRC
Intermodal Hubs	Kafue Hub	Intermodal Hub at Kafue	• Provide freight interchange at meeting between ZRL mainline and proposed Lion's Den connection to Beira

These infrastructures where chosen based on their performance in the freight model. In addition, the central ZRL mainline track, from Lusaka to the Copperbelt will be upgraded as a result of the future implementation of fast passenger rail on that same corridor. This upgrade will include sidings, signaling, stations upgrades and a new operational scheme. Coupled with in progress upgrades in the inter-mine rail network, it is expected that the railway: Copperbelt-Lusaka-Lion's Den will provide an important freight corridor for Zambia on a domestic and international level.

Chapter 4: Optimal Scenario

The optimal scenario is the product of two reports during the formulation of the Zambia National Transportation Master Plan:

- Report 3: Development of Travel Demand Models; and
- Report 4: Scenario Definition and Assessment

The previous chapter concluded the utilization of the transport demand models and scenarios by applying a concise Multi Criteria Analysis. This analysis evaluates scenarios from a number of perspectives to ascertain which projects and policy changes when packaged together provide the greatest benefit to Zambia for the horizon year of 2037.

This chapter will describe the output of the scenario assessment phase, that of the optimal or recommended scenario. This scenario is one which has been shown both through qualitative and quantitative indicators to provide the maximum benefit to Zambia both in terms of transportation and in terms of economic benefit. This chapter will be split up into the following sections:

1. Reference Projects – Those projects which are committed or in progress per transportation sector;
2. Mandatory Projects – Projects which are essential to the future of the transportation sector; and
3. Unique Projects – Large scale investments which were evaluated in the TDM

Projects per transportation sector were collected through meetings with stakeholders and a stakeholder workshop. The full project inventory is presented in Report 4 of this project.

Finally, this chapter will provide a description of the institutional measures which will accompany the infrastructure and service development projects outlined in this chapter. The success of infrastructure and operational investments rest in how they are supported at a regulatory, policy level. Accurate policy will ensure that new investments are efficiently run both from a perspective of cost efficiency and public service. For example, institutional measures will pave the way for Public Private Partnerships in passenger rail service, or help establish a public transportation institution for Zambia.

Following this chapter will be a comprehensive action plan for the optimal scenario. The plan will help prioritize investments into the short, medium and long terms with the goal of facilitating the successful implementation of the Master Plan's recommendations.

4.1 Reference Projects

Reference projects are projects which at the time of the Master Plan project where committed or under construction. These projects are not changed in any way by the master plan but are included as they form the basis for transport supply going into the future.

4.1.1 List of Reference Projects

Table 4-1: Inventory of Reference Projects

Project / Location	Description	Type	Res.	Status	ECM	ECD
Road Sector						
Annual Projects	2017-2018 approved and prioritized projects	REF	RDA	In Progress	450	Annual
Link Zambia 8000	Strategic road improvement project for all of Zambia	REF	RDA	In Progress, Phase II-III	200	2019
LSK 400	Strategic road improvement project for Lusaka	REF	RDA	In Progress, nearing completion	50	2018
CB 400	Strategic road improvement project for Copperbelt	REF	RDA	In Progress	500	2021
Zambia Township Roads Project	Strategic improvement of urban roads throughout the country with 306km so far committed on the Copperbelt	REF	RDA	In Progress	461	2020
Muchulila – Lumangwe Road (Lot 1)	40 km of road and drainage upgrade in Lusenga Plains Park	REF	ZWA	In Progress	0.63	2018
Muchulila – Lumangwe Road (Lot 2)	33 km of road and drainage upgrade in Lusenga Plains Park	REF	ZWA	Planned	0.87	2018
Riverside Drive	9 km of road resurfacing in Mosi oa Tunya Park	REF	ZWA	Planned	1.14	2019
Lusaka Park Loop	9 km of road resurfacing in Lusaka Park	REF	ZWA	Planned	1.05	2019
Hook Bridge - Kabanga	108 km of road rehabilitation in the KNP	REF	ZWA	Planned	2.84	2020
Kabanga Gate – D181 Junction	20 km of road rehabilitation in the KNP	REF	ZWA	Planned	0.53	2021
Ngoma Loop Roads	50 km of road rehabilitation	REF	ZWA	Planned	1.05	2021
Luanginga Bridge – Liuwa Plains	80 km of road rehabilitation in Liuwa Plains	REF	ZWA	Planned	2.11	2022
Mano – Luangwa Pontoon	66 km of road rehabilitation in North Luangwa	REF	ZWA	Planned	1.74	2023
Mfuwe - Lusangazi	51 km of road rehabilitation in South Luangwa	REF	ZWA	Planned	0.57	2023
Lusangazi – Luamfwa	25 km of road maintenance in South Luangwa	REF	ZWA	Planned	0.53	2024

Project / Location	Description	Type	Res.	Status	ECM	ECD
Mfuwe – Chichele	27 km of road maintenance in Lower Zambezi	REF	ZWA	Planned	2.11	2024
Chiawa – Jeki	80 km of road rehabilitation in Lower Zambezi	REF	ZWA	Planned	2.11	2025
Nsumbu – Chitutu Bridge – Lake Kakao	42 km of road construction in Nsumbu	REF	ZWA	Planned	1.11	2026
Sioma – IP Zone Boma	55 km of road construction in Sioma Ngwezi	REF	ZWA	Planned	1.45	2026

Project / Location	Description	Type	Res.	Status	ECM	ECD
Provincial Tourism Access Roads: Northwestern Province	• Mwinilunga – Ikelengi road (4km) • Solwezi college – Kifubwa Ntl Monument (4km) • Solwezi – Mwinilunga road to Nyambwezi falls (15km) • Bridge at Nyambwezu Stream • Road to Chief Kanyama's Palace (17km) • Solwezi – Mwinilunga to Shakenge Hills (8km) • The Ntambo Loop • Solwezi – Mwinilunga to Mumbezhi falls (15km) • Shilenda – E. Lumwana Waterfalls (10km) • Kasempa CBD to Shibalange hills (30km) • Chavuma CBD to Chanda falls (20km) • Zambezi – Chavuma to Chinyingi bridge (2km) • Access road to Jivundu Camp in Mufumbwe District (10km)	REF	MTA	Proposed	6.5	

Project / Location	Description	Type	Res.	Status	ECM	ECD
Provincial Tourism Access Roads: Copperbelt Province	• Zambia forestry college to Mwekera Rapids at Kitwe (3km) • Nampamba tur off to Lake Kashiba (26km) • Ndola – Kabwe to Lake Chilengwa (16km) • Kapisha Compound to Kapisha Hot Springs • Road to Mpata hills (18km)	REF	MTA	Proposed	20	
Provincial Tourism Access Roads: Western Province	• Livingstone-Mulobezi • Sioma– Shangombo • Kalabo – Liuwa National Park • Lukulu – Kalabo • Sioma – Ngwezi Route	REF	MTA	Proposed	20	
Provincial Tourism Access Roads: Southern Province	• Siavonga - Lake Side • Batoka - Sinazongwe and Mamba) • Monze - Lochnivar • Namwala - Itezhi-Tezhi • Kalomo - Dundumwezi • Zimba - Sichifulo	REF	MTA	Proposed	20	
Provincial Tourism Access Roads: Northern Province	• Mbala- Kalambo Falls • Mbala –Iyendwe • Nsama- Nsumbu • Kawambwa – Mporokoso leading to Lumangwe waterfalls. • Bridge actross the Lufubu river on the Mbala – Iyendwe road	REF	MTA	Proposed	20	

Project / Location	Description	Type	Res.	Status	ECM	ECD
Provincial Tourism Access Roads: Lusaka Province	• Nampundwe Road (D534) • Chimbotelo Machiya – Blue Lagoon Road • Great East -Airport road • Chirundu – Chiawa Road • Kavalamanja Road • Luangwa Airstrip access road	REF	MTA	Proposed	20	
Provincial Tourism Access Roads: Central Province	• Itezhi tezhi – Dundumwezi road • Itezhi tezhi – Chunga (hook bridge road) • Itezhi tezhi – Mongu road junction	REF	MTA	Proposed	20	
Provincial Tourism Access Roads: Eastern Province	• Nsefu- Lundazi via Mwanya • Mambwe – Petauke Via Malama • Masumba – Katete Via Msoro • Mambwe – Chipata Via Nyokatoli • Nyimba – Mwape • Nyimba - Mnyamadzi • Nyimba - Kazumba • Nyimba - Mbizi	REF	MTA	Proposed	20	
Feeder Roads Program	20 projects for 650 km of rural access roads	REF	MLG	In Progress	4.27	2018
Routine Maintenance on NMT Infrastructure Program	Phased NMT network maintenance/upgrade project	REF	MLG	New 3 year cycle including Lusaka, Ndola, and Kitwe	4.81	2021

Project / Location	Description	Type	Res.	Status	ECM	ECD
Access road to existing MFEZ's and Industrial Parks	• Lusaka East MFEZ- 10 km of internal road connectivity has been tarred and linked up • Lusaka South MFEZ- Construction of 20km of internal asphalt roads within the LS-MFEZ • Roma Industrial Park- Construction of 6km of internal asphalt tarred road network • Sub-Sahara Gemstone Industrial Park-4km of internal road network	REF	RDA	Nearing Completion or Constructed	5	2019
One Stop Border Posts	Integrated border posts (5 points) which integrate all border activates for road passengers and freight trips	REF	RDA	In Progress	15	2021
Road Safety Sector						
Design, Installation and Implementation of an Intelligent Transport System (ITS)	Major highways are facing road traffic challenges in terms of congestion and increased road crashes. To apply information and Communication Technology in road transport infrastructure for traffic surveillance, traffic and mobility management	REF	RTSA	Phase1 between Kafue and Ndola under procurement	1.89	2019
Construction of Motor Vehicle Inspection Centers	Upgrading infrastructure for motor vehicle inspection.	REF	RTSA	Preliminary planning	3.16	2022
Mechanized Motor Vehicle Testing equipment	Currently most of the motor vehicle inspection is conducted manually and hence subjective, There is need to mechanize motor vehicle inspection of the Zambian Motor Vehicle population in order to improve road safety.	REF	RTSA	Preliminary planning	0.80	2021

Project / Location	Description	Type	Res.	Status	ECM	ECD
Digital Accident Recording	Utilization of GPS equipped tablets for accident recording	REF	RTSA	Procurement and Pilot	0.5	2019
Road Signs	New roads signs across Zambia	REF	RDA		0.63	2020
Railway Sector						
Mpika Workshop Upgrade	Manufacture of high speed train components	REF	TAZARA	In Progress		2020
Furnace Rehabilitation	For manufacture of components at Mpika	REF	TAZARA	In Progress	1.2	2020
Kasama-Nakonde Rerouting	Rerouting and upgrade of rail section for safety and speed	REF	TAZARA	Construction contract signed (contractor: CEEC)	148.2	2025
Kapiri-Kasama track maintenance	Annual maintenance of rail section	REF	TAZARA	Annual	5.5	2037
Existing railways annual maintenance	Lifting, packing and aligning of the track, repairing of formation, vegetation clearance and attending to emergencies	REF	ZRL	In Progress	40	Annual
Comprehensive railway rehabilitation (Full railway infrastructure rehabilitation)	Re – sleepering of 305 km of track; Deep screening 46km; Ballasting 885km; Tamping and aligning of the track 587km; Rail conversion (CWR) 133,000 joints; Replacement of worn out rails (98,500 tons; Fencing of railway reserves in built up areas; Reconstruction of major station buildings; and Re-construction of all mainline bridges and culverts.	REF	ZRL	Re-sleepering, ballasting, tamping and welding of the track are on-going; Replacement of worn out rails, fencing of railway reserves and re-construction of station buildings has not yet started (awaiting funding)	1000	2021
Mainline Signaling Phase I	Development of signaling system along ZRL mainline	REF	ZRL	In Progress	51	2020

Project / Location	Description	Type	Res.	Status	ECM	ECD
Construction on Inter-Mine railway	Railway linkage of 100 km to the new mining plants on the Inter – mine in the copper belt province	REF	ZRL	Ongoing and the following lines have been constructed: • Manica Line; Bridge Shipping; Chambishi Copper Smelter; and Zambia Furnace Supplies. ZRL intends to construct the following lines: (a) 9km from Bwana to Dangote Cement (b) 5km Ndola St to Handymans. (c) 4km from Ndola to Zambezi Portland Cement (d) 3.5km from Ndola to Neelkant Mine (e) 9km from Ndola to Mwekera Copper Mine (f) 38km from Ndola to Luanshya Mine (g) 20km from Chililabombwe to Lubambe Mine	50	2019
Establishment of a Concrete Sleeper Factory	Establishment of a Concrete Sleeper Factory in Ndola	REF	ZRL	Surveys and analysis done. There is need to engage independent consultants to undertake detailed feasibility studies	10	2018

Project / Location	Description	Type	Res.	Status	ECM	ECD
Establishment of Quarry Plants	Establishment of Quarry Plants in Chisamba, Kasavasa, etc for the purpose of ballast production	REF	ZRL	Surveys and analysis done. There is need to engage independent consultants to undertake detailed feasibility studies	12	2018
Rehabilitation of the Mulobezi Line	Livingstone- Mulobezi Line (162km) Concrete Re-sleepering, Replacement of Rails, Ballasting, Repair of Bridges and Welding of the Rails	REF	ZRL	Only repairs to the line have been done	103	2020
Rehabilitation and Acquisition of Rolling Stock Assets	Remanufacture of 10 GE U20C Locomotives Rehabilitation of 640 wagons; Acquisition of: • 40 locomotives • 2,600 Wagons • 50 Passenger Coaches • 4 Diesel Multiple Units • Workshop Equipment	REF	ZRL	(a) SMH Rail (already on site) has been contracted to remanufacture 10 locos, to date 1 is complete; (b) Rehabilitation of 640 wagons is awaiting finances. (c) ZRL intends to acquire: (d) 40 new locos (4 by 2018, 10 by 2020, 10 by 2024 and 16 by 2030; (e) 2,600 wagons (250 by 2017, 500 by 2019, 1000 by 2021 and 850 by 2022; (f) 50 passenger coaches by 2022; (g) 4 DMUs by 2020	550	2022
Serenje-Chipata greenfield railway	388 km	REF	ZRL	Contracting Phase	2300	2021
Aviation Sector						

Project / Location	Description	Type	Res.	Status	ECM	ECD
Kenneth Kaunda International Airport Upgrade Project	This airport will serve the Lusaka provinces in carrying both passengers and goods	REF	ZACL	In Progress	360	2019
Copperbelt International Airport	This airport will serve the Copperbelt and Northwestern provinces in carrying both passengers and goods	REF	ZACL	In Progress	397	2020
Mfuwe International Airport	This airport will serve the Eastern and Muchinga Provinces in carrying both passengers and goods	REF	ZACL	Financing/Negotiations	122	2020
Kasama Airport	Rehabilitation of Kasama airport runway	REF	MTC	In Progress	47	2020
Kasaba Bay Airport	Rehabilitation of Kasaba Bay airport	REF	MTC	In Progress	2	2018
Solwezi Airport	Rehabilitation of Solwezi airport	REF	MTC			
Provincial Aerodrome Program	10 strategic provincial and district airports for rehabilitation, orgainized into Lots 1, 2 and 3	REF	MTC	In Progress, contracts for works are approved	2.5	2020
Maritime and Inland Waterways Sector						
Port Terminal Facilities (ICD) Rehabilitation Program	Dar es Salaam – Mukuba Depot Mumbasa Copper Yard Walvis Bay ICD (privately financed)	REF	Dpt. M&W	In Progress	15	2019
Lake Tanganyika Harbors	Mplulugu Harbor rehabilitation Nsumbu Harbor rehabilitation	REF	Dpt. M&W	In Progress	50	2019

Project / Location	Description	Type	Res.	Status	ECM	ECD
Lake Mweru	Nchelenge Harbor rehabilitation Chipungu Harbor rehabilitation Kilwa Island Harbor rehabilitation	REF	Dpt. M&W	In Progress	5	2021
Lake Bangweulu	Samfya Govt. Harbor rehabilitation Mbabala Harbor development Chishi Harbor development Chilubi Harbor development	REF	Dpt. M&W	In Progress	3	2021
Lake Kariba	Siavonga Harbor rehabilitation Chipepo Harbor rehabilitation Sinazongwe Harbor rehabilitation	REF	Dpt. M&W	In Progress	3	2022
Zambezi River	Luangwa Harbor development Mulamba Harbor rehabilitation Kalabo Harbor development	REF	Dpt. M&W	In planning	1	2019
Kafue River	Namwala Harbor development Kafue Town Harbor development	REF	Dpt. M&W	In Planning	1	2021
Chambeshi River	Mbati Harbor rehabilitation	REF	Dpt. M&W	In Planning	0.6	2021
Nyengo-Makoma Canal	Connects Zambia-Angola (115 km) annual maintenance	REF	Dpt. M&W	In Progress	1	2018
Shangombo/Rivungu Canal	Canal Development Shangombo Harbor Development	REF	Dpt. M&W	In Progress	0	
Swamp Harbor Rehabilitation Program	Bangweulu Swamp Lukanga Swamp Chinyama Litapi Swamp	REF	Dpt. M&W	In Planning	0.75	2022
Provincial Canal Dredging Program: Luapula Province	500 km of canal dredging	REF	Dpt. M&W	In Progress	400	2037
Provincial Canal Dredging Program: Northern Province	200 km of canal dredging	REF	Dpt. M&W	In Progress	160	2037
Provincial Canal Dredging Program: Central Province	150 km of canal dredging	REF	Dpt. M&W	In Progress	120	2037

Project / Location	Description	Type	Res.	Status	ECM	ECD
Provincial Canal Dredging Program: Western Province	1,000 km of canal dredging	REF	Dpt. M&W	In Progress	800	2037
Provincial Canal Dredging Program: Muchinga Province	100 km of canal dredging	REF	Dpt. M&W	In Progress	80	2037
Provincial Canal Dredging Program: North Western Province	100 km of canal dredging	REF	Dpt. M&W	In Progress	80	2037
Public Transport Sector						
Bus Station Program	8 new/upgraded intercity bus stations	REF	MLG	In Progress	1.6	2020
Urban Transport Sector						
Urban Roads Program	40 projects for 700 km upgrading local road networks	REF	MLG	In Progress	52.63	2018
Pave Zambia 2000	Urban road project utilizing cost effective materials to improve urban roads across Zambia	REF	RDA	In Progress	370	2021
Ndola Roads Project	Ndola urban road network upgrades 43 km	REF	MLG	Design Construction contract is signed	50	2019
Urban PT Projects	Projects being undertaken in various towns across Zambia to improve access and safety at urban PT stations.	REF	MLG	In Progress	3	2020
Lusaka Decongestion Project	Lusaka Traffic Decongestion Project Implementation	REF	MLG	On-going, Contract with engineering/construction firm signed	289.47	2023

4.1.2 Reference Projects Conclusions

Reference projects include a number of long term projects

- Roads projects such as Link Zambia 8000, LSK 400, CB400 and more;
- Railway mainline maintenance and essential upgrades;
- Canal Dredging for inland waterways;
- Airport upgrades;
- Urban roads projects

While each sector has a number of large scale reference projects, the focus in terms of resources and scale are on the roads sector;

- The sector has received assistance in the form of international funding and consultancy which partially explain the heavy emphasis on roads.
-

It is essential that periodic maintenance become a priority in Zambia for each sector of the transportation system

Conclusions by sector:

- Roads Sector – many reference projects include both new infrastructures and maintenance projects. It is important to keep the focus on preservation of existing infrastructures to keep the road network efficient and cost effective into the future.

- Road Safety Sector – For this sector, reference projects are precisely those projects which will upgrade the effort into a modern system. The utilization of well tested and internationally accepted technologies will lead to a significant increase in the understanding and location of traffic accidents. These areas can then be systematically dealt with to ensure a safer road network for all Zambians.

- Railway Sector – the major focus on maintenance in the reference projects of this sector show that the back log has been growing for some time. Upon these projects rests the future of Zambia's railway sector as they represent an effort to bring the most basic elements of the system back up to a reasonable operating level. The main effort is annual maintenance, up to the writing of the master plan, the annual budget was set at only 5 million USD, a fraction of the value of the infrastructure. The consultant recalculated this value to be approximately 2 billion USD with a international best practice maintenance rate of 2% of the total value per year. This equates to 40 million USD per annum for maintenance only. Clearly this figure is far higher than current practice and shows how current resources cannot possible keep the railway in a state of good repair.

- Only with the completion of this can new infrastructures and operations be considered. TAZARA has recently signed a large scale construction contract to reroute a dangerous section of infrastructure between Kasama and Nakonde. This rerouting project will allow for faster and safer operations. TAZARA also plans to continue upgrading its

Mpika workshop and annual track maintenance at a annual budget of 5.5 million USD, a figure which would benefit from an increase.

- Aviation Sector – this sector will see a renaissance over the project period as a number of new facilities are opened beginning with the opening of a new terminal building in Livingstone and finishing with the completion of ongoing aerodrome rehabilitation projects. The most important projects for the aviation sector up to 2037, those which will have the greatest impact on the aviation sector as a whole include: the completion of the new KKIA terminal building as a new gateway to Zambia and the completion of the Provincial aerodromes project which will provide a foundation for domestic air travel all across Zambia. Supporting projects such as the establishment of a Search and Rescue department and regular maintenance at small airfields are also important projects.

- Maritime and Inland Waterways Sector – Similar to the railway sector, the reference projects in this scenario represent a backlog of maintenance and upgrades which are lagging far behind the needs of many Zambians. The canal dredging projects across Zambia are far behind schedule, unfortunately, the longer canals are not maintained, the more difficult and resource intensive becomes their rehabilitation. This is a sector with significant opportunities for PPP, wherein the regulator may contact private dredging companies to undertake the significant amounts of work. This will relieve the state from needing to buy expensive equipment and pay employees. Harbor development and rehabilitation is another important subject in the upgrading of this sector. Currently existing harbors are in a state of disrepair or all together nonexistent. This is the case on both lakes, rivers and swamps across Zambia. Generally put, a program of long term and consistent maintenance is required in this sector in order to keep the waterways of Zambia viable for transportation.

- Public Transport Sector – The lack of projects in this sector which are in progress shows the neglect in this sector. The Ministry of Local Government does have a limited bus station program however this sector requires significant improvement for the horizon year 2037. The main cause of this lack of attention to the sector is that the administrative and planning capacity does not exist. This will be addressed in the following report section which focuses on policy and institutional changes recommended by the master plan.

- Urban Transport Sector – A focus on urban roads projects has created a number of large scale projects in urban areas such as the Pave Zambia 2000 project and MLG's revolving urban roads projects. It is very optimistic to see projects focusing on non-motorized transportation as this is a sub sector of roads which is often ignored in developing countries.

4.2 Mandatory Projects

Mandatory projects are projects which are not yet in progress. These projects may be in a conceptual state, in planning but have yet to be formally committed. Projects were collected through the stakeholder workshop and developed during meetings between the stakeholder and the consultant. Mandatory projects can be categorized into a further two types:

1. Mandatory projects which will implement new standalone infrastructures for transport For example, mandatory projects such as the farming block access road program, access roads to areas earmarked for Multi Facility Economic Zones and industrial parks development or the program to comprehensively overhaul docks and jetties around Zambia are standalone projects. The projects will have an important impact on their individual transport sectors but are not directly connected to a larger infrastructure project.
2. Mandatory projects which support unique projects. These mandatory projects are essential prerequisites for larger infrastructure development projects. An example of this type of projects is a overhaul to ZRL's mainline signalling system phase 2, which is an important supporting infrastructure to high quality passenger rail services. Other examples include capacity building projects which will allow various transport institutions the ability to manage new infrastructures; for example the CAA requires expansion of its economic regulation unit in order to ensure efficient aviation operations, or the development of a intercity public transport department under the jurisdiction of the MTC in order to manage improvements to the PT system in Zambia.

Mandatory projects vary in scale and resource requirements however it is the perspective of stakeholders and the consultant that these projects be implemented as part of the master plan. These projects in general do not require assessment within the model and they do not represent changes in strategy for Zambia's transportation system.

4.2.1 List of Mandatory Projects

A list of mandatory projects to be implemented under this document are listed in the table below:

Table 4-2: Inventory of Mandatory Projects

Project / Location	Description	Type	Res.	Status	ECM	ECD
Roads Sector						
Agriculture Access Roads	• Nansanga Farming Block From Great North Road to Kabundi about 90 Km.(Serenje District) • Chikankata Road about 51Km from Chikankata Turn off in Chikankata District • Luena Farm Block from Kawambwa to Luena farm block block 21 km • Road from Lufwanyama to Luswiwishi Farm block in Lufwanyama District	MND	RDA	Preliminary Planning	3.8	2022
Lusaka Bypass Road	• Outer ring road around Lusaka on the West side of the city with connection to M9 road	MND	RDA	Planning	20	2022
Rest Areas Program	• Construction of rest areas to improve road safety	MND	RDA	Planning	3	2022
Farm Block Roads and Access Road Network	• Improved access roads to all existing and planned Farm Blocks and access roads for agriculture production	MND	RDA	Conceptual	2	2022
Access Roads to areas earmarked for the development of Multi facility Economic Zones and Industrial Parks	MFEZ development in: • Kasumbalesa • Choma • Kabwe • Chembe • Kafue • Lumwana • Livingstone • Maamba • Kalumbila	MND	RDA	Contract Design	45	2025
City Bypass Road Program	Bypass roads at major urban areas to remove through traffic from urban centers • Kabwe • Kapiri Mposhi • Kitwe • Chingola • Choma • Mazabuka • Livingstone	MND	RDA	Planning	50	2026

Project / Location	Description	Type	Res.	Status	ECM	ECD
Routine Maintenance on NMT Infrastructure Program	Phased NMT network maintenance/upgrade project which utilizes performance contracts	MND	MLG	New 3 year cycle with 5 largest towns in Zambia	10.68	20232023 and every 3 years
Railways Sector						
Mainline Signaling Phase II	Development of mainline safety systems such as crossing gates and lights Approx 60 units	MND	ZRL	Conceptual	9	2022
Greenfield railways annual maintenance	Lifting, packing and aligning of the track, repairing of formation, vegetation clearance and attending to emergencies for new railways: • Upgraded Passenger Service • Serenje-Chipata Kafue-Lion's Den	MND	ZRL	Conceptual	60	Annual
Road Flyover Program	Construction of road flyovers are key road rail junctions Approx. 20 units	MND	ZRL	Conceptual	30	2026
Aviation Sector						
Capacity Building: Training of Technical Personnel.	There is need for training of various technical personnel in order to revamp the institution.	MND	ZASTI	Preliminary Planning	0.25	2017
ATO Certification: Approved Training Organisation (ATO) Certification by Zambia Civil Aviation Authority.	There is need for certification by Zambia Civil Aviation Authority of ZASTI as an Approved Training Organisation (ATO) in order to regularize its training activities.	MND	ZASTI	Ongoing	0.25	2017
ICAO TRAINAIR PLUS: Recognition of ZASTI as an ICAO TRAINAIR PLUS Institution.	There is need for ZASTI to attain international status by earning recognition as an ICAO TRAINAIR PLUS Institution.	MND	ZASTI	Ongoing	0.25	2018
Capacity building of ZCAA technical personnel in ATO Certification: This is required to enable Approved Training Organisation (ATO) Certification of ZASTI by Zambia Civil Aviation Authority.	There is need for capacity building of ZCAA technical personnel with regard to Approved Training Organisation (ATO) Certification in order for them to certify ZASTI.	MND	ZASTI	Preliminary Planning	0.25	2017

Project / Location	Description	Type	Res.	Status	ECM	ECD
Organisation: Creation of new CAA Economic Regulation Unit	An Economic Regulation Unit is to be created in order to implement the economic regulation of service providers as soon as it is mandated by ICAO.	MND	CAA	Ongoing	0.15	2018
CAA Expansion and Capacity Building	• There is need for capacity building of technical personnel, especially with regard to Economic Regulation, Approved Training Organisation (ATO) Certification, General Surveillance and Resolution of Safety Concerns. • There is need to construct, furnish and equip the new CAA Head Office in order to accommodate the entire establishment in bespoke accommodation.	MND	CAA	Preliminary Planning	0.63	2020
Procurement, Installation and Commissioning of the BAGASOO Web-based Safety Oversight Software	There is need to procure, install and commission the BAGASOO Web-based Safety Oversight Software to improve the efficiency and productivity of the CAA in carrying out its certification, surveillance and resolution of safety concerns activities	MND	CAA		0.23	2017
Maintenance of District Aerodromes to facilitate for the Zambia Aeronautical Search and Rescue Organisation (ZASARO)	There is need for improved maintenance of rural aerodromes to avail landing facilities for aircraft in distress or search and rescue missions. The Rural Reconstruction Unit of Zambia National Service should be mandated to assist local administrations in maintaining rural airstrips.	MND	CAA	Preliminary Planning	1	2020

Project / Location	Description	Type	Res.	Status	ECM	ECD
Nationwide adaptation or design of road portions as emergency landing areas to facilitate for the Zambia Aeronautical Search and Rescue Organisation (ZASARO)	There is need for nationwide adaptation or design of road portions as emergency landing areas for aircraft in distress or search and rescue missions. The Road Development Agency (RDA) should be mandated to spearhead this project. 10 Units	MND	CAA	Preliminary Planning	40	2030
Establishment of helipads at major hospitals to facilitate for the Zambia Aeronautical Search and Rescue Organization (ZASARO)	There is need to establish helipads at major hospitals to facilitate the landing of helicopters evacuating casualties from accident sites as part of search and rescue missions. The Ministries responsible for health and infrastructure should be mandated to spearhead this project.	MND	CAA	Preliminary Planning	0.15	2025
Maritime and Inland Waterways Sector						
Kafue River Navigability Phase I	Connecting Mumbwa to Kafue Town via Mumbesh Rivera and Kafue River Approximately 150 km	MND	Dpt. M&W	Conceptual	180	2027
Capacity Building for Maritime and Inland Waterways Sector	Upscaling of sector capability	MND	Dpt. M&W	Conceptual	0.6	2018
Waterways Safety Program	Search and Rescue functions Hazard Marking Education program	MND	Dpt. M&W	Conceptual	0.6	2019
Inland Waterways Master Plan	Long term strategy and prioritization of investments	MND	Dpt. M&W	Conceptual	0.6	2020
Comprehensive Jetty/Harbor Rehabilitation	Survey, prioritization, and implementation of rehabilitation projects at key water transport facilities	MND	Dpt. M&W	Conceptual	3	2022
Nautical Training School	School teaching essential boat handling and safety skill	MND	Dpt. M&W	Conceptual	0.4	2020
Integrated Transport Sector						
KKIA Groundside Upgrade	Upgrading the road between Lusaka and KKIA (approx. 25 km)	MND	RDA	Planning	15	2020
Urban Transport Sector						
Traffic Management Lusaka	Complete traffic Management for Lusaka including signaling and control center	MND	MLG	Conceptual	15	2021

Project / Location	Description	Type	Res.	Status	ECM	ECD
Provincial Capital Urban Roads Program	Upgrading and rehabilitating urban roads in major towns: • Kabwe • Chipata • Choma • Kasama • Chinsali • Mongu • Solwezi • Mansa	MND	MLG	Demand driven Planning, Pre Planning	8.7 - 26	2034
Traffic Management	Centralized traffic management for major cities	MND		Conceptual	10-15	2034
Urban Transport Master Plan	Urban Transport Master Plan 2035 for various cities	MND		Conceptual	0.5-1	2022

4.2.2 Mandatory Projects Conclusions

- Mandatory projects have a large spectrum of interventions across all sectors
- Mandatory projects are focused on taking the given transport sectors to the next level or operations and service provision;
- Many mandatory projects are focused in sectors which are lacking reference projects such as the urban transport and public transport sectors
- Conclusions by transport sector
    - Road Sector – projects which focus on interventions which are not generally included in RDA's yearly plan. Because the RDA is the chief road building agency in Zambia, it is called upon to develop roads for all economic sectors and to serve the needs of the general population. The prioritization of so many projects coupled with a limited budget is a challenge for the agency, and the natural result is that larger projects or projects which are not immediately required or not served. The mandatory projects for the road sector represent a number of new and upgraded roads which are of the type that may not fall into the immediate priority of the RDA, such as agricultural access roads or farm block access roads. These projects will require a special mandate which comes with extended resources to allow the RDA to implement in addition to its normal road maintenance and building activities. Other projects that fall into this category include road bypasses around Lusaka and other central corridor cities.

    - Road Safety Sector – The reference projects suggested for the Road Safety sector in the master plan are comprehensive and will provide the already

successful RTSA with even more tools and technology to continue the effort toward road safety. As such there are no mandatory projects for this sector;

- Railway Sector – A majority of the needs of the railway sector were included in extensive committed projects and are packaged as part of the reference scenario of this project. The result is a single, albeit essential mandatory project in the form of a comprehensive mainline signalling overhaul program. In 2016, trains are dispatched using mobile phones, there is no system which provides the real time location of trains, their speed or status. Cargo is tracked via pen and paper methods. Together these antiquated methods leave the railway in a state which is unsafe and uncompetitive. The mandatory signalling project will look to provide these basic needs which are standard on all developed railways in the world in order to improve safety and operational capability. In addition, no type of fast passenger railway can be built without this project, it is the essential perquisite to the expansion and success of any railway project;

- Aviation Sector – The aviation sector has a long list of mandatory projects. The reality is that these projects are those which will allow the sector to become more self-sustained, technologically advanced and up to international standards. The main obstacle to this sector not already having achieved these standards is a lack of funding. While there appear a large number of projects in the inventory, they are relatively small in scale and resource requirements. Projects such as ATO certification and capacity building of training personal will bring ZASTI up to international standards. The CAA similarly is lacking in capacity in terms of economic analysis and management of the sector. In addition, a comprehensive program to undertake a minimum level of maintenance at the over 90 aerodromes in Zambia is included as these facilities are falling into disrepair;

- Maritime and Inland Waterways Sector – This sector has a number of mandatory projects designed in order to upgrade the sector in its capacity and ability to provide safer operations. The leading mandatory project is a recommendation for the creation of a sectoral master plan. Because the infrastructures of the sector have been neglected over the long term, it is necessary to review all existing facilities and prioritize their development or rehabilitation. This will help to achieve the most efficient rehabilitation of the sector which faces

significant and resource intensive maintenance projects. Other projects include moderate capacity building in the department, the establishment of nautical training classes to help advance the cause of waterway safety and a comprehensive survey and rehabilitation of the countries waterway resources. In Zambia there are nearly 100,000 people who rely on water transport for their basic needs, including clean drinking water and food. Currently these populations are forced to receive these goods without the basic infrastructures which make water transport possible.

- Intermodal Transport Sector – Mandatory projects in this sector focus on improved groundside transport to the upgraded KKIA Lusaka airport. This upgrade is in the form of a new road, however this can be further improved to a commuter rail system which would directly connect to any passenger rail scheme operating along Zambia's main corridor.

- Urban Transport Sector – This sector receives a number of important projects which are not yet part of the planning discourse outside of the MLG. These projects focus on improving urban transport infrastructures, managing traffic in urban areas and providing resources for the long term strategic planning of transport in Zambia's cities. The final point is essential, each city has different needs and development plans, this requires that each city take the time to compile its own strategy for transport. The MTC is obliged to define certain requirements for these master plans, such as PT as a priority and sustainability as an objective. It is not enough to plan only at a national level, this will leave large populations without the accessibility they need to improve their quality of life, only focused and specific urban master plans can accomplish this important task.

4.3 Unique Projects

Unique projects are those which change the strategy of Zambia's transportation system. This projects feature major infrastructure interventions with extremely high resource requirements. The purpose of these unique projects are to provide solutions for Zambia's long term mobility needs with an eye to demand in 2037. Each unique project in this project was assessed using both Transport Demand Models (TDM) as well as a Multi Criteria Analysis (MCA) presented in section 3.2

Because of the potential risk involved with these projects, they will require further Pre-Feasibility and Detailed Feasibility Studies to ensure that they are indeed the correct and feasible interventions for Zambia.

4.3.1 List of Unique Projects

Table 4.3 (Table 4-3: Inventory of Unique Projects) below contains unique projects. The table further describes each project and how it integrates into the existing and future transport system and demand of Zambia for the year 2037.

Table 4-3: Inventory of Unique Projects

Project	Description	Type	Resp.	Status	ECM	ECD
T2 Road Upgrade	Upgrade of T2 road to dual carriageway between Lusaka to Ndola (approx. 350 km) • Improved Safety Systems	UNQ	RDA	Procurement	280	2021
Toll Roads Program	Comprehensive toll gates program including operations	UNQ	NRFA	In Progress	90	2019
Central Corridor Fast Passenger Train	Upgraded Passenger Rail between Chingola and Kafue • High speed and LOS railway • 2 new stations • Rehabilitation of existing stations	UNQ	ZRL	Conceptual	800	2025
Greenfield Freight Railway	Kafue – Lion's Den Extension • Extension of main line to border at Chirundu (104 km) Chingola – Jimba Phase I: Chingola - Solwezi (178 km)	UNQ	ZRL	Conceptual	1,100	2028
Intercity PT Improvement Program	Comprehensive improvements to Zambia's intercity PT system • Improved passenger information • Rationalization of service provision • Establishment of PT organization at MTC • Improved LOS across the board	UNQ	MTC	Conceptual	2	2020

Project	Description	Type	Resp.	Status	ECM	ECD
Intermodal Hubs	Establishment of 3-4 intermodal hubs to facilitate intermodal freight transport • Ndola • Kapiri Mposhi • Lusaka • Livingstone (Optional)	UNQ	MTC	Conceptual	60	2027

4.4 Central Corridor Fast Passenger Train

This scenario adds an improved passenger rail line from Chingola in the north of the Copperbelt to Kafue, south of the Lusaka. The rationale behind this infrastructure is:

- Highest performing new infrastructure from a scenario which tested multiple alternatives
- To provide a high quality public transport alternative for commuter traffic within a 1 hour drive of the capital, Lusaka, with a focus on traffic from Kafue and Kabwe
- To provide a high quality public transport alternative for trips between the Copperbelt and the capital, Lusaka
- To provide a high quality public transport alternative for trips between the Copperbelt's major cities, Ndola, Kitwe and Chingola
- To establish a culture of high public transport supply which in turn will produce induced demand train travel and public transport usage overall
- To create a foundation for the future of passenger rail in Zambia and beyond, this project fits with SADC strategic corridors and in the future can be expanded to neighboring cities and countries

Table 4-4: Project Summary; Central Corridor Fast Passenger Train

General Data	
Speed	Approximately 110 km/h
Track Length	Approximately 500 km
Headway	60 min
Stations	9 (2 stations were added for 2037)
Passengers on Chingola-Kafue Rail Corridor in Scenario 2037a	**36,172** (76.6% of potential)
Assessment Data	
Public Transport Modal Shift	+4%
MCA Final Score	54.3

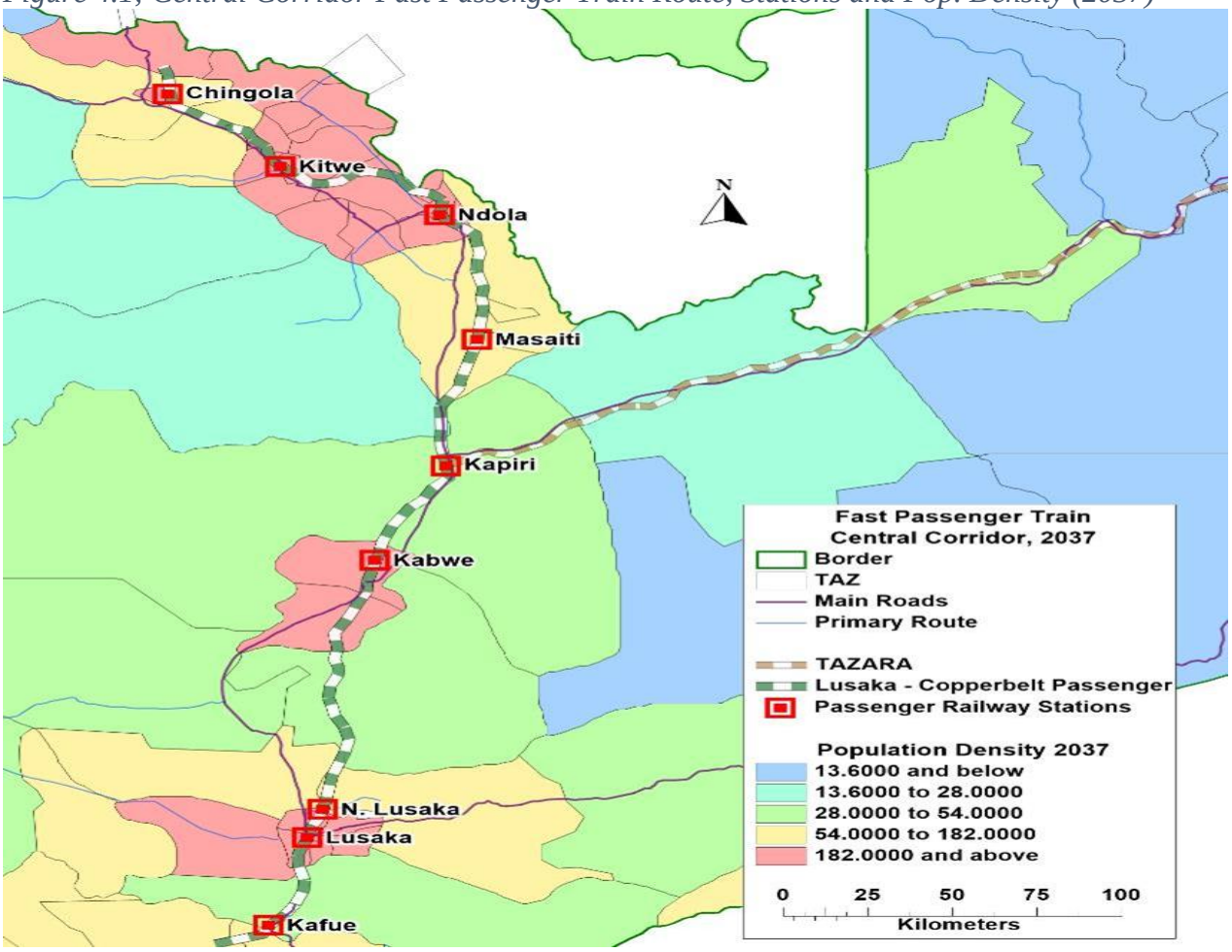
Estimated Annual Economy Savings (USD)	12-15 million

This project represents a strategy shift in Zambia from one which focused on road development, and therefore supporting private vehicle use, to one which looks to shift passengers to more sustainable modes of travel. Since the beginning of this project, Zambia's "central corridor" has shown itself to be the route upon which a majority of the country's traffic flows. This is the case both for passenger and freight trips. Transport surveys undertaken by the RDA and the consultant from 2015 and 2016 show that this is still the case, model predictions for the year 2037 also show that this traffic will only continue to increase.

In order to meet this current and future demand, the proposal of a high quality passenger rail link along this main corridor was tested by the master plan. It was found that not only does the new fast train carry an acceptable number of passengers to make it financially viable (see below) but also that it stimulates significant modal shift away from private vehicles to public transport. The following list outlines some of the sub projects that would be required for the success of this unique project:

- Upgraded railway to allow for safety and high speed travel;
- Upgraded signalling system to allow for safety and high speed travel;
- Rehabilitation of existing stations to provide an adequate level of passenger service;
- Construction of 2 new passenger stations: North Lusaka and at Masaiti;
- Procurement of rolling stock, both powered and unpowered;
- Budgeting for operations and maintenance; and
- Outsourcing for operations and potential maintenance to private firms.

Figure 4.1; Central Corridor Fast Passenger Train Route, Stations and Pop. Density (2037)



Because of the relatively simple, linear structure of the network, it is both intuitive and simple to operate. A simple operating scheme is outlined in table 4:6 below which shows that at a ridership level of over 35,000 Passenger Per Day and at 2016 PT ticket prices, the train will be able to provide a high level of frequency on two separate routes as well as incur a profit. This profit margin is essential if the operations of the train is to be outsourced to private enterprise.

Table 4-5: Central Fast Passenger Rail Operation Costs Estimates for 2037

	Routes	Daily Passengers	Ticket Revenue (USD)	Route Length (km)	Departures per day	Daily km	Vehicles needed per day	Route Daily Operating Cost (USD)
A	Kabwe-Kafue	10,906	**87,245**	180	18	3240	8	**66,320**
	Kafue-Kabwe	10,906	**87,245**	180	18	3240	8	**66,320**
B	Chingola-Kafue	7,270	**109,056**	500	9	4500	10	**91,000**
	Kafue-Chingola	7,270	**109,056**	500	9	4500	10	**91,000**
	Total	**36,352**	**392,602**	**1,360**	**54**	**15,480**	**36**	**317,740**

An important point for this project, and one which unfortunately is often overlooked, especially in Africa is the question of maintenance. The above estimate is for operations alone and does

not budget for maintenance. This is something which would be an essential part of any pre-feasibility study in preparation for the implementation of this project. It is often recommended that the share of the annual budget of this type of project be set at:

- 30% for operations; and
- 70% for maintenance

The rationale behind these figures is that such large investments are built to last many years, however this is only possible with proper maintenance practices.

4.4.1 Project Conclusion

This project represents a strategy change for Zambia. It is a unique and bold project which entails an amount of risk, however the potential benefits for the country and its people are significant. In the effort to make Zambia a truly land linked country this keynote infrastructure will represent the highest level of the transport hierarchy. This project will effect land use trends, travel behavior and more for Zambia. The change in travel behavior will be in some measure a move toward sustainability, something which benefits Zambia in many ways such as economic savings from decreased congestion in Lusaka's city center to a decrease in greenhouse gas emissions. This is a key opportunity for the progress of Zambia and with the proper care and maintenance, can continue to serve the country in the long term.

4.5 T2 Road Dual Carriageway Upgrade and Lusaka Bypass

This scenario improves key road infrastructures along the country's main corridor of travel. Considering the substantial increase in passenger trips expected by 2037, this road corridor which in 2016 was already the busiest and most dangerous in terms of road safety, will be required to carry even more passengers on a daily basis. As of 2017 the dualisation of this corridor is a priority project of the RDA and currently in the contracting phase. In addition, as the Lusaka metropolitan area continues to grow, traffic in the central business district is expected to increase. In 2016 the Ministry of Local Government put forth a proposal for a bypass road around the west side of Lusaka which would allow through traffic to move quickly around the city center without entering the city itself.

The reasons for including this project in the Optimal Scenario are listed below:

1. Increased vehicle demand on the T2 road between the Copperbelt and Lusaka could benefit from a supply upgrade in the form of road expansion;

2. The T2 road is the focal point of traffic accidents in Zambia, a road upgrade would help to improve the situation by providing improved safety facilities along this busy corridor;

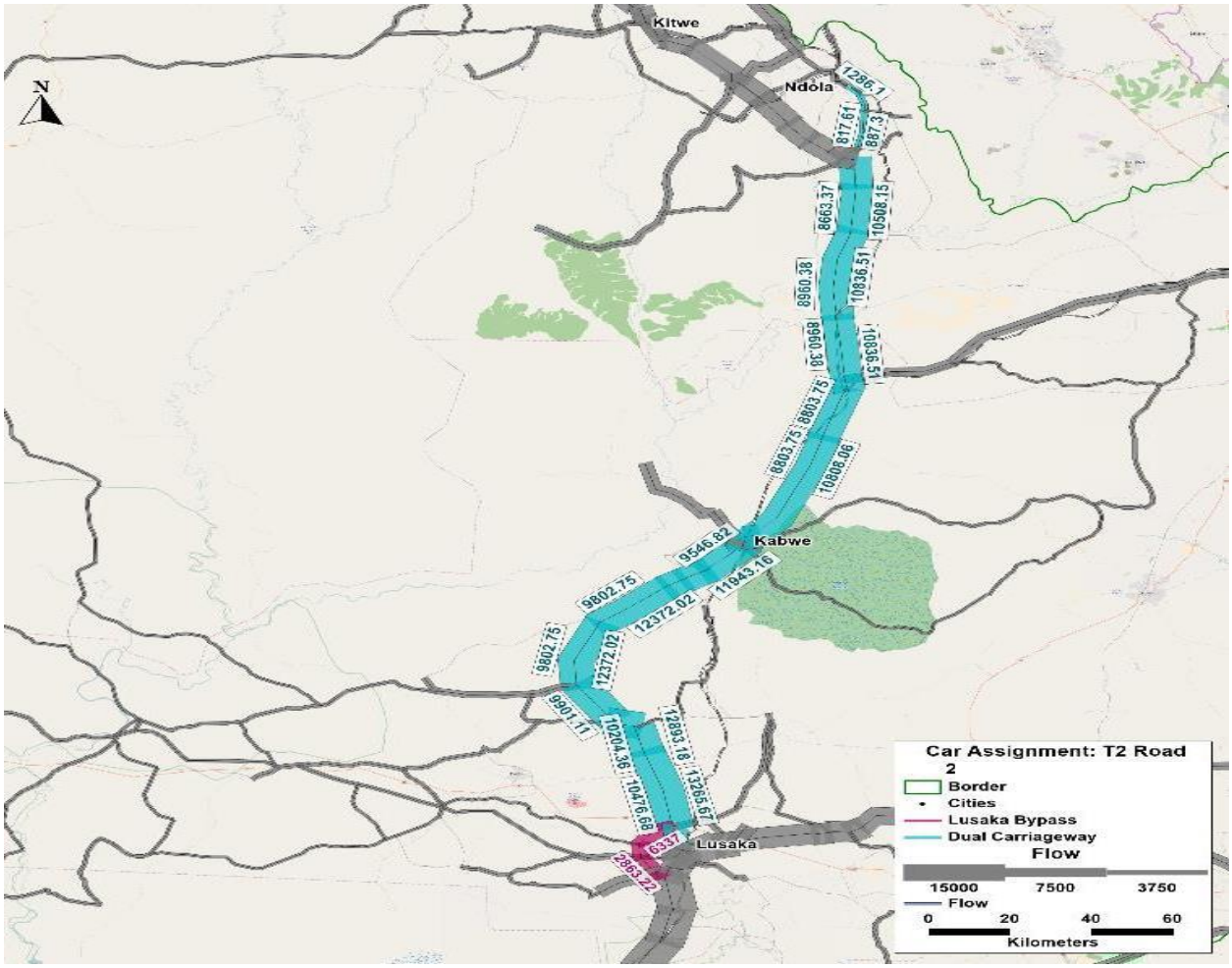
3. Heavy traffic through Lusaka's city center congests the city, a bypass road will reroute through traffic around the city, significantly reducing the amount of vehicles in the CBD; and

4. This road corridor serves a large amount of cargo truck traffic in addition to passenger trips, a road upgrade and expiation will allow for smoother travel in this mixed traffic reality as it will be possible to safely pass larger and slower vehicles.

Table 4-6: Project Summary; T2 Road Dual Carriageway Upgrade and Lusaka Bypass

General Data	
T2 road upgrade length	305.5 km
T2 upgraded road characteristics	110 km/h maximum speed, 2 lanes per direction, segregation between directions of travel
Impact of T2 road upgrade	• Reduction in road accidents and fatalities • Increased supply along strategic road corridor
Lusaka Bypass Road length	More than 25 km
Lusaka bypass road characteristics	80 km/h maximum speed, 2 lanes per direction, segregation between directions of travel
Impact of Lusaka bypass road	• Reduction of significant amount of private vehicle and freight traffic from the city center • Reduction of congestion in city center
Assessment Data	
Public Transport Modal Shift	-1%
MCA Final Score	55.6
Estimated Annual Economy Savings (USD)	-15 million

Figure 4.2 : T2 road upgrade traffic flow and Lusaka Bypass, 2037



It is recommended that this project be implemented in the following phases:

1. Works on the T2 road directly north of Lusaka, this is perhaps the most congested and dangerous road in Zambia;
2. Continuation of the road upgrade from Lusaka northward;
3. Construction of Lusaka West Bypass;
4. Coupling of T2 road upgrade with the RDA bypass road program projects which are on the T2 road
    a. Kabwe
    b. Kapiri Mposhi
    c. Kitwe

4.5.1 Project Conclusions

While it is the goal of the NTMP to focus on sustainable transportation, this road corridor represents an important strategic infrastructure for the countries transportation system. The congestion on this road corridor, specifically directly north of Lusaka, will continue to increase as the motorization rate in Zambia increases. Because of this it is viable to provide an improved supply for the road network. It should be noted that the relationship between road improvement and increased car use is well documented in the history of transportation planning. This rebound effect is something which should be understood by all planning professionals and result in focused and intelligent road improvements in place of broad infrastructure building projects. The risk of road upgrades is that they will motivate private car use and thus negate the increased capacity in a short time frame.

While the negative effects of road upgrades are clear, there are clear positive impacts which cannot be overlooked. This project will decrease travel times by allowing safe passing of slow vehicles. The upgraded road will inherently organize road junctions and intersections, making for safer merging of traffic. Road based public transportation will also move faster as a result of this project. Most importantly, this project will promote road safety by expanding and improving the most dangerous stretches of road on the corridor. A second lane allows for safer passing as drivers need not move into oncoming traffic to pass, this in addition to a significant segregation between directions of traffic should result in reduced accidents, especially those ending in fatalities.

The Lusaka bypass road will have similar effect as the upgraded T2 road by removing traffic from Zambia's city center. Congestion within the city has grown, a major driver of that congestion is through traffic of trips both from north to south and the opposite. A large volume of freight vehicles also pass through central Zambia each day on their journey between the Copperbelt and countries to the south of Zambia. The bypass road will relocate this traffic out of the city center. The positive impacts of this should be decreased congestion in the city, reduced accident rates as a result of reduced traffic and decreased trip durations because of the ability of travelers to bypass the city.

On a final note, although it was not assessed as part of this project, it may be beneficial to expand this project south of Lusaka to the town of Kafue as the amount of traffic between the capital city and Kafue has increased significantly in the last few years. Kafue town is expected to continue to expand, making an upgraded connection between the cities more important.

This project is in advanced stages under the jurisdiction of the RDA. The master plan project's independent assessment of this project shows it to be a viable intervention for Zambia.

4.6 Public Transport (PT) Improvement Program

In order to improve the provision of sustainable and accessible mobility, and as a response to the forecasted increase in car use predicted by 2037, a comprehensive Public Transport (PT) improvement program was created and assessed within the model. To improve PT by 2037, a

package of measures are put in place such as ITS, information systems for passengers, signage, increased frequency, rationalization of the PT system in Zambia, and the creation of an authority responsible for more efficient PT service.

The interventions included in this program are:

1. The development of an intercity PT Organization, under the jurisdiction of the MTC which will define and manage the provision of PT for all of Zambia;
    - This organization would be responsible for defining minimum levels of service for all operations, upholding a responsibility to the public to provide affordable transportation alternatives and the regulation of the sub-sector from a competition and legal perspective;
    - This organization would be responsible for defining the future strategy of PT provision in Zambia, either through competitive contracting of bus operators, direct negotiations with existing operators or other options.

2. It is the recommendation of this master plan that PT provision for intercity travel in Zambia be redefined by a system of "off road" competition instead of the open market "on road", a kind of competition being practiced in 2017. This recommendation represents a time tested and internationally accepted best practice which protects both the regulator, the operator and most importantly the passenger;

3. Provision of information to passengers so that the utilization of PT for travel is more reliable and useful for passengers. Information provision can be in the form of printed timetables, internet sites and clearly market bus stations. The positive impacts of this interventions are well known internationally and represent the best practice in PT service provision;

4. Improvement of bus services on high demand routes and the establishment of new routes to serve areas previously underserved. These objectives can be in the form of increased route frequency and the addition of new routes.

Table 4-7: Project Summary; Public Transport Improvement Programme

General Data	
New organization establishment	Organization for the management and regulation of intercity PT in Zambia
Owner of organization	MTC
Vision of PT Program	• Improve PT service provision • Provide increased accessibility to impoverished populations • Establish a framework for the long term success and reliability of the intercity PT scheme • Rationalize and regulate intercity PT to provide an acceptable minimum level of service

Methods of improving intercity PT	• Improved information provision to passengers • Improved route frequency • Additional routes to underserved areas • Rationalization of routes to provide logical service
Assessment Data	
Public Transport Modal Shift	+3.5%
MCA Final Score	70.2
Estimated Annual Economy Savings (USD)	+9 million

4.6.1 Project Conclusions

The comprehensive improvement of intercity public transport provision is a long term process which requires focused and incremental improvements. Fortunately, this is a program which requires relatively few resources to be successful. This is a result of the employment of mainly soft policy measures to make an impact, such as the building of a website which shows bus timetables and maps of routes, as opposed to the building of a road bridge. The former is a soft measure in that it is immediately attainable. The focus of this program is on bus PT as that is the mode of transport which best supports impoverished communities. The long term goal of this program would be to redefine the perception of public transport into something which competes with private vehicle trips and provides high quality service for all populations.

The PT improvement program receives very high assessment scores because it provides significant benefits in the form of modal shift toward PT, reduced in vehicle time overall, improved accessibility to basic needs, decreased pollution and the support of impoverished populations. Any move toward PT is also a move toward sustainability for Zambia, something which must become a high priority in an increasingly fuel focused world. In general this program is highly recommended as it has relatively low risk, low resource requirements and is something which is badly needed in Zambia. This transportation program has the greatest ability to improve the quality of life of Zambia's citizens immediately.

4.7 Road Tolls Program

A comprehensive road tolling program is being undertaken in Zambia. In 2017 ten inland toll gates are to be completed along the T2 road. In addition, another 33 toll gates are planned in addition to 9 existing entry points on the country's borders. The projected is owned by the RDA and managed by the NRFA and is expected to be completed by the year 2019. The master plan undertook an independent assessment of this program to understand its impact on the Zambian transportation system for the year 2037. The impact of the road tolls program was inputted into the TDM to ascertain the costs and benefits of the program. Based on revenue calculations, it is clear that this is an extremely viable program which has many positive benefits for Zambia, in addition it was concluded that there is little reason to charge public transport vehicles fees at toll gates for the following reasons:

(i) Bus vehicles carry a large number of people but on relatively few vehicles, thus income from PT vehicles will be low as compared to private vehicles;
(ii) Any extra costs incurred by bus operators will be indirectly translated to the passengers, making PT less desirable, this contradicts the goals of sustainability of the NTMP; and

(iii) Revenue from bus traffic is estimated to make up only 4% of the daily income at all toll gate and border entry points for a total of 46,817 USD, in comparison car flows generate an income of 820,155 USD per day

A prerequisite to any exemption of PT vehicles would be the establishment of an intercity PT Organization which would license and regulate bus transport in order to ensure that any exemptions are not taken advantage of.

Table 4-8: Project Summary; Road Toll Programme

General Data	
Border entry points	9
Total inland toll gates	42
Estimated project cost	90 million USD
Estimated daily income by mode (2037)	• Car flow: 820,155 USD • Bus flow: 46,817 USD • Truck flow: 318,761
Estimated total daily income (2037)	• 1.185 million USD
Estimated annual revenue (2037)	• 355.7 million USD
Assessment Data	
Public Transport Modal Shift	+4%
MCA Final Score	60.0
Estimated Annual Economy Savings (USD)	+355.7 million

Figure 4.3 : Road toll program facilities by daily revenue (2037)

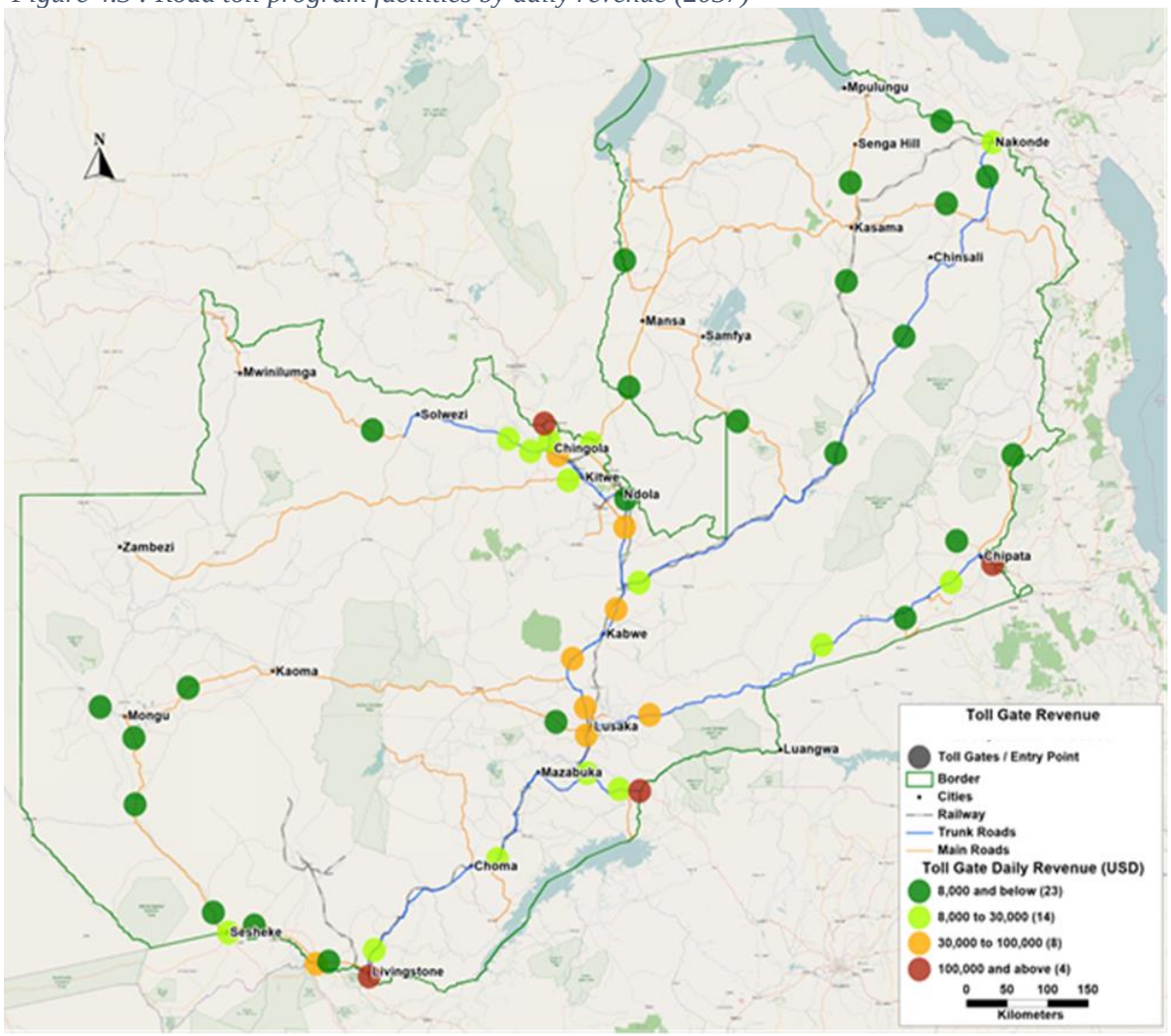
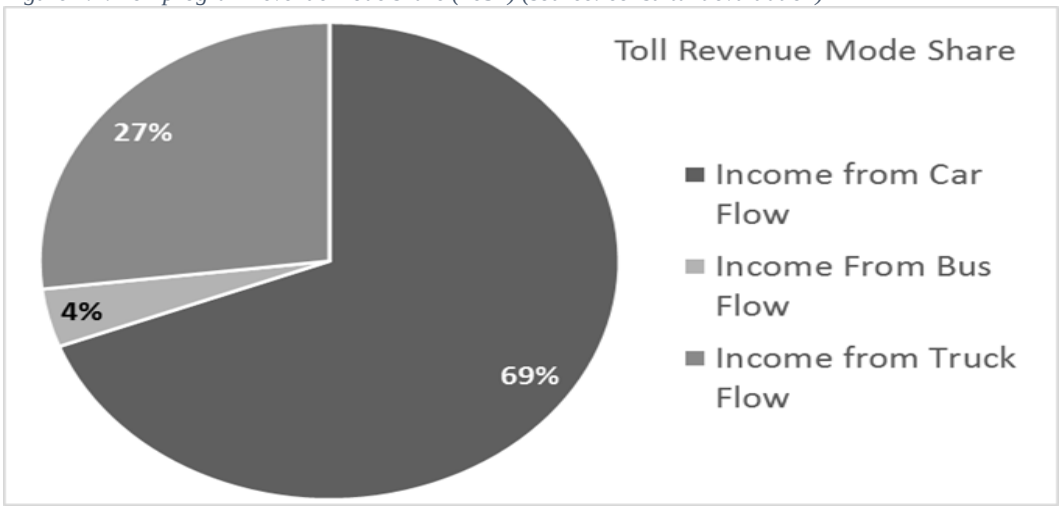


Figure 4.4: Toll program revenue mode share (2037) (source: consultant evaluation)



4.7.1 Project Conclusions

The inland toll program as of 2017 is in its beginning stages of implementation, focused mainly on the T2 road between Kafue and north toward Kapiri Mposhi. Within a short time frame, the entire of the program will be operational along Zambia's core road network. The toll program has a number of major impacts on Zambia's transportation system:

- Modal shift away from private vehicle use toward public transport as a result of having to pay at toll gates;
    - This point is illustrates the important of the intercity public transport program and its vision of improving accessibility via PT;
    - For example, one of the most contested toll gates is that between Kafue and Lusaka, as Kafue town grows into a satellite city of the capital, the amount of daily commuter travel between the cities grows. These commuters will be required to pay the toll on a twice daily basis, something which over time could equate to approximately 1,000 kwacha per month at the current toll fee. If high quality public transport is on offer, it will provide these commuters with a sustainable alternative to their private vehicle.
- When combining the benefits of car and truck flow, the daily revenue of the full toll program is significant. It will be the responsibility of GRZ to put these funds to good use;
- Because of the high fees placed on large trucks, the toll program will also have the effect of causing cargo shippers to look for less expensive alternatives. It is important to provide a rail based alternative, especially for long distance trips where rail has been shown to provide a lower per ton cost for travel.

This public road tolls program has the ability to decrease private car usage and cargo shipping via truck by raising the cost of travel. It is important however that Zambia's transport then provide alternatives to these traditional modes such as public transport and upgraded freight railways in order to enjoy the full benefits of the road tolls program.

4.8 Integrated Cargo Rail

The negative impacts of road freight traffic in Zambia are well documented and represent a problem which cannot be solved in a business as usual scenario. Some change in strategy must be implemented in order to reduce the amount and weight of trucks that are currently traveling on Zambia's roads and mitigate the road safety risks attributed to road cargo transport. Currently, the RDA and NRFA are undertaking one of the best projects possible to encourage a shift of traffic cargo to means other than truck, the project is that of road tolling. At current prices, a truck is paying nearly 8 times the amount a private vehicle does to pass through an inland toll gate, border entry point rates are even higher. In addition to the revenue this will

generate for the state, it will have the impact of reducing the attractiveness of truck usage in the cargo shipping market.

In response to the push impact of road tolling, there is a need for pull measures to counter the negative impacts of road borne freight trucking, it is proposed that certain elements of the ZRL mainline railway be upgraded to compete with trucking. In order to further bolster the freight rail upgrade, the establishment of intermodal facilities is recommended to be developed in conjunction with the freight rail. This project therefore focuses on cargo moving from the inter-mine rail network on the Copperbelt to Zambia's southern borders with Zimbabwe and Botswana. New railway projects are also proposed as part of the master plan, these projects are selected based on their economic feasibility in that they reduce operating costs for shipment, improve the railway's ability to compete with road transport and provide Zambia with alternatives to the congested ports of South Africa. Three Greenfield railway projects are recommended by the master plan. The Serenje – Petauke Railway which will provide a direct link to the port of Nacala in Mozambique, the Kafue to the Lion's Den in Zimbabwe to provide an additional rail link directly to Zimbabwe and subsequently to the port of Beira, as well a Phase I of the Chingola – Jimba railway from Chingola to Solwezi to support the significant development in mining activities in that region projected over the next decade. The rationale for these projects is:

- Opportunity to capitalize on lowered attractiveness of trucking in the freight shipping market due to the road toll program;

- Opportunity to capitalize on the upgrade of passenger rail proposed by the master plan along Zambia's central corridor as well as significant rehabilitation projects currently underway;

- Opportunity to focus the expansive committed projects being advanced by ZRL into a concentrated effort for making intermodal freight rail a reality;

- Limiting greenfield development in order to reduce increased annual maintenance costs and keep the operation at a scale which can be kept in good working order;

- This project supports SADC strategic corridors in a number of ways, this support can lead to funding and increased railway traffic;

- To establish a foundation for the expansion of intermodal freight operations across Zambia based on the success of this railway;

- Taking advantage of a new emphasis and resource allocation for maintenance and infrastructure upkeep in the transport sector;

- Provide alternative direct routes to port facilities.

Project Fishes provide summary data for each Greenfield freight rail project. Project summaries for all railway projects are included in the annex of this report.

Table 4-9: Serenje – Petauke Railway Project Summary

Project Name	**Serenje – Petauke Railway**	SADC Corridor	Nacala Corridor
Project Cost	2.3 billion USD	Project Length	406 km
Annual Maintenance Est		16.24 mil USD per annum	
Project Objective	To link the TAZARA line in Northern Province and Eastern Province of Zambia to the Nacala Corridor.		
Project Description	The railway line involves linking the Chipata–Mchinji line through Petauke District to the port of Nacala in Mozambique.		
Project Status	Preparing for implementation, construction contracted with CECC		

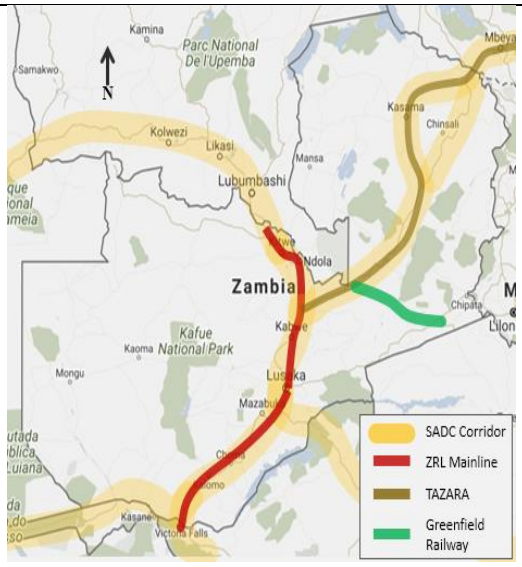


Table 4-10: Kafue (Zambia) to Lion`s Den (Zimbabwe Railway Project Summary)

Project Name	**Kafue Zambia to Lion's Den Zimbabwe**	SADC Cooridor	Beira Corridor
Project Cost	1.36 billion USD	Project Length	341 km
Annual Maintenance Est		13.64 mil USD per annum	
Project Objective	To connect the Zambian Railway line to the National Railway Systems in Zimbabwe at Zawi to the Port of Beira in Mozambique. This is the shortest route to the port of Beira for Zambia.		
Project Description	The railway line will link Zambia Railway line to Ziwa Zimbabwe to the Beira Port.		
Project Status	Feasibility study is complete, talks are ongoing between Zimbabwe and Zambia for a joint venture		

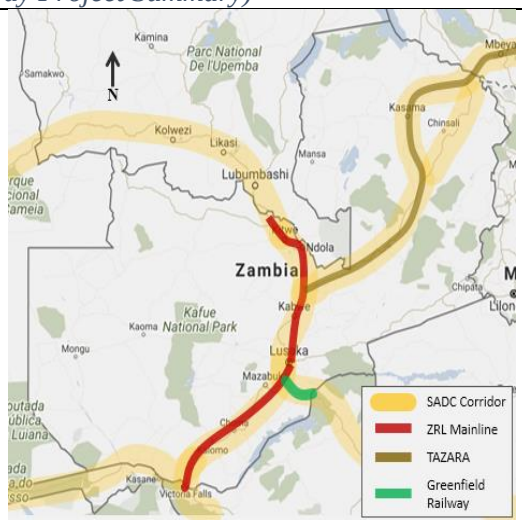
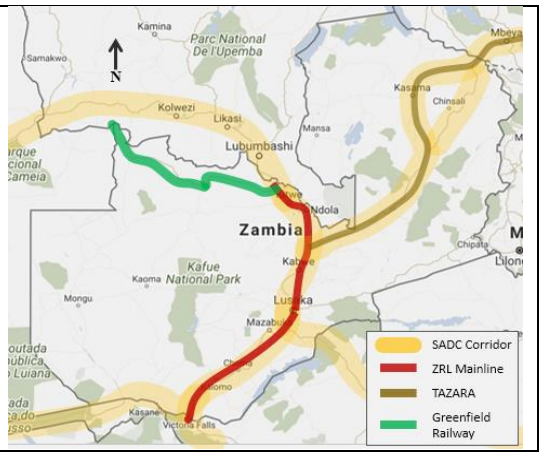


Table 4-11: Chingola to Jimbe Railway Project Summary

Project Name	**Chingola – Jimba**	SADC Corridor	Lobito Corridor
Project Cost	2.4 bill USD	Project Length	604 km
Annual Maintenance Est		24.16 mil USD per annum	
Project Objective	To link Zambia to the western coast of Africa via Angola through a railway network. This will enhance both regional and international trade between Zambia and Angola. This		

	railway's importance is increased by expected significant mining sector development in the Solwezi region.	
Project Description	The railway line involves linking the existing line in Chingola through Solwezi to the border town of Jimbe through to the Port of Lobito. To be constructed in two phases, Phase I – Chingola to Solwezi, Phase II – Solwezi to Jimbe.	
Project Status	Feasibility study complete,	

It is impossible to propose a freight rail project without discussing the inherent risk and failure which has plagued the mode in the region and in Zambia in the past. Some of the main weaknesses of this mode of freight transport are large sunk costs of infrastructure, fierce competition from trucking and a lack of focus on maintenance. Competition with trucks is something which will always be a factor, the same is true for the sunk costs of railway development. Maintenance however is something which can improved in the future. It is essential that proper maintenance on existing and new freight rail infrastructures be made the top priority in the transport sub sector. Best practice shows that around 70% of the annual budget for the freight railway should be devoted to maintenance. The objective of this maintenance is to keep infrastructures viable for the long term, maximizing the investments` benefit.

Currently, feasibility or pre-feasibility plans have been completed for four Greenfield railways:

(i) Nseluka – Mpulungu (Feasibility completed);

(ii) Kafue – Lion's Den (Pre-Feasibility completed);

(iii) Chipata – Serenje (Pre-Feasibility completed); and

(iv) Livingstone – Katima (Feasibility completed)

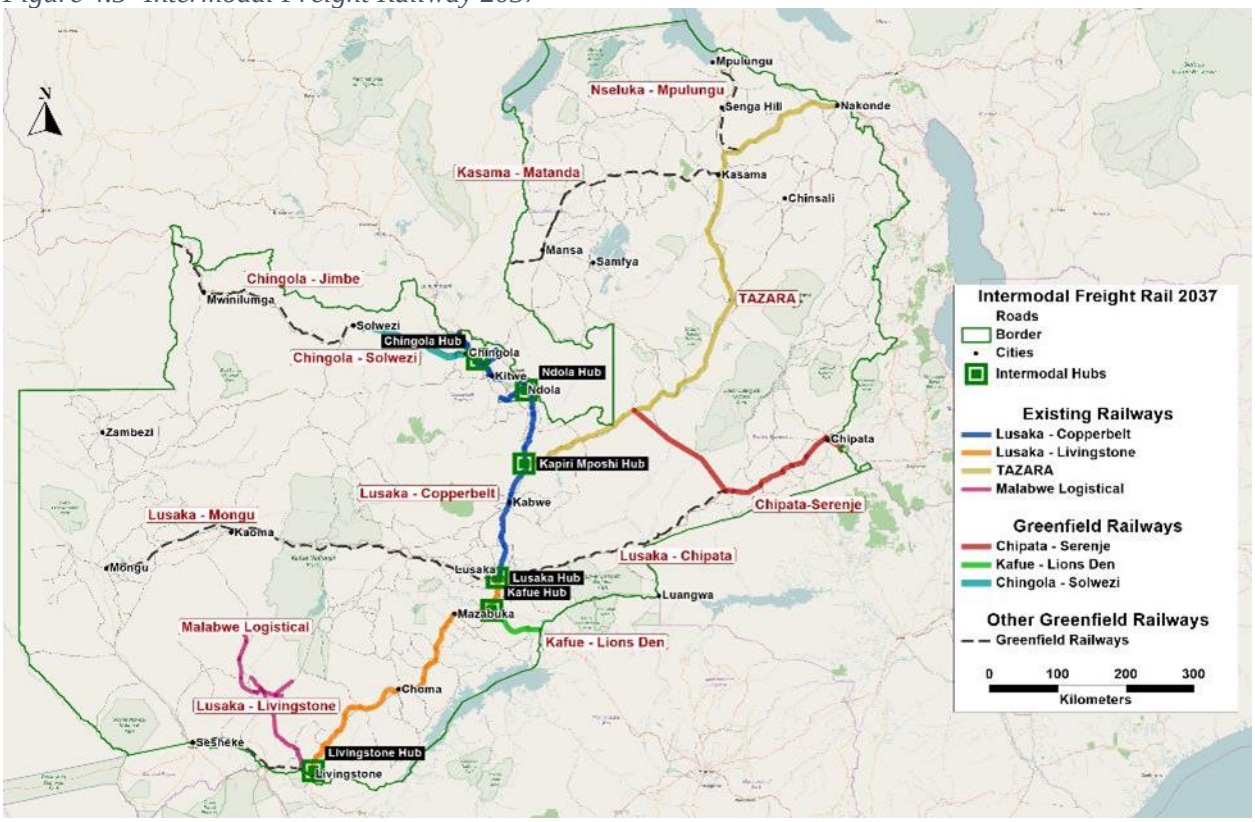
Only the Chipata – Serenje railroad is scheduled to begin construction in 2017, this railway will provide a direct connection to the deep water port of Nacala in Mozambique. The railway is 388 km long and is expected to cost 2.3 billion USD. It is import to remark that the existence of a feasibility study does not mean that a project is committed for implementation and it has been shown that project construction does not require a completed feasibility study, for example, the implementation of the Chipata – Serenje railway.

Table 4-12: General Data on Green Field Railway and Auxiliary Transport Facilities

General Data

Greenfield Railway Projects	• Serenje - Petauke • Kafue – Lions Den • Chingola - Solwezi
Railway upgrades	• Significant shift of freight traffic to railway as a result of increased goods movement and upgrades in rail operating speed • Improvements as a result of completions of extensive backlogged maintenance as proposed by ZRL • Improvements as a result of upgraded passenger railway along countries central corridor including track, stations and signaling • Upgraded operational speeds based on rehabilitated infrastructures coupled with upgraded signaling
Greenfield intermodal hubs	• Chingola • Ndola • Kapiri Mposhi • Lusaka • Kafue • Livingstone • Chipata
Advantages of intermodal transport	• Reduced truck traffic on roads • Sustainable use of railway, especially for long distance trips where railway is less expensive per ton • Change in development strategy to one of alternatives and diversity in the marketplace

Figure 4.5- Intermodal Freight Railway 2037



Three intermodal hubs were selected based on the TDM assessment, these intermodal hubs were shown within the transport demand model to provide the largest benefit for the transfer

of freight from road to rail and rail to road. In addition, three more where chosen because of other considerations, such as future growth, international connectivity and their ability to replace costly rail infrastructure projects. The desired utilization of these hubs is to act as collection and distribution centres for cargo traffic. For example, copper cathode which is extracted from the Solwezi mine is transported to Ndola by truck, from there the copper is transferred at the intermodal facility to train. The train can now continue all the way to the Port of Beira because of the new Lion's Den railway addition.

4.8.1 Project Conclusions

This project is a significant step to rehabilitating the ZRL mainline for freight operations. Years of underfunding, lacking maintenance and increased truck usage have left the railway slow and uncompetitive. This coupled with the large investment in the railway to the Port of Nacala via Chipata makes further investment something to be carefully considered. The strategy of this project is to capitalize on the impacts of other large projects in the master plan, namely improved passenger railways and the road toll program, to jump start a rehabilitated freight rail system with a reasonable investment.

If successful this project will achieve a foothold in Zambia's domestic and international freight transport market once again. Projections should continue to be conservative and wary of projects insisting that large Greenfield projects and investments will bring about significant model shift. The master plan is optimistic in that this relatively modest project is packaged with larger projects which will help this strategy to succeed. While dated, the conclusions of the 2011 ZIPAR report on the case for freight rail in Zambia still have merit and are not to be ignored. The master plan recommends continued effort to rehabilitate Zambia's railway system using the momentum of other large scale transport projects, the advantages of intermodal transport and a renewed and high priority focus on maintenance.

4.9 Institutional and Legal Reforms Required

4.9.1 Introduction

Successful implementation of the projects, facilities and services recommended in the master plan requires the implementation of several institutional changes, without which it will not be possible to obtain the benefits expected from these projects. Moreover, in some cases, it is better not to invest in a project if the necessary institutional arrangement is not in place. In addition to the institutional changes required for the successful implementation of the master plan's projects, the recently completed National Transport Policy identified certain institutional reforms which are required in order to obtain the best performance of the various transport sub-sectors.

The institutional changes presented in this section focus on the central changes required. These changes are quite massive and significant, and will require a sizeable effort and application of resources from the Ministry of Transport and Communications. Thus it is not recommend that the MTC engage in many other institutional changes prior to the implementation of those entities recommended here. The recommended main institutional changes are:

a) ***Introduction and establishment of a strong Railway Regulation Department within the MTC***. This department should regulate and monitor all rail operation in Zambia, both for passengers and freight. In addition, the Railway Regulation Department will monitor and regulate the utilization of the railway infrastructure and rolling stock to ensure safety for public carriage of goods and people. A strong rail regulator is a mandatory requirement for the operation of the proposed fast passenger trains and the improvement of the freight trains recommended previously in this document. Further details on the functions, responsibility, and organization of this rail regulation department are listed below;

b) ***Establishment of Central Public Transport Authority***. This authority, reporting to the MTC, will be responsible for planning, licensing and monitoring public transport operation in Zambia, both in the rural and in the urban areas. It will not be possible to create an attractive, reliable and safe intercity and urban bus service without such an authority. The master plan is aware of the recommendation of the National Policy document to create local public transport authorities, however it is strongly argued that first, a national Public Transport Authority (PTA) should be established. The high level of professional capacity required for the creation of a transport authority rules out the feasibility that such qualifications can be found for all local public transport authorities. The function, responsibility and structure of such authority is detailed below.

c) **Enhancement of the Transport Department at MTC.** Capacity should be built in the Department of Transport to provide policy guidance under Urban and Rural Transport.

d) **Enhance the Capacity of Managing the NTMP in the Transport Sector**. Establishment of a strategic planning unit within the MTC. This unit should be responsible for updating the transport master plan, collecting regular transport data and information, preparing cost-benefit analysis for the various projects, prioritizing proposed investments, setting and regulating the various transport fees, etc.

e) ***Establishment of Maritime and inland water administration offices in local authorities.*** These units will be responsible for water transport management in water transport dominated areas. MTC in collaboration with MLG will facilitate the establishment of these units in local authorities.

f) **Establishment of the National Railway Development Agency (NRDA).** The NRDA will be responsible for the development, maintenance, rehabilitation and upgrade of the railway infrastructure in Zambia. In this way, the railway operators will no longer be in charge of the railway infrastructure development and maintenance thereby making them commercially competitive. Further due diligence studies will be undertaken to appreciate the best practices.

The above Institutional changes are designed with consideration of the revised National Transport Policy and Institutional Framework document. The overarching goal of the updated policy is to "improve the role and contribution of the Zambian transport sector towards

economic growth, job creation and poverty reduction, and by incorporating regional and international best practices, taking into account the specific characteristics of the Zambian transport sectors." The document analyzed and updated institutional and policy frameworks for various transport sectors with the objective of finding gaps and issues in the existing framework and streamlining it for future efficient operations. Where applicable, summaries of relevant portions of the policy document are provided in order to harmonize the master plan with the new transport policy framework. The following sections will briefly present the recommended institutional changes for each of the above elements.

4.9.2 Railway Regulation

The Railway Regulator (RR) holds the mandate to devise and shape various aspects of the railway system throughout the country. When it comes to public transportation (PT) the RR must encourage existing and potential passengers and shippers to choose the train as a means of travel and prioritize it over other modes, most importantly, private vehicles and trucks. The regulator must be a professional body with the know-how on technological aspects on the one hand, and a deep knowledge of system management on the other hand, this knowledge will be based on international and regional standards. Safety, on and off board, is of utmost importance. Overall, the regulator's knowledge base in this field should strive to be ever improving and be able to assess risks, deduce and implement directives to all railway operating parties; licensing and certification of job positions, equipment and machinery standards; supervision and overseeing of rail operations is inherent and must operate as a standalone subdivision.

4.9.2.1 Connection to 2016 National Transport Policy

Chapter 4 of the revised National Transport Policy document focuses on railway transport. A key recommendation of that policy is the separation of infrastructure and operations which will allow for the entrance of private operators on the railway. Other considerations in the document include separating passenger transport and freight transport, the subject of public funding in railways, the cost/productivity factor in railways, private sector involvement, and an overall analysis of the sector's current status (2016).

However, vast international experience shows that it is absolutely mandatory to have a strong rail regulator before private operators can commence their operation. International experience shows that rail operators refrain from entering into a country that has a weak regulatory framework, for the following reasons:

(i) If the regulations are weak, there is a high probability that sometime in the future the government will change the regulatory regime, or even cancel completely the concession. Operators view such a regime as too risky and will not enter this country;

(ii) Private sector operators requires close monitoring to verify that they comply with safety regulations as well as with all their contractual commitments and the international (UIC) standards. Without strict monitoring, the private sector will avoid investments required

for maintenance of the fleet and the infrastructure as well as investments for further development of the rail network in order to increase profits;

(iii) Passenger rail operations requires the regulation of level of service (schedule, travel time, routes, fees, cleanliness of the train, etc.). In addition, there is a need to integrate the rail level of service with the inter-city bus operation, to make sure that these two services are coordinated;

(iv) Because freight transport via rail is often international, complex multi country agreements must be drafted and upheld. Only a centralized regulating body can communicate with other similar railway concerns in neighbouring countries to ensure efficient operations to keep rail transport competitive

As such it is obvious that the introduction of a strong and professional rail regulation department within the MTC is a pre-condition to the implementation of all rail improvement projects and it is also connected to the proposed improvements in the intercity bus operation.

4.9.2.2 Main Functions of the Railway Regulator

The main functions of the railway regulator will be to:

(i) Prepare regulations for safe operation of trains in Zambia in harmony with international (UIC) standards as well as all relevant regional standards;

(ii) Publish professional guidelines regarding train operation in Zambia, including: how operators should maintain their fleet, how to carry a cargo in a train, how to serve passengers, etc;

(iii) Plan and prioritize the upgrades in passengers and cargo service and infrastructure;

(iv) Select train operators through a tender or other procedure, prepare service contracts based on surveys and demand assessments, and sign service contracts with operators;

(v) License operators to provide rail services in Zambia, monitor their operations and cancel the license if the required minimum level of service is not delivered;

(vi) Train and license train drivers and other relevant train related profession;

(vii) Serve as a point of access for all public enquiry;

(viii) Investigate any accident involving trains;

(ix) Plan improvements and upgrades to the network and monitor implementation;

(x) Monitor compliance of rail operators with all safety and other regulations issues;

(xi) Approve any purchase of new rolling stock;

(xii) Harmonize regional operations and sign regional agreements;

(xiii) Periodically collect data through transportation surveys;

(xiv) Integrate the rail level of service with the intercity bus level of service;

(xv) Evaluate market shares of other railway systems to assess opportunities for Zambian railways;

(xvi) Assess regional protocols and status quo and consider renegotiating long standing agreements which are to the detriment of the Zambian railway sector;

(xvii) Create solutions for land encroachment, a significant obstacle to development and rehabilitation;

(xviii) To ensure efficient establishment (structure) and operation (detailed functions) of the RR, a due diligence study will be required to appreciate the best practices.

4.9.2.3 Proposed Key Positions of the Railway Regulator

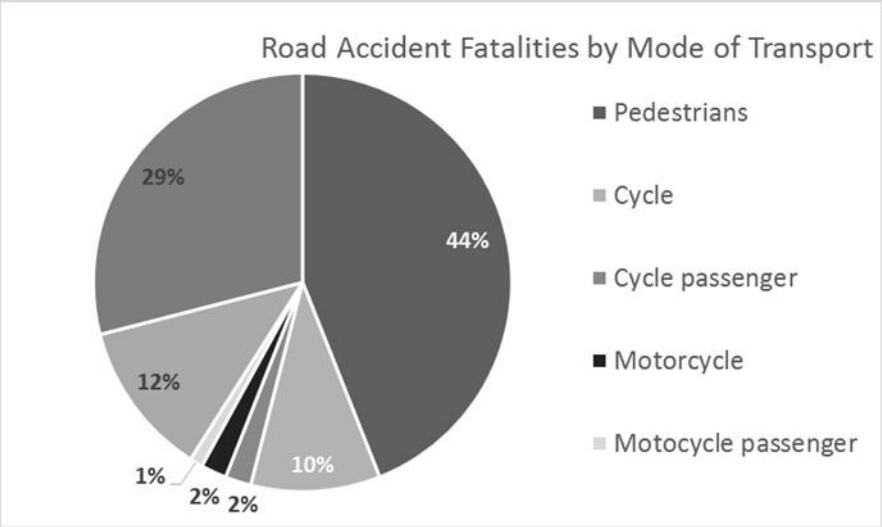
Table 4-13: Key Positions for the Railway Regulation Unit

Position	Description
Director – the railway regulator	Understanding of rail operation, legal aspects of rail operation, some experience in rail operation
Head of legal department	Legal advisor responsible for all legal changes required, contracts to be signed with operators, etc.
Head of operations	Experience with rail operation, both for passengers and cargo
Head of infrastructure	Civil engineer with experience in design, construction and maintenance of rail infrastructure including stations, deport, etc.
Head of enforcement	Responsible for enforcing regulations on all operators. Experience with enforcement and legal background
Head of rolling stock	Responsible to license and approval any rolling stock operating in Zambia

4.9.3 Urban Transport Department

It has been shown that future transportation challenges such as road accidents, congestion and increased pollution will be focused in urban areas. This can be seen in the share of road accidents leading to fatalities occurring in cities and involve vulnerable road users (pedestrians and cyclists). Figure 4.6 below is a pie-chart showing the percentage contribution of road accidents by mode urban transport.

Figure 4.6: Road Fatalities by Mode of Transport



A majority of these accidents occur in the Lusaka Province based on RTSA's 2015 annual summary. This high proportion is a result of poor provision of safe infrastructure and services for NMT users. This could have been avoided if urban street design guidelines were in place. The formal responsibility for the development of infrastructure and services in urban areas lies within the local governments. However, these lack any professional capacity to deal properly with the growing needs, and definitely lack any financial resources. Thus, there is a need to establish an Urban Transport Department within MTC.

4.9.3.1 Connection to 2016 National Transport Policy Paper

Unfortunately, the policy document does not provide a specific discussion of urban transport in Zambia. This is a topic which is technically outside of the scope of the master plan, however it is clear that the cities of Zambia are already and will continue to be the focal point of the country's transport challenges. In this light the master plan recommends, in addition to the urban roads and urban PT solutions mentioned in the policy document, a complete institution for Zambia which will focus on urban transport and solutions to the challenges which urban travelers face.

The recommendation to introduce local public transport authorities under the responsibility of the local governments will not address this issue. The role of the Central Government is to harmonize urban transport design, publish professional design guidelines, and review and approve local traffic arrangements, support financially investments in urban transport, etc. This can be done only by a strong and professional central entity, specializing in urban transport issues.

4.9.3.2 Proposed Main Functions of the Urban Transport Department

The functions and authority of the urban transport department:

(i) Prepare and update urban transport design guidelines, covering all aspects of urban transport including: geometric design of urban street, parking design, traffic signal

design, street lightning, design for NMT, integration with urban planning, guidelines for traffic impact assessment, etc;

(ii) Assist local governments to prepare sustainable urban transport master plans for each major urban area;

(iii) Plan and or approve detailed traffic and parking arrangements for all urban areas;

(iv) Plan, design and implement measures to support priority operation of public transport in urban areas (park and ride, bus lanes, bus rapid transport, light rail, etc.);

(v) Review and approve all traffic arrangements in urban areas;

(vi) Review all traffic arrangements for new land use development and whenever relevant, conduct traffic impact assessment of the new development to select mitigation measures;

(vii) Represent the Ministry in the meeting of local planning committees; and

(viii) Periodically collect data through transportation surveys

4.9.3.3 Proposed Key Positions of the Urban Transport Department

To carry the above functions, the main positions for this department should be:

Position	Description
Head of department – transport commissionaire	Manager with understanding and knowledge of urban transport
Chief traffic engineer	Civil engineer responsible for review and approval of traffic arrangements in urban areas
Head of urban transport planning	Preferable civil engineer responsible for preparation and review of urban transport master plans for all cities in Zambia and responsible for coordination of local land use plans with transport plans. Represents the Department in planning committees.
Head of infrastructure	Civil engineer responsible to review applications of local government for financing of urban infrastructures

4.9.4 Department of Public Transport

One of the measures recommended in the master plan is a significant improvement of the public transport service and integration of the bus operation with the new passenger rail operation. While the actual provision of the services will be done by the private sector, the public sector needs to plan, license and monitor the operation, and integrate it within the complete Public Transport (PT) system in Zambia.

All over the world, successful public transport operation is associated with successful implementation of public transport authority. Sometimes, the PT Authority is included in a general transport authority, but always there is a need for a strong PT entity. This entity has

the legal power to plan, design and operate attractive and safe public transport, both intercity and urban.

4.9.4.1 Connection to 2016 National Transport Policy Paper

Chapter 3.3 of the transport policy document focuses on passenger transport. That document proposed the establishment of a Public Transport Authority in order to overcome mobility challenges in Zambia. The policy document provides additional discussion for this subject regarding an introduction to the current situation (2016) of passenger transportation in Zambia, the current legal framework of PT, expected future developments in the sector, relevant institutions, a situational analysis, coordination considerations, enforcement issues and finally conclusions and recommendations. The main conclusions for passenger transport from the policy document focus on the difficulties of unregulated PT operations for both urban and intercity PT as well as an insufficient coordination in the sector resulting from a lack of a sole PT institution.

Only a centralized public transport authority can hold the authority to define guidelines for the strategy of competition in the PT market, required Level of Service (LOS) and to monitor the delivery of that service. While local governments can contract operators to provide services and monitor that service provision, it is the responsibility of the national level public transport institution to guide and regulate both the local government and operators in order to ensure fair competition, acceptable service delivery and overall ensure that public transport services and infrastructure are of high quality.

4.9.4.2 Main Functions of the Department of Public Transport

The functions and authority of the Department of Public Transport include:

(i) Design integrated public transport services for all bus services in the country, both for inter-city and urban transport service;

(ii) Develop a transparent fare structure that is affordable to all users and common to all operators;

(iii) Develop common passenger information systems;

(iv) Improve passenger transport facilities including bus parks, bus stops and bus only lanes wherever necessary;

(v) Organize a consistent and acceptable fare collection system and establish a common clearinghouse that serve all operators;

(vi) Select packages of services that are balanced financially and tender these packages on a regular basis to maintain competition;

(vii) Sign public service contracts with all operators and monitor the compliance of the operators with their contracts;

(viii) Promote, design and implement priority measures for PT operation (i.e. P&R, BRT, LRT, bus lanes, priority as signalized intersections, etc.);

(ix) Protect the economic viability of the PT services;

(x) Periodically collect information regarding all aspects of PT supply and demand through transport surveys

4.9.4.3 Proposed Key Positions of the Department of Public Transport

Main key positions of such an authority are:

Position	Description
Head of the authority	Manager with basic understanding of public transport operation
Head, planning unit	Responsible for the design of the overall public transport services in Zambia. The planning should cover routes, timetables, stops, type of buses, etc.
Head of public transport infrastructure	Civil engineer with experience in design, construction and maintenance of transport infrastructure including stations, depots, bus parks, bus lanes, BRT, LRT, etc.
Head of enforcement	Responsible for enforcing the compliance of the operators with their respective public service contracts
Head of procurement	Responsible to procure the operating services through a competitive tender process, prepare public service contracts with the operators

4.9.5 Strategic Planning Department

The National Transport Master Plan needs to be updated on a regular basis. This is because social, political and regional needs as well as technological changes keep impacting national needs. One of the main functions of MTC is to set the transport policy and strategy for future years as well as to prepare the master plan and the action plan that supports this policy.

As part of this assignment, the consultant demonstrated the importance of working in a methodological manner using quantitative tools like travel demand models, cost-benefit analysis, environmental assessment, traffic impact assessment and more. These tools help decision makers to set the proper priorities for investment that will enable them to achieve defined goals and objectives. This long term planning requires a level of professional capacity that does not exist today within the MTC, but is highly important to develop.

4.9.5.1 Connection to Revised 2002 National Transport Policy (NTP – 2026)

The policy document does not provide for a strategic planning institution, however it takes great effort to emphasize the importance of coordination in the transport sector as well as define numerous crosscutting measures and issues for consideration. The master plan takes the policy documents recommendations a further step by recommending a strategic planning department. The department would serve the needs of national policy framework by working to coordinate transport solutions at a national and local level while taking a macro, holistic and harmonized view of Zambia's transportation system. In many countries, this department is

also responsible for promoting and managing national PPP transport projects which is the recommendation of the master plan for this department as well.

4.9.5.2 Main functions

The functions of the Strategic Planning Department include:

(i) Collect traffic and other transport data on a regular basis;

(ii) Update the travel Demand Model with the changes in supply and demand as well with the changes in development scenarios;

(iii) Conduct cost-benefit analysis for various investment projects using the TDM to obtain the expected benefits;

(iv) Conduct Environmental Impact assessments for each project to ensure maximum protection of the environment;

(v) Prepare annual work plan for each sector before the beginning of the budget year

4.9.5.3 Key Positions Required for the Strategic Planning Department

Table below contains the role to be played by key officials of the strategic planning department.

Table 4-14: Key Positions for the Strategic Planning Department

Position	Description
Head of department	Transport economist or planning expert, with managerial qualifications
Transport planner	Civil engineer or economist or similar with experience in the development and the use of transport models and transport planning
Chief transport economist	Economist responsible for conducting cost-benefit analysis for the various proposed investments, setting fares and fees for the various transport services in the country
Head of PPP projects	Accountant or legal expert with relevant experience in promoting PPP projects

4.10 Optimal Scenario Conclusions

It is time for Zambia to step away from a de facto passenger car oriented strategy to one which provides mobility for all populations, reduces car dependency, provides significant economic benefit and will improve the quality of life for Zambians.

The main objective of this project as defined by the original terms of reference is as follows: *To develop the country's national transport infrastructure master plan aligned to addressing the country's transport requirements in the short term, medium term and long term periods beyond 2030.*

This master plan has achieved this objective by providing a futuristic comprehensive development for the year 2037. This master plan provides short, medium and long term

projects chosen to continuously improve Zambia's transportation system in an integrated manner. Further, the projects prioritized by this master plan will build a foundation of best practice and sustainable transport alternatives upon which Zambia can continue to build a better and more holistic transportation system. Finally, this master plan, in the form of the optimal scenario is based on the current and future needs of all Zambian's. The optimal scenario's broad approach to transport looks to improve the level of service of all sectors, across the whole of the country.

This master plan represents a beginning of a new strategy for Zambia with sustainability and equality as its core values. From this point Zambia will have the capacity to continue responsible development into the future.

Chapter 5: Action Plan

The action plan is a recommended investment plan for the achievement of the master plan. It represents the final product of the NTMP, a prioritized list of investments and infrastructure projects which have been collected and updated throughout the whole master plan process. The list is very long and organized from committed projects through unique projects. The Gantt Chart approach shows the timeline and prioritization of each project based on data collected from stakeholders, general best practice and project complexity.

It is essential that the action plan be taken in the context of the transport system as a whole. For example, it is not possible to consider freight railway rehabilitation without the consideration of the impact of inland road tolls on international trucking. In addition, big ticket projects are not necessarily the most important, small scale projects must not be overlooked as they often are the most cost and time feasible as well as providing essential positive impacts for local populations. A prime example of this are missing jetties and harbor facilities which support large populations who rely on water transport. As such the action plan is a graphic representation of the independency and complexity of the NTMP. The action plan takes into consideration the following factors:

(i) Budget limitations;

(ii) Time limitations; and

(iii) Projects which are prerequisite to the success of other projects.

The action plan is based on the assumption of a **One (1) Billion USD** annual budget for 20 years. While this appears to be a high number, it is a significant limitation to development and requires careful prioritization of projects in order to stay within budget.

5.1 NTMP Action Plan Summary Table

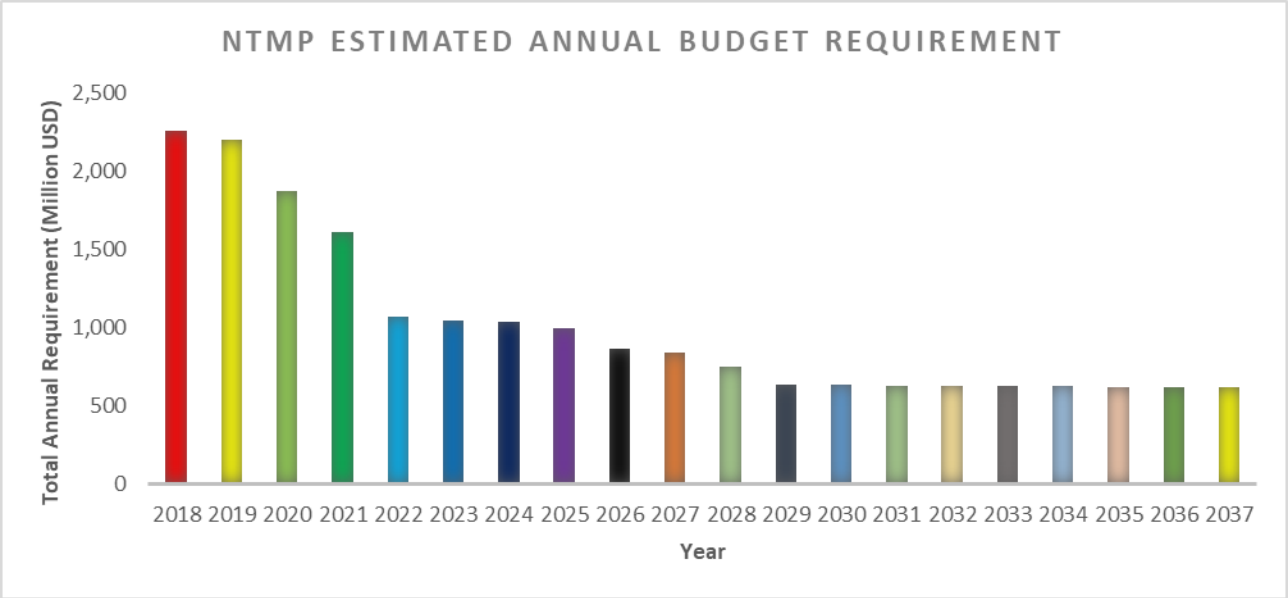
Table 5-1: NTMP Action Plan Summary Table

Project Type	Description	№ of Projects	ECM of All Projects
REF	Projects which are on-going or approved for implementation	74	17,330
MND	Projects not yet approved but essential for the development of the sub sector that should be included in the Master Plan	30	1,221
UNQ	Potential future projects which would benefit the sector greatly, should budget become available	6	1,585
Total		**110**	**20,136**

Projects are assigned phases of implementation which are spread across the 20 years of the master plan. Each project has a cost estimate, this allocation of resources will need to be correctly distributed across the life of the project in order to ensure its successful conclusion.

5.2 NTMP Annual Funding Requirements

Figure 5.1: Estimated Needful Budget per year for funding the Master Plan



5.3 Implementation Schedule of the NTMP

Project Type	Description
Planning-Standards	Phase of project focused on planning and the definition of operating and design standards
Tender / Procurement	Phase of procurement and contract tendering for construction phase
Construction	Construction Phase
Operational / Opening	Opening of new infrastructure to use or the beginning of operations

5.4 Implementation Matrix

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Reference Projects																									
Road Sector Projects																									
Annual Projects	2017-2018 approved and prioritized projects	REF	RDA	In Progress	450	Yearly																			
Link Zambia 8000	Strategic road improvement project for all of Zambia	REF	RDA	In Progress, Phase II-III	200	2019																			
LSK 400	Strategic road improvement project for Lusaka	REF	RDA	In Progress, nearing completion	50	2018																			
CB 400	Strategic road improvement project for Copperbelt	REF	RDA	In Progress	500	2021																			
Township Roads Project	306km of roads throughout the Copperbelt	REF	RDA	In Progress	461	2020																			
Muchulila – Lumangwe Road (Lot 1)	40 km of road and drainage upgrade in Lusenga Plains Park	REF	ZWA	In Progress	1	2018																			

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Muchulila – Lumangwe Road (Lot 2)	33 km of road and drainage upgrade in Lusenga Plains Park	REF	ZWA	Planned	1	2018																			
Riverside Drive	9 km of road resurfacing in Mosi oa Tunya Park	REF	ZWA	Planned	1.14	2019																			
Lusaka Park Loop	9 km of road resurfacing in Lusaka Park	REF	ZWA	Planned	1.05	2019																			
Hook Bridge - Kabanga	108 km of road rehabilitation in the KNP	REF	ZWA	Planned	2.84	2020																			
Kabanga Gate – D181 Junction	20 km of road rehabilitation in the KNP	REF	ZWA	Planned	0.53	2021																			
Ngoma Loop Roads	50 km of road rehabilitation	REF	ZWA	Planned	1.05	2021																			
Luanginga Bridge – Liuwa Plains	80 km of road rehabilitation in Liuwa Plains	REF	ZWA	Planned	2.11	2022																			
Mano – Luangwa Pontoon	66 km of road rehabilitation in North Luangwa	REF	ZWA	Planned	1.74	2023																			
Mfuwe - Lusangazi	51 km of road rehabilitation in South Luangwa	REF	ZWA	Planned	0.57	2023																			

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Lusangazi – Luamfwa	25 km of road maintenance in South Luangwa	REF	ZWA	Planned	0.53	2024																			
Mfuwe – Chichele	27 km of road maintenance in Luangua Valley	REF	ZWA	Planned	2.11	2024																			
Chiawa – Jeki	80 km of road rehabilitation in Lower Zambezi	REF	ZWA	Planned	2.11	2025																			
Nsumbu – Chitutu Bridge – Lake Kakao	42 km of road construction in Nsumbu	REF	ZWA	Planned	1.11	2026																			
Sioma – IP Zone Boma	55 km of road construction in Sioma Ngwezi	REF	ZWA	Planned	1.45	2026																			
Provincial Tourism Access Roads: North Western Province	5 road upgrade projects	REF	MTA	Conceptual	20	2022																			
Provincial Tourism Access Roads: Copperbelt Province	5 road upgrade projects	REF	MTA	Conceptual	20	2022																			
Provincial Tourism Access Roads: Western Province	6 road upgrade projects	REF	MTA	Conceptual	20	2022																			

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Provincial Tourism Access Roads: Southern Province	6 road upgrade projects	REF	MTA	Conceptual	20	2022																			
Provincial Tourism Access Roads: Northern Province	5 road upgrade projects, 1 bridge project	REF	MTA	Conceptual	25	2022																			
Provincial Tourism Access Roads: Lusaka Province	6 road upgrade projects	REF	MTA	Conceptual	20	2022																			
Provincial Tourism Access Roads: Central Province	3 road upgrade projects	REF	MTA	Conceptual	20	2022																			
Provincial Tourism Access Roads: Eastern Province	8 road upgrade projects	REF	MTA	Conceptual	20	2022																			
Feeder Roads Program	20 projects for 650 km of rural access roads	REF	MLG	In Progress	4.27	2018																			
Access road to existing MFEZ's and Industrial Parks	40 km of access roads to industrial parks and MFEZ's	REF	RDA	In Progress	5	2019																			
Routine Maintenance on NMT Infrastructure Program	Phased NMT network maintenance /upgrade project	REF	MLG	New 3 year cycle including	4.81	2020																			

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																				
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
One Stop Border Posts	Integrated border posts (5 points) which integrate all border activates for road passengers and freight trips;		MCTI	In Progress	75	2021																				
	Kazungula OSBP																									
	Mwami OSBP																									
	Nakonde OSBP																									
	Katima Mulilo	R																								
	Kasumbalesa																									
Road Safety Projects																										
Design, Installation and Implementation of an Intelligent Transport System (ITS)	To apply information and Communication Technology in road transport infrastructure for traffic surveillance, traffic and mobility management	REF	RTSA	Phase1 between Kafue and Ndola under procurement	1.89	2019																				
Construction of Motor Vehicle Inspection Centers	Upgrading infrastructure for motor vehicle inspection.	REF	RTSA	Preliminary planning	3.16	2022																				

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																				
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Mechanized Motor Vehicle Testing equipment	There is need to mechanize motor vehicle inspection of the Zambian Motor Vehicle population in order to improve road safety.	REF	RTSA	Preliminary planning	0.8	2021																				
Digital Accident Recording	Utilization of GPS equipped tablets for accident recording	REF	RTSA	Procurement and Pilot	0.5	2019																				
Road Traffic Signing	New roads signs across Zambia	REF	RDA	In progress	0.63	2020																				
Railway Sector Projects																										
Mpika Workshop Upgrade	Manufacture of high speed train components	REF	TAZARA	Conceptual stage		2030																				
Rehabilitation and upgrade of design and manufacturing shops	For manufacture of external business components and core business components at Mpika	REF	TAZARA	Awaits conclusion on business cooperation model	1.2	2020																				
Kasama-Nakonde Rerouting	Rerouting and upgrade of rail section for safety and speed	REF	TAZARA	Awaits conclusion on the business cooperation model	148.2	2025																				

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Kapiri-Nakonde track maintenance	Rehabilitation of rail section	REF	TAZARA	Annual maintenance	5.5	Annual																			
Existing railways annual maintenance	Lifting, packing and aligning of the track, repairing of formation, vegetation clearance and attending to emergencies	REF	ZRL	In Progress	40	Annual																			
Comprehensive railway rehabilitation and Upgrade of infrastructure	Comprehensive rehabilitation and upgrade of all infrastructure	REF	ZRL	Procurement stage	1,000	2021																			
Installation Mainline Signaling System (Phase I)	Installation of signaling system along ZRL mainline	REF	ZRL	Awaits funding	51	2020																			
Construction on Inter-Mine railway	Railway linkage of 100 km to the new mining plants on the Inter – mine in the copper belt province	REF	ZRL	In Progress	50	2019																			
Establishment of a Concrete Sleeper Factory	Establishment of a Concrete Sleeper Factory in Ndola	REF	ZRL	Surveys and analysis done.	10	2018																			

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Establishment of Quarry Plants	Establishment of Quarry Plants in Chisamba, Kasavasa, etc for the purpose of ballast production	REF	ZRL	Surveys and analysis done.	12	2018																			
Rehabilitation and upgrade of the Mulobezi Line	Livingstone-Mulobezi Line (162km) Concrete Re-sleepering, Replacement of Rails, Ballasting, Repair of Bridges and Welding of the Rails	REF	ZRL	Procurement stage	103	2025																			
Rehabilitation and Acquisition of Rolling Stock Assets	Remanufacture of 10 GE U20C Locomotives Rehabilitation of 640 wagons; Acquisition of: • 40 locomotives • 2,600 Wagons • 50 Passenger Coaches • 4 Diesel Multiple Units • Workshop Equipment	REF	ZRL	Procurement stage	550	2022																			

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Serenje-Chipata Greenfield Railway	388.8 km	REF	ZRL	Mobilization of funds by the contractor	2300	2021																			
Aviation Sector Projects																									
Kenneth Kaunda International Airport Upgrade Project	This airport will serve the Lusaka provinces in carrying both passengers and goods	REF	ZACL	In Progress	360	2019																			
Copperbelt International Airport	Construction of a new intl. airport at Ndola	REF	ZACL	In Progress	397	2020																			
Mfuwe International Airport	Upgrade of airport infrastructure at Mfuwe Airport	REF	ZACL	Financing/Negotiation	122	2020																			
Kasama Airport	Upgrade of Kasama airport runway	REF	MTC	In Progress	14.3	2020																			
Kasaba Bay Airport	Rehabilitation of Kasaba Bay airport	REF	MTC	In Progress	2	2018																			
Provincial Aerodrome Program	10 key provincial airports for rehabilitation in 3 Lots	REF	MTC	In Progress, contracts for works are approved	2.5	2020																			
Maritime and Inland Waterways Projects																									

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																				
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Port Terminal Facilities (ICD) Rehabilitation Program	Dar es Salaam – Mukuba Depot Mumbasa Copper Yard Walvis Bay ICD (privately financed)	REF	Dpt. M&W	In Progress	15	2019																					
Lake Tanganika Harbors	Harbor rehabilitation/ development program	REF	Dpt. M&W	In Progress	8.5	2019																					
Lake Mweru	Harbor rehabilitation/ development program	REF	Dpt. M&W	In Progress	5	2021																					
Lake Banguelu	Harbor rehabilitation/ development program	REF	Dpt. M&W	In Progress	3	2021																					
Lake Kariba	Harbor rehabilitation/ development program	REF	Dpt. M&W	In Progress	3	2022																					
Zambezi River	Harbor rehabilitation/ development program	REF	Dpt. M&W	In planning	1	2019																					
Kafue River	Harbor rehabilitation/ development program	REF	Dpt. M&W	In Planning	1	2021																					
Chambeshi River	Harbor rehabilitation/ development program	REF	Dpt. M&W	In Planning	0.6	2021																					

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Nyengo-Makoma Canal	Connects Zambia-Angola (115 km) annual maintenance	REF	Dpt. M&W	In Progress	1	2018																			
Shangombo/Rivungu Canal	Canal Development Shangombo Harbor Development	REF	Dpt. M&W	In Progress	0																				
Swamp Harbor Rehabilitation Program	Banguelu Swamp Lukanga Swamp Chinyama Litapi Swamp	REF	Dpt. M&W	In Planning	0.75	2022																			
Provincial Canal Dredging Program: Luapula Province	500 km of canal dredging	REF	Dpt. M&W	In Progress	400	2037																			
Provincial Canal Dredging Program: Northern Province	200 km of canal dredging	REF	Dpt. M&W	In Progress	160	2037																			
Provincial Canal Dredging Program: Central Province	150 km of canal dredging	REF	Dpt. M&W	In Progress	120	2037																			
Provincial Canal Dredging Program: Western Province	1,000 km of canal dredging	REF	Dpt. M&W	In Progress	800	2037																			

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Provincial Canal Dredging Program: Muchinga Province	100 km of canal dredging	REF	Dpt. M&W	In Progress	80	2037																			
Provincial Canal Dredging Program: North Western Province	100 km of canal dredging	REF	Dpt. M&W	In Progress	80	2037																			
Public Transport Sector Projects																									
Bus Station Program	7 intercity and 1 international new/upgraded bus stations	REF	MLG	In Progress	15	2020																			
Urban Transport Projects																									
Urban Roads Program	40 projects for 700 km upgrading local road networks	REF	MLG	In Progress	52.63	2018																			
Pave Zambia 2000	Urban road project utilizing cost effective materials to improve urban roads across Zambia	REF	RDA	In Progress	370	2021																			
Ndola Roads Project	Ndola urban road network upgrades 43 km	REF	MLG	Design Construction contract is signed	50	2019																			

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Urban PT Projects	Projects being undertaken in various towns across Zambia	REF	MLG	In Progress	3	2020																			
Lusaka Decongestion Project	Lusaka Traffic Decongestion Project Implementation	REF	MLG	On-going, Contract with engineering /construction firm signed	289.47	2023																			
Mandatory Projects																									
Roads Sector Projects																									
Agriculture Access Roads	• Nansanga from Great North Road to Kabundi • Chikankata Road • Kawambwa to Luena farm block • Lufwanyama to Luswiwishi Farm block	MND	RDA	Preliminary Planning	3.8	2022																			
Access roads for future MFEZ and industrial parks	9 development sites	MND	RDA	Preliminary Planning	45	2025																			
Lusaka Bypass Road	Outer ring road around Lusaka on the West side of the city with connection to M9 road	MND	RDA	Planning	20	2022																			

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
City Bypass Road Program	Bypass roads at major urban areas to remove through traffic from urban centers • Kabwe • Kapiri Mposhi • Kitwe • Chingola • Choma • Mazabuka •Livingstone	MND	RDA	Planning	50	2026																			
Rest Areas Program	Rest areas to improve road safety	MND	RDA	Planning	3	2022																			
Farm Block Roads and Access Road Network	Improved access roads to all existing and planned Farm Blocks and access roads for agriculture production	MND	RDA	Conceptual	2	2022																			
Routine Maintenance on NMT Infrastructure Program	Phased NMT network maintenance/upgrade project	MND	MLG	New 3 year cycle with 5 largest towns in Zambia	10.68	2023 and every three years																			
Railways Sector Projects																									

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Mainline Signaling Phase II	Development of mainline safety systems such as crossing gates and lights Approx. 60 units	MND	ZRL	Conceptual	9	2022																			
Greenfield railways annual maintenance	Lifting, packing and aligning of the track, repairing of formation, vegetation clearance and attending to emergencies for new railways: • Upgraded Passenger Service • Serenje-Chipata • Kafue-Lion's Den	REF	ZRL	Conceptual	60	Annual																			
Road Flyover Program	Construction of road flyovers are key road rail junctions Approx. 20 units	MND	ZRL	Conceptual	30	2026																			
	Aviation Sector Projects																								

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Capacity Building: Training of Technical Personnel.	Capacity Building	MND	ZASTI	Preliminary Planning	0.25	2017																			
ATO Certification	Internationally certified training activities	MND	ZASTI	Preliminary Planning	0.25	2017																			
ICAO TRAINAIR PLUS	ZASTI attains international status	MND	ZASTI	Preliminary Planning	0.25	2018																			
ZCAA Capacity Building	Establishment of an Economic Regulation Unit and other equipment	MND	ZCAA	Ongoing	0.78	2020																			
BAGASOO Procurement	Installation of safety oversight technology	MND	ZCAA	In Progress	0.23	2017																			
Infrastructure Upgrade at ZASTI	Lecture theaters, Dormitories, Social amenities and equipment	MND	ASTI	Conceptual Stage		2023																			
Maintenance of District Aerodromes	Rehabilitation of District Aerodromes	MND	MTC	Preliminary Planning	1	2020																			
Nationwide adaptation or design of road portions as emergency landing strips	Emergency landing strip development along specific roadways	MND	MHID	Preliminary Planning	40	2030																			

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Establishment of helipads at major hospitals	Establish helipads at major hospitals	MND	MHID	Preliminary Planning	0.15	2025																			
Maritime and Inland Waterways Sector Projects																									
Kafue River Navigability Phase I	Connecting Mumbwa to Kafue Town via Mumbesh Rivera and Kafue River	MND	Dpt. M&W	Conceptual	180	2027																			
Capacity Building for Maritime and Inland Waterways Sector	Upscaling of sector capability	MND	Dpt. M&W	Conceptual	0.6	2018																			
Waterways Safety Program	Search and Rescue functions Hazard Marking Education program	MND	Dpt. M&W	Conceptual	0.6	2019																			
Inland Waterways Master Plan	Long term strategy and prioritizatio n of investments	MND	Dpt. M&W	Conceptual	0.6	2020																			
Comprehensiv e Jetty/Harbor Rehabilitation	Survey, prioritizatio n, and implementat ion of rehabilitatio n projects at key water transport facilities	MND	Dpt. M&W	Conceptual	3	2022																			

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																			
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Nautical Training School	School teaching essential boat handling and safety skill	MND	Dpt. M&W	Conceptual	0.4	2022																				
Integrated Transport Projects																										
KKIA Groundside Upgrade	Upgrading the road between Lusaka and KKIA (approx. 25 km)	MND	RDA	Planning	15	2020																				
KKIA connectivity	Construction of a Railway line to KKIA	MND	MTC	Concept																						
Urban Transport Sector Projects																										
Traffic Management Lusaka	Complete traffic Management for Lusaka including signaling and control center	MND	MLG	Conceptual	15	2021																				

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Provincial Capital Urban Roads Program	Upgrading and rehabilitating urban roads in major towns: • Kabwe • Chipata • Choma • Kasama • Chinsali • Mongu • Solwezi • Mansa • Ndola • Lusaka	MND	MLG	Demand driven Planning, Pre Planning	160	2034																			
Traffic Management	Centralized traffic management for major cities	MND	MLG	Conceptual	75	2034																			
Urban PT Master Plan	Urban Transport Master Plan 2035 for various cities	MND	MTC	Conceptual	7.5	2022																			
Unique Projects																									
Road Sector Projects																									
T2 Road Upgrade	Upgrade of T2 road to dual carriageway between Lusaka to Ndola (approx. 350 km) • Improved Safety Systems	UNQ	RDA	Procurement	280	2021																			

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Toll Roads Program	Comprehensive toll gates program including operations	UNQ	NRFA	In Progress	90	2019																			
Railway Sector Projects																									
Central Corridor Fast Passenger Train	Upgraded Passenger Rail between Chingola and Livingstone • High speed and LOS railway • 2 new stations • Rehabilitation of existing stations	UNQ	ZRL	Conceptual	800	2025																			
Greenfield Freight Railway	• Kafue – Lion's Den; • Chingola – Solwezi to Jimbe • Nseluka-Mpulungu • Livingstone-Sesheke	UNQ	ZRL	Conceptual and studies have been completed	1,100	2030																			
Public Transportation Sector Projects																									
Intercity PT Improvement Program	Comprehensive improvements to Zambia's intercity PT system	UNQ	MLG	Conceptual	4	2020																			
Integrated Transport Projects																									

Project / Location	Description	T	Res.	Status	ECM	ECD	Implementation Period of the NTMP (2018 – 2037)																		
							18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Intermodal Hubs	Establishment of 3-5 intermodal hubs to facilitate intermodal freight transport • Ndola • Kpiri Mposhi • Lusaka •Livingstone • Chingola Chipata	UNQ	MTC	Conceptual	60	2027																			

Appendix A : Review of Greenfield Freight Railway Projects

The 2017 National Transport Master Plan (NTMP 2018 – 2037) took a holistic approach to transportation planning, therefore the plan focused not only on improvements, projects and policies which are sector specific, but also to emphasize the interdepend reality of Zambia`s transportation system. The plan shows that the success of railways in Zambia, especially for moving bulk cargo and passenger, is dependent on its ability to compete with road transport. This short document will focus specifically on Greenfield Freight Rail Projects for long term development as a response to government`s policy to translate freight transport to railways and to provide a brief review of potential projects for future planning.

As has been stated previously in the master plan, freight rail transport has been a challenge in Zambia and its neighboring countries since independence. The reasons for this are many, however the key issues are twofold. The first being a lack of maintenance due to its low priority and low resources. The second issues is the rise of low cost, highly flexible and accessible international trucking in the sub Saharan region. Zambia will need comprehensive strategy updates if it is to revamp freight rail as is called for by government policy. The master plan only recommends a few freight projects based on the data collected during the project and the application of the custom made travel demand model. The remaining projects in this brief are listed in order to provide a resource for future planning and network expansion. Greenfield freight railway projects which are included in the master plan include:

(i) Serenje to Petauke railway;

(ii) Kafue to the Lion's Den railway; and

(iii) Chingola to Jimbe railway, Phase I (Solwezi to Chingola)

Considerations for planning and implementing Greenfield Freight Railway Projects are listed below:

(i) It must be understood that infrastructure development is an extremely resource intensive undertaking and may not provide an economic or social benefit that outweighs the cost;

(ii) Freight rail transport in Zambia and throughout Africa has continuously challenged countries and their budgets, these projects must not be implemented without thorough study and criticism;

(iii) Maintenance must be key factor in any Greenfield Railway Project. Annual maintenance budgets should equate to at least 2% of the total value of the asset;

(iv) Push and pull policies should be set in place, for example, providing tax credits for utilization of rail transport while increasing truck transport fees in order to make rail transport competitive;

(v) Increasing the size of the freight rail network requires the success of two sector projects;

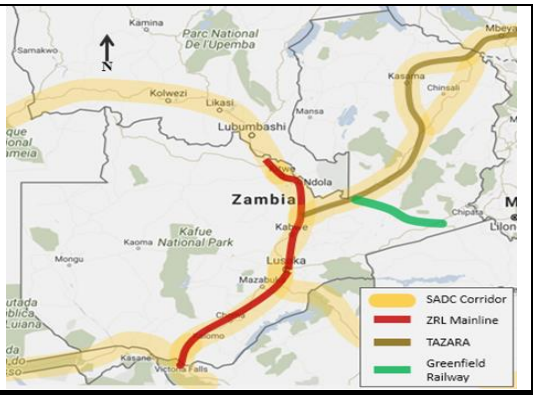
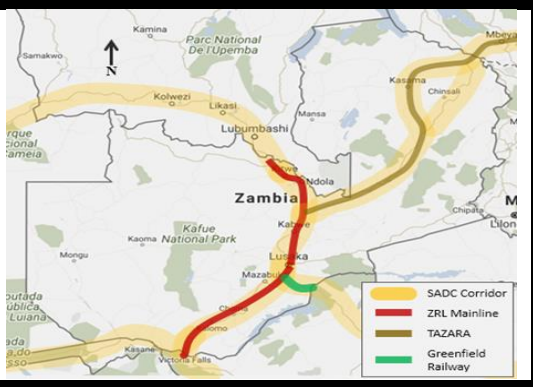
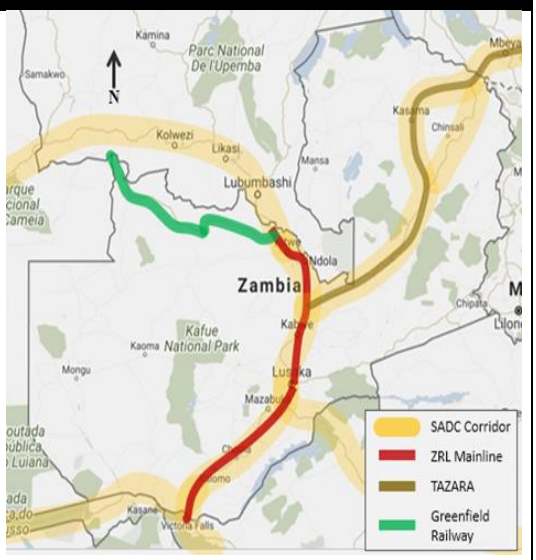
(vi) The rehabilitation of the ZRL mainline as the foundation for competitive rail transport; and

(vii) The separation of rail infrastructure and operators and the establishment of a regulator

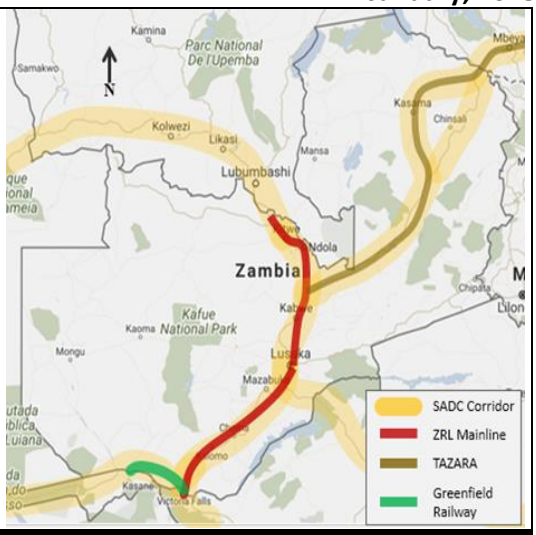
Logistical savings, or preserving roads may not be an adequate rationale for freight rail investment for Zambia as the costs of development often outweigh the benefits for the people. It is imperative that all development be planned in a holistic way which reflects the interdependent reality of freight rail transport in Zambia.

Appendix A.1 List of All Greenfield Railway Projects

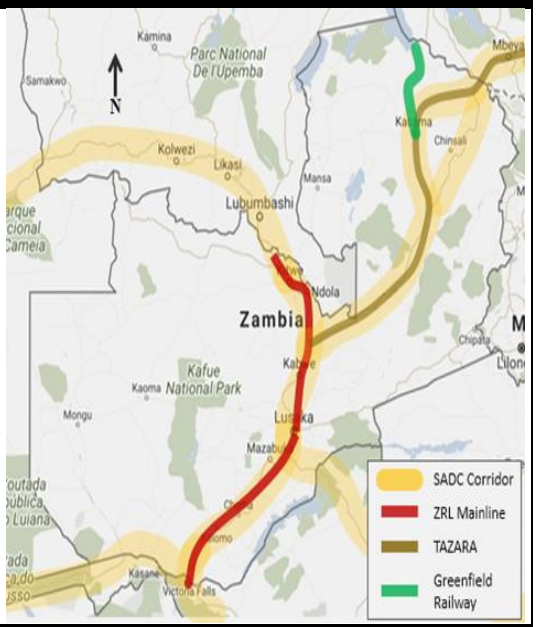
5-2: List of All Greenfield Railway Projects

№ 1	**Project Name**	Serenje – Petauke Railway	**Corridor**	Nacala	
	Project Cost	$ 2,300,000,000	**Project Length**	406 Km	
	Maint Costs p.a.	$ 16,240,000 p.a.			
	Project Objective	To link the TAZARA line in Northern Province and Eastern Province of Zambia to the Nacala Corridor.			
	Project Description	The railway line involves linking the Chipata–Mchinji line through Petauke District to the port of Nacala in Mozambique.			
	Project Status	Preparing for implementation, construction contracted with CECC			
№ 2	**Project Name**	Kafue to Lion's Den	**Corridor**	Beira	
	Project Cost	$ 1,360,000,000	**Project Length**	341 Km	
	Maint. Costs p.a.	$ 13,640,000 p.a			
	Project Objective	To connect the Zambian Railway line to the National Railway Systems in Zimbabwe at Zawi to the Port of Beira in Mozambique. This is the shortest route to the port of Beira for Zambia.			
	Project Description	The railway line will link Zambia Railway line to Ziwa Zimbabwe the way to the Beira Port.			
	Project Status	Feasibility study is complete, talks are ongoing between Zimbabwe and Zambia for a joint venture			
№ 3	**Project Name**	Chingola to Jimbe	**Corridor**	Lobito	
	Project Cost	$ 2,400,000,000	**Project Length**	604 Km	
	Maint Costs p.a.	$ 24,160,000 p.a			
	Project Objective	To link Zambia to the western coast of Africa via Angola through a railway network. This will enhance both regional and international trade between Zambia and Angola. This railway's importance is increased by expected significant mining sector development in the Solwezi region.			
	Project Description	The railway line involves linking the existing line in Chingola through Solwezi to the border town of Jimbe through to the Port of Lobito. To be constructed in two phases, Phase I – Chingola to Solwezi, Phase II – Solwezi to Jimbe.			
	Project Status	Feasibility study complete,			

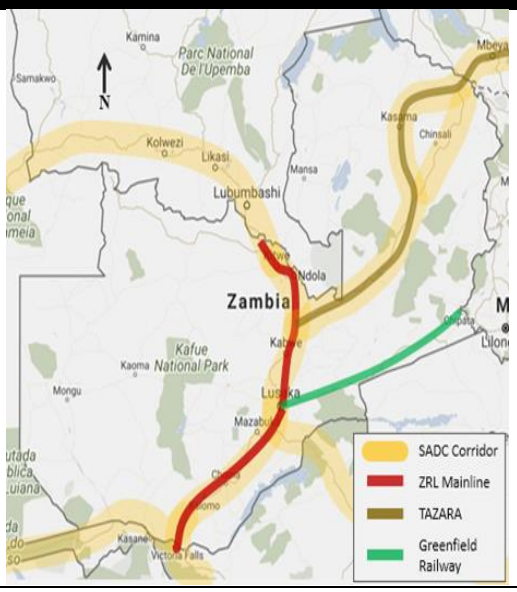
№ 4	**Project Name**	Livingstone to Sesheke via Kazungula	**Corridor**	Walvis Bay – Ndola – Lubumbashi
	Project Cost	$ 800,000,000	**Project Length**	200 Km
	Maint Costs p.a.	$ 8,000,000 p.a		
	Project Objective	To provide an alternative sea route by linking Zambia to the Namibian Port of Walvis Bay through the Trans-Namib transport system.		
	Project Description	The construction of this line involves the partial rehabilitation of the Mulobezi line and feasibility studies for construction of a spur between Livingstone and Katima Mulilo via Kazungula and connect to the Namibian System at (Border) as part of the Walvis Bay – Livingstone – Lusaka – Ndola – Lubumbashi Corridor.		
	Project Status	Pre-feasibility study has been completed.		



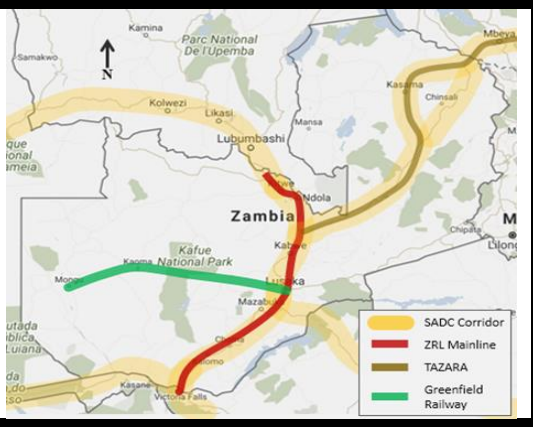
№ 5	**Project Name**	Nseluka – Mpulungu	**Corridor**	Lake Tanganyika Water Ways Corridor
	Project Cost	$ 768,000,000	**Project Length**	192 Km
	Maint Costs p.a.	$ 7,680,000 p.a.		
	Project Objective	Allow bulk cargo transport by rail which would be cheaper and efficient to the great lakes region of East Africa via lake Tanganyika.		
	Project Description	Railway link between TAZARA and Mpulungu Port linking Mpulungu Port to TAZARA line at Nseluka in Northern Province. This is in anticipation of the increase in volume of trade with the Great Lakes Region. Zambia is currently exporting sugar and cement products to the Great Lakes Region by road.		
	Project Status	The Ministry is currently negotiating a contract with a private investor to carry out feasibility study and construct the railway line as BOT		



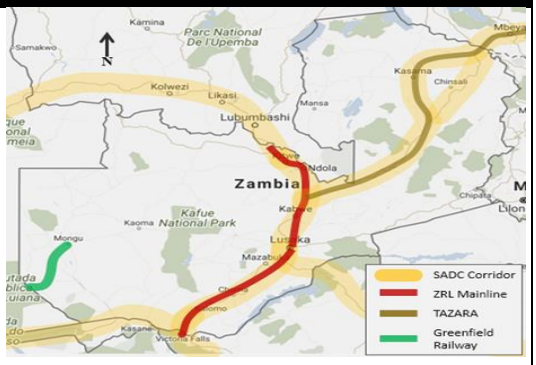
№ 6	**Project Name**	Lusaka – Chipata	**Corridor**	Nacala
	Project Cost	$ 2,270,000,000	**Project Length**	568 Km
	Maint Costs p.a.	$ 22,700,000		
	Project Objective	Creating a direct connection from Central Zambia to the Port of Nacala		
	Project Description	Greenfield railway from Lusaka to Chipata. This route would take advantage of the committed Serenje – Petauke railway as well as new infrastructure in Malawi just East of the border with Zambia		
	Project Status	Conceptual		



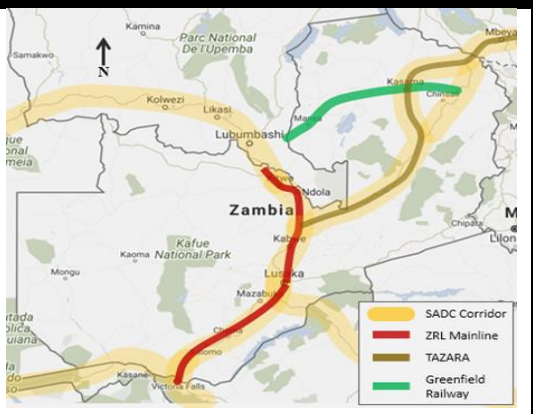
№ 7	**Project Name**	Lusaka – Mongu	**Corridor**	Lobito and Namibie
	Project Cost	$ 2,260,000,000	**Project Length**	600 Km
	Maint Costs p.a.	$ 22,600,000 p.a.		
	Project Objective	Provide connection from Central Zambia, via the Western Province to the Atlantic Coast ports of Angola (Namibie Port and Benguela Port). This project would take advantage of Angola railway development from the ports toward the border with Zambia as well as the soon to be completed Shangombo-Rivungu Canal		
	Project Description	Direct rail route from Lusaka to Mongu in Western Province.		
	Project Status	Conceptual		



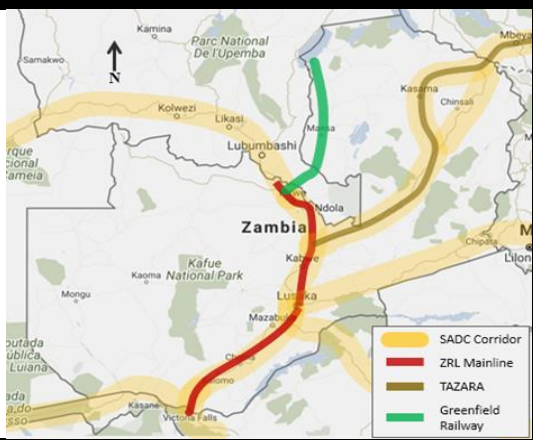
№ 8	**Project Name**	Mongu – Shangombo	**Corridor**	Namibie
	Project Cost	$ 780,000,000	**Project Length**	195 Km
	Maint Costs p.a.	$ 7,800,000 p.a.		
	Project Objective	Provide connection from Central Zambia, via the Western Province to the Atlantic Coast ports of Angola (Namibie Port and Benguela Port). This project would take advantage of Angola railway development from the ports toward the border with Zambia as well as the soon to be completed Shangombo-Rivungu Canal.		
	Project Description	Rail route connecting Mongu to Angola via Angolan built bridge at the Shangombo-Rivungu canal.		
	Project Status	Conceptual		

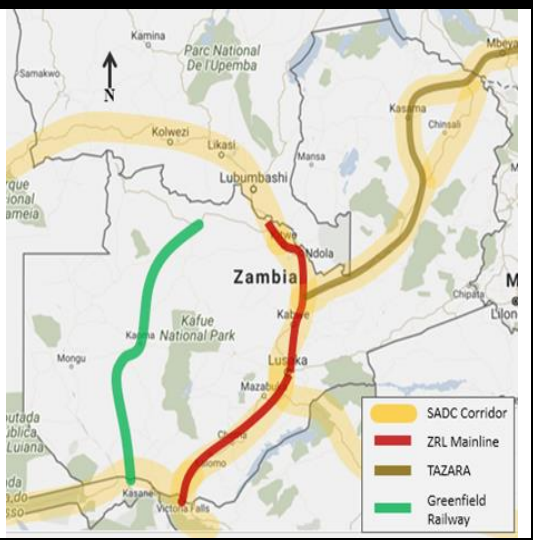


№ 9	**Project Name**	Kasama – Luwingu – Mansa – Matanda – Lubumbashi	**Corridor**	Dar es Salaam
	Project Cost	$ 1,900,000,000	**Project Length**	475 Km
	Maint Costs p.a.	$ 19,000,000 p.a.		
	Project Objective	To provide a shorter connection between Copperbelt and Katanga Province to the Port of Dar es Salaam		
	Project Description	The route crosses the border at Matanda and moves through Kasama before connecting to TAZARA		
	Project Status	Pre-Feasibility study completed		



№ 10	**Project Name**	**Muflira – Mans – Nchelenge**	**Corridor**	North – South
	Project Cost	$ 1,600,000,000	**Project Length**	407 Km
	Maint Costs p.a.	$ 16,280,000		
	Project Objective	To provide a railway link to an upcoming potential inland Port of Nchelenge		
	Project Description	The project to act as an economic stimulant and will traverse through the DRC. Segmented into two phases; phase 1: Mufulira – Mansa; phase 2 Mansa Nchelenge		
	Project Status	Conceptual		



№ 11	**Project Name**	Solwezi – Kasempa – Kaoma – Luampa – Mongu – Sesheke – Katima Mulilo	**Corridor**	Walvis-Bay – Ndola – Lubumbashi and the North South	
	Project Cost	$ 3,100,000,000	**Project Length**	780 Km	
	Maint Costs p.a.	$ 31,000,000 p.a.			
	Project Objective	Provide connection between Copper Belt and Luapula Province and the proposed Matanda-Mansa- Luwingu-Kasama railway to TAZARA main line. The route will also unearth the economic potential of the region of Luapula province such as mining, agriculture and tourism.			
	Project Description	The project will run through the Congo and provide a direct link to the towns in Luapula and the Copperbelt. Two phase project, Phase I: Mufulira – Mansa, Phase II: Mansa - Nchelenge			
	Project Status	Conceptual			

Appendix B : National Transport Policy (2017 – 2026)