URBAN DESIGN RESEARCH PROJECT

EVALUATING THE ROLE OF ACTIVE MOBILITY IN ALLEVIATING TRAFFIC CONGESTION. A CASE STUDY OF SOUTH B, NAIROBI COUNTY

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DECLARATION

This design research project is my original work and has whatsoever not been presented for examination and award of degree in any other university.

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This design research project has been submitted for examination and award of the degree with my approval as the Technical University of Kenya supervisor.

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DEDICATION

I dedicate this research project to the residents of Nairobi South Ward for their support all through the research project period as they informed my respondents.

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My greatest ineptness to my parents Dinah Oboro, Gladys Ongori and my siblings for their support and guidance throughout my entire stay in the university.

Technical University of Kenya in particular the department of Spatial Planning and Design, I am grateful for the chance to explore the world of academia.

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Finally, to my classmates we just got started in making the world a better place. Let's keep going!

"Thank you all"

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LIST OF ACRONYMS AND ABBREVIATIONS

KURA	Kenya Urban Roads Authority
KeNHA	Kenya National Highways Authority
KeRRA	Kenya Rural Roads Authority
NMT	Non-Motorized Transport
KRB	Kenya Roads Board
KARA	Kenya Alliance for Residence Association
GDP	Gross Domestic Product
CDKN	Climate and Development Knowledge Network
JICA	Japan International Cooperation Agency
NCCG	Nairobi City County Government
NTSA	National Transport Safety Authority
NAMATA	Nairobi Metropolitan Area Transport Authority
NEMA	National Environment Management Authority
PuT	Public Transport
PrT	Public Transport
NMIMTs	Non-Motorized and Intermediate Means of Transport
SMEs	Small Medium Enterprises

ABSTRACT

Major infrastructure development for Nairobi city on the road sector for a long time now has been mainly focusing on motor vehicles only while not exploring other means such as cycling. Over the recent years along the new development of highways and increase in urbanization has led to rapid increase in motorization to complete trips within and out of areas around. South B has been a fast-growing node of transit for both modes of transport offering accessibility and circulation routes linking the study area to various land uses an even the CBD. Developments in terms of housing, developers have resolved to construct vertical developments to maximize on the floor area ratio to accommodate more residents. This has given a blind eye in the transport sector which now has become a menace in the study area. Traffic congestion is one of the many problems this research project intends to curb through shift in modes of transport. The research was conducted in 10 days whereby interviews, questionnaires, focused group discussions, traffic survey and key informant interviews were key components for data collection deployed.

This research paper analyzes each and every data collected and formulates various proposals including adopting of active mobility as an appropriate means of alleviating traffic congestion in South B.

CHAPTER ONE - INTRODUCTION

1.1 Background of the study

Non-Motorized Transport (NMT), also called active transport or human powered transport, refers to walking, cycling, and variants such as wheelchair, scooter and handcart use. NMT plays an important and unique role in an efficient transport system. It provides basic mobility, affordable transport, access to motorized modes, physical fitness and enjoyment, (Litman, 2011). In Western Europe, North America and Australia for instance, there exist various differences among the rates of cycling adoption. Netherlands ranks top with 27% of all their trips done through cycling as Denmark comes second with trips made by bike at 18%. Germany, Finland and Sweden hold relatively the same rate of bike use at 10%. Most cycling experiences in the Netherlands, Denmark and Germany are for essential activities such as travel to workplaces or to schools and shopping. Of these activities, travel to work or school accounts for 32% of bike trips in the Netherlands, 35% in Denmark and 25% in Germany. Shopping trips account for 22% of bike trips in the Netherlands, 25% in Denmark and 20% in Germany, (Buehler & Pucher, 2008). While more than 25% of all trips are easily walkable and 63% of all trips can be completed on a bicycle, the majority of trips—more than 90%—take place by automobile. The average American driver, according to the US Department of Transportation, spends 335 hours—or 8.4 work weeks—in their car annually, attributed to lack of alternative travel modes, (LEED ND Core Committee, 2006).

Walking is already the primary mode of transport for the majority of people in Africa, with up to 78% of people walking to reach essential services. For instance, the majority of the urban poor live in peripheries of the cities, travel to work or school, they travel long distances through public transport or NMT and have to navigate streets without sidewalks and cross roads with speeding vehicles which poses risk to their lives and health through pollution caused by increased motorization. African cities i.e., Kinshasa and Dar Es Salaam walking accounts for two thirds of total trips made within the cities (Vanderschuren, 2015),

The growing demand for knowledge on urban transport cycling is an indication that there are great limitations when it comes to motorized transport systems given the aspect of traffic congestion and congestion of parking lots within urban cities, air pollution and road traffic accidents. There has not been any major improvement in transport infrastructure in Kenya`s major towns for over two decades now and the basic urban network is still the one traditionally designed during the precolonial period. The urban road network is about 12,549km or 8% of

the total road network which supports 32% of the total population and the generation of 75% of GDP in the country, (KRB, 2021). All these result in immense congestion, which are in turn expected soon to cause complete gridlock given the rate under which traffic is growing. Nairobi`s road network was initially designed to accommodate not more than one million inhabitants, currently the population has quadrupled hence putting more pressure on the roads. Consequently, decongestion and the development of new infrastructure surrounding the city is critically necessary. Nairobi city had a population of 4,397,073 in the 2019 census, whereas the metropolitan area had a population of 9,354,580. Nairobi is also ranked as one of the fastest growing cities in Africa, with the population of the city expected to rise even higher, (KNBS, 2019). Diverse research papers seek to propose the adoption of active transport as opposed to car travel as a means to decongest the city by providing well-grounded recommendations from credible authorities.

Traffic in Nairobi city and its' neighborhood has been marked on many occasions by city residents as one of those factors that drag the city's development agenda backwards as records of economic losses experienced through delays in traffic. The working-class majority who reside in Nairobi have opted to purchase private cars, hence putting pressure on roads which still are not up to the capacity to contain the rising number of cars each and every day, (Andrew, Bryant, & Walcott, 2014). Therefore, the lack of an efficient public transportation system to accommodate the use of private vehicles continues to worsen with time. Attention therefore ought to be diverted towards exploring other forms of transportation that are cost effective and contribute to the well-being of individuals and the economic setting. In this research therefore the focus is on cycling as a means of easing traffic and promoting mobility while exploring the other benefits that bike riding might bring along ranging from social, economic and physical.

Active mobility is the most widely used mode of transport in Kenya, with 45% of the people walking for their daily trips. Private car use makes up a small percentage, 13% of the modal split relative to walking 49%, (ITDP, Street Design Manual for Urban Areas in Kenya, 2022). The predominant modes of transport among Nairobi residents are public transport 46% and walking 39%, while cycling is the least popular 1% among the split, (GIZ, 2022).According to the World Bank 70% of the Nairobi Metropolitan area labor population, either walk or cycle to their respective workplaces.

The adopted NMT Policy made a mandatory requirement for road construction firms that all new roads be considerate of both cyclists and the pedestrians in their road designs (UNEP,

2016). Civil society stakeholders such as the Kenya Alliance for Residence Association (KARA) have constantly been vouching for the Government to ensure the needs of pedestrians and cyclists are given priority as their demographics are significant as majority of the city road users hence impacting the economic decisions of the county.

This research aims at ways of enhancing the use of NMT, so as to ease traffic congestion in South B estate, a case study of Nairobi.

1.2 Statement of the Problem

Considering Kenya commitment to Nationally Determined Contributions (NDCs) to reduce emission of greenhouse gas (GHG) by 32% by 2030 to realize these goals sustainable mobility is one of the strategies that entails adoption of mass transport and NMT, (KNBS, 2015). The 36% walking modal share and 1% cycling who account for 96.9% male cyclists and 3.6 female cyclists speak loudly of the gender desegregation in terms of gender as per CDKN (2021). NMT routes are characterized with; cycle tracks ending end up abruptly in curves and one has to dismount and carry the bike; cycle tracks paved with rough blocks making it uncomfortable; Vehicles parked on or along NMT routes hindering circulation of pedestrians; hawkers encroaching the NMT routes forcing pedestrians and cyclists to share the already traffic congested carriageway, (ITDP, 2022)

Traffic congestion in Nairobi is mainly caused by gridlocked streets characterized with mix of cars, trucks and matatus - the privately owned and operated paratransit vehicles that serve as the city's primary means of public transport. These streets experience recurrent congestion. The mass movement during specific peak hours of the day causes heavy traffic amidst all the other activities going on, (Gonzales, Celeste, & Daganzo, 2009).

Nairobi residents, the majority of whom commute to work daily spend on average 64.7 minutes, according to the NAMATA, BRT line 5 report. The report also estimates that the social cost of traffic congestion in the capital City is around USD $ 175 million. NAMATA attributes the traffic congestion to lack of an organized scheduled public transport, lack of an elaborate non-motorized (NMT) network. [KENYA BRT_final report part1(ch1-4) 180105.hwp (namata.go.ke)] Other causes of congestion in Nairobi include illegal public bus stops, overlapping by motorists, low capacity public transport vehicles (matatus) as well as general laxity in observation of traffic rules. NMT remains the low-lying fruit to tap into with up to 46% of the population already walking to their place of work and 1% cycling. This figure includes those using walking as a mode of transport for first and last mile connectivity. South

B Estate is approximately 5 km to the CBD and 2 km to the industrial area where a sizable share of the residents work and active mobility can easily be taken up for work and other related trips.

Major infrastructure development for Nairobi city on the road sector for a long time now has been mainly focusing on motor vehicles only while not exploring other means such as cycling. This approach of investing in motorized transport has failed to address the traffic menace in the city and the study area. This study aims at exploring ways in which Non-Motorized Transport (NMT) can be enhanced to be fully integrated in a holistic way in South B estates to facilitate the residents to walk and cycle to work safely. It also aims at looking at ways in which NMT can be made more favorable to attract private car users to shift and use this mode as the main mode to navigate the mixed-use estate.

The realization that focusing on infrastructure alone was not enough prompted the interest to carry out this research with a view of coming out with recommendations that cross through various disciplines, integrated and holistic in their approach to the traffic congestion mess within Nairobi city residential neighborhood.

The level of safety, efficiency and comfort in cycling as way of checking regulating traffic is very low and this is the issue that this research is yet to address through assessing the readiness of road users especially car owners to resorting to cycling if the necessary conditions are well provided by the respective authorities i.e., great infrastructure and implementation of policies that surrounds cycling as the main mode of navigation across the entire mixed-use neighborhood.

1.3 Research Objectives

1.3.1 General Objective

To enhance the use of NMT (walking and cycling), so as to ease traffic congestion in South B estate

1.3.2 Specific Objectives

1. To establish the modal split of residents in the selected case study area
2. To establish the reasons why cycling has low uptake in the study area
3. To find out how cycling can be enhanced to help address traffic congestions in South B

1.4 Research Questions

1. What are the existing trends/patterns of traffic situations in the area and the key causes?
2. What characterizes demographic in the study area using walking and cycling as the main modes of transport?
3. What types of trips are mostly done by walking and cycling?
4. What are some of the challenges facing the users of walking and cycling in the study area?
5. What is the current state of infrastructure provision for walking and cycling and how is this integrated with public transport?
6. How can walking and cycling be enhanced to attract more users and help to alleviate traffic congestion in the study area?

1.5 Study Assumptions

1. If more people chose to use bicycles, transport-related problems such as congestion could be alleviated.
2. Recurrent traffic congestion within the site if not checked will increase gradually considering vertical developments in the area.
3. Mixed-use developments can positively impact uptake of walking and cycling for short distance commuting.
4. Cycling and Walking are cheaper and convenient for short-distance journeys and promote good health and mental relaxation

1.6 Significance of the Study

Upon actualization of cycling and walking neighborhoods accessibility within the residential, industrial and educational facilities in South B will be eased hence saving on time travels and trips made in and out of the study area and this will have a positive ripple effect in the city. Walking and cycling will not only help in easing traffic congestion but has other benefits such as health benefits for the users, reduced air emissions, cost savings on transport costs as well as overall social cost savings on traffic congestion, (Andrew, Bryant, & Walcott, 2014). Transitioning to zero or low emissions mobility is crucial to safeguard the climate, improve air quality and ensure road safety and accessibility, particularly for women, children, the elderly and persons with disabilities. Investments in active mobility is essential for achieving economic and financial transformation, improving social equity and addressing environmental concerns. This therefore suggests that investing in green and healthy transport is economically profitable,

conserves the environment and the health of the people, (UNEP, Emission Gap Report. The closing Window, 2022).

1.7 Justification for the Study

South B provides a suitable location for implementation of NMT as it is strategically located within a 5 km radius to the CBD and Industrial area and has mixed land-use development. The neighborhood provides an opportunity for commuters to use NMT for the short distance commute to work places and to access other services, which will provide relieve from the chronic traffic congestion.

The findings of this research will also be helpful to administrative authorities within the Nairobi Metropolitan Area, as it will save them millions of cash lost due to traffic congestion caused by the overdependent on private transport on residential roads, (Andrew, Bryant, & Walcott, 2014). In addition, this study is helpful to policy makers, urban designers and planners within Nairobi whose main focus is on urban planning and design. Once implemented the general public will also benefit from benefits accrued from walking and cycling such as improved physical and mental health, transport cost savings, improved property value among other benefits.

1.8 Study Limitation

- This research study was undertaken using personal resources which are limited and this posed a constraint in the collection of desired data.
- Most residents reside in gated communities with restrictions on entries, this posed a challenge in administration of questionnaires and conducting interviews.

1.9 Study Scope

The study will be conducted in South B Neighborhood bounded by Mariakani Road to The North, Mukenia Road to the West, Daidai Road to South West, Zanzibar Road to the South and Kapiti Road to the East.

CHAPTER TWO- LITERATURE REVIEW

2.1 Introduction

This chapter intends to explore various literature works that have been put forward to defend the potential of adopting urban cycling as a means of decongesting Nairobi South B residential Neighborhoods. It starts with an empirical literature review section, based on the objectives that were well outlined in chapter one. Consequently, a detailed summary of the knowledge gaps and the conceptual framework follows.

2.2 Empirical Literature Review

This section presents the empirical review of this study. It reviews literature not limited to walking and cycling infrastructure, economic impact of NMT infrastructure and traffic congestion cost and experience and perception of motorized transport system from the city residents.

2.2.1 Scenario of Traffic Congestion in Nairobi

2.2.1.1 Paratransit Operations

As per the Traffic Act, a matatu is classified as a vehicle that carries between 7 and 25 passengers, while a bus is a vehicle that carries 25 or more passengers. The deregulation of the transport sector in 1973 aforementioned in chapter 1 resulted in the growth of paratransit operations.

According to a weekly newsletter on Kenyan Wall Street done September, 2019, Nairobi was ranked as the fourth congested city in the world. A large fraction of vehicles plying the roadways in Nairobi are matatus. When they are filled, buses and vans are highly energy efficient per passenger kilometer of travel. The paratransit operators currently use a fill-and-go system with 100% load factor on most trips operation. This is further encouraged by NTSA licensing regime that does not take into consideration supply and demand patterns.

According to the study by Gonzales & Daganzo (2019), congestion occurs in the city simply because of the redundant street and road network compared to other cities of the same population in developed countries. The lack of alternate routes contributes immensely to congestion even at low car ownership. In Nairobi, traffic models estimate vehicle speeds to be 8.3 km/hr during morning peak and 7.6 km/hr during the evening peak.

Further, survey done by JICA in 2013 and World Bank Report in 2013 on average travel times indicates that average travel times in Nairobi are similar to different motorized modes (cars

and matatu), and that the average walk trip is approximately half the duration of the average motorized trip.

2.2.1.2 NMT Infrastructure and value

Non-motorized transport use and value is underserviced despite its high share in the modal share split in Nairobi. The modal share of cyclists and public transportation users may rise if road infrastructure is designed with thoughtful consideration for NMT users in mind. This can be achieved by including crosswalks, bike paths, sidewalks, and improved pedestrian amenities, (NCCG, 2014). With the recent adoption of the NMT Policy, budgetary allocation of 20% has geared major improvement of NMT infrastructure across the CBD to cater for the highest modal share, walking 46% and promotion of cycling infrastructure. Improving multimodality within Nairobi will help in realization of the sustainable mode of transport systems that will pioneer protection of the natural environment. One of the key components in the Nationally Determined Contributions towards Climate Change, (CDKN, 2021).

Improvements in NMT infrastructure will increase involvement in physical activities thus reducing the risk of heart diseases, diabetes, strokes and other chronic diseases. In addition, risks are attributed to car exhaust which is directly proportional to increased motorization in Nairobi, (Kigozi, 2020)

Benefits of Cycling

Investment in the cycling infrastructure contributes to cost savings for individuals and the society at large. The following are the benefits of a cycling economy;

- Individuals will save time upon shifting trips from vehicles to bicycles especially during peak commute time when vehicle congestion is high i.e., Mexico City, cycle lane users save 11.5 min and 5.40 pesos per trip on average compared to using different modes of transport.
- Reducing vehicle trips and increasing bicycle trips minimizes costs to society. Opting to increase bicycle trips improves health outcomes, reduces congestion, reduces air pollution and greenhouse gas emission. With the current NDCs Kenya commitment to reducing GHG by 32% by 2030 will be effective.
- Improved logistics for local goods delivery. Investing in e-bikes facilitates the last mile connectivity as the deliveries are made to one prospective customer doorstep. Improved cycle infrastructure will reduce overdependence on fossil fuel delivery vans which in the long run will reduce emissions.

2.2.1.3 Economic Impact of NMT

Cycling is economical in its inherent nature; it is relatively a cheap means of travel as compared to private cars or even rail transport in monetary terms. For instance, the annual costs of cycling in the Netherlands according to the Ministry of Transport 2018**,** range from 175 to 300 euros whereas the costs necessary in driving a car lies between 2,500-8,500 euros per annum, based on an average annual mileage. Cycling also has a greater social impact of a kilometer of bike riding in urban areas when compared to such cost incurred in a kilometer of travel by car or by bus: each kilometer of bicycle use yields a social benefit of 0.68 euros, whereas car and buses cost society 0.37 euros and 0.29 euros per kilometer, respectively. The annual infrastructure costs per traveler kilometer are 0.03 euros for bicycles, 0.10 euros for cars, 0.14 euros for buses, and 0.18 euros for trains.

I. Traffic Related Cost

According to the NAMATA, BRT line 5 report. The report also estimates that the social cost of traffic congestion in the capital City is around USD $ 175 million. The amount of time that people spend commuting to work has an impact on the productivity of different sectors and the economy as a whole. Shifting the mode priorities with regards to investment and financing is attributed to shortening the journey to work and increasing productivity of individuals at work since NMT saves on time spent on the traffic.

II. Cost of Infrastructure Development and maintenance compared to motorized transport

In terms of cost evaluation in establishing cycling infrastructure, there is dire need to put emphasis on constructing bikeways rather than planning for cars only. For the cost of 1km of urban highway one could build 150 km of bicycle paths, 10,000km of bicycle lanes or well-structured and calculated 30kph zone according to Global Site Plans-The Grid (2017)

III. More demand for bicycles spurs jobs and economic opportunities.

With the current estimated 1.8 billion bicycles in use globally, serving an urban population of 3.9 billion, clearly shows the potential of expanding the market. Job opportunities related to bicycles which are not limited to; bicycles and parts manufacturing; and retail, including sales, repairs and services, are created hence improvement of livelihoods, (Blandiau & Zeebroeck, 2016).

IV. NMT Traffic related accidents

In the United States for instance, according to research done by Pucher & Buehler (2017), the Center for Diseases Control and Prevention's injury statistics from 2014 indicates that 902 cyclist fatalities and 35,206 grievous injuries reported were realized. The United States

therefore ranks top of higher fatality experienced and serious injuries reported rates per kilometer cycled than comparable to high-income countries. In 2023, NTSA recorded 330 fatalities involving the pedestrians and increase in pedal cyclist fatalities from 15-17. This upsurge in increased fatalities was related to inadequate provision of reliable NMT infrastructure facilities which prompted pedestrians and cyclist in using the carriageways.

V. Health

Report by WHO on health and economic impacts of transport interventions in Accra, it estimates Ghana can save up to 5500 premature deaths and this number could be attained through access to decarbonized public transportation and increased walking and cycling infrastructure which promotes air quality and development of a healthy city free of air pollution.

A lot of time goes to waste on road traffic resulting in mental breakdown or degradation from longer hours spent in traffic thus the rise in cases of mental health of travelers and drivers they are in turn rendered non-productive. Workers also arrive late at their respective places of work, schedule meeting and late arrivals to schools by learners (pupils and students), (Buekers & Dons, 2015)

2.2.1.4 Cycling Infrastructure and value of cycling

Cycling infrastructure such as cycle tracks and painted bicycle lanes is critical in improving safety of existing cyclists and in increasing the overall mode share of bicycling in communities. However, the implementation of such infrastructure has been troubled by lack of political goodwill from leaders who are expected to provide the support structure. Another way to include bicycles in multi-modal transport is evident in major European cities such as Paris where cycling is out rightly a public transport mode. The rental prices are attractive, reasonable, and affordable (i.e., free up to 30 minutes) and bicycles can be picked-up and dropped off at over 1800 locations across the city. Therefore, offering such services as bike rentals within the city and its neighboring residential busy roads would definitely ease traffic but this has to take consideration of the underpinning conditions such as repairs incases of breakage and insurance to cover for any damages that may be realized.

The politicization of cycling infrastructure is a result of the dominance of automobilists in not only Western transportation culture but a culture that is slowly cropping into Africa and its major cities Nairobi not being an exemption. In other words, it is not the physical presence of the cycling infrastructure, nor its social and political representations, but rather the automobile

that is political, and a battle for (road) space against it remains and may continue to remain a major policy and professional challenge to urban planners, (Scott, 2002).

2.2.1.5 Economic Impact of Traffic

Elaborative literature on health and environmental benefits of cycling have also extensively been outlaid in Africa and its major research center and policy institutes in order to address the case of traffic congestion. However, extensive economic bearings of approach that has been ignored over time have received little attention from academic researchers and urban planners. This review therefore is set out to describe and give an outlay of the economic value and benefits of cycling available in the literature and also give the negative economic impact traffic congestion has had in the budgeting of Nairobi County.

Fuel that goes to waste from long hours spent on the roads, emissions from the exhaust fumes that contain carbon dioxide that leads to global warming attributable to idling, speeding up and braking constantly during traffic jams is also another costly affair of relying heavily on motorized transport systems. In the long run if more fuel is consumed the prices will tend to shoot due to rising and constant demand. Similarly, motor vehicle traffic results in wear and tear of machines due to discontinuous movement on the road as the car will be forced to speed and break more often than usual which leads to frequency to the garage to carry out repairs and replacement of worn-out parts.

Traffic also impacts on the way emergencies are handled on the roads, the underlying costs of not attending to such emergencies may be very huge. For instance, a case of fire outbreak in the neighboring Mukuru Kwa Njenga Slums would require the fire brigades to rush on the scene to put off the fire, on which failure to do so would imply loss of lots of properties to the fire outbreak. Additionally, patients under critical conditions being rushed to health facilities for emergency medical attention may lose their lives as they are transported for treatment on the road due to traffic.

Next in the list of negative impacts we have the spillover effect. This is when the traffic spreads from the congested main routes to secondary roads and side streets, as people try to use these roads as alternative routes to avoid traffic, (Gonzales, Celeste, & Daganzo, 2009)

On the positive side, traffic congestion from observation on the roads in Nairobi seems to be benefiting hawkers who walk between the car lanes putting their products on offer. They are able to make sales and earn a living from it. Furthermore, when there is traffic, cars move really slow hence reduced chances of accidents taking place.

2.2.1.6 Experience and Perception on Cycling

Majority of Nairobi residents would not adopt cycling as an alternative to car travel, quoting some of their fears being the reckless driving on the Kenyan roads, poor cycling infrastructure, and the fact that cycling is considered as a poor person mode of transport. An integrated cycling infrastructure or non-motorized transport system should incorporate planning with the motorized transport modes but taking into consideration their main demands of directness; safety; coherency; and comfort. This ought to be achieved through avoiding encroachment into spaces already assigned for cyclists through law enforcement agencies such as traffic police. Installation of speed bumps can also deter reckless driving from continuously happening and causing accidents especially those ones that cost cyclists their valuable lives. Parking facilities as well ought to be put into consideration, these parking areas should also guarantee safety of bikes in various designated destination zones.

2.3 Theoretical Framework

Global Site Plans-The Grid (2017) narrates the risk involved in cycling on the Nairobi's most congested roads, for instance, Waiyaki Way and Thika Superhighway has testimonial case of the 2013 Tour De France Winner Chris Froome who started his cycling as a young boy in Kenya due to competition for space among motorists, cyclists and pedestrians. Thika Highway is a main artery to the CBD as for the various towns surrounding Nairobi and also serves economic hubs of Kiambu, Juja and Ruaraka. The stretch of 45km road has various economic activities which attracts low-income groups who entirely use NMT to their places of work and schools. With the ongoing construction of BRT line 2 along the corridor it will ensure mass transit of people and incorporate it with NMT infrastructure facilities not limited to footbridges and at-grade crossing which will guarantee pedestrians and cyclist safety, (KARA & CSUD, 2012).

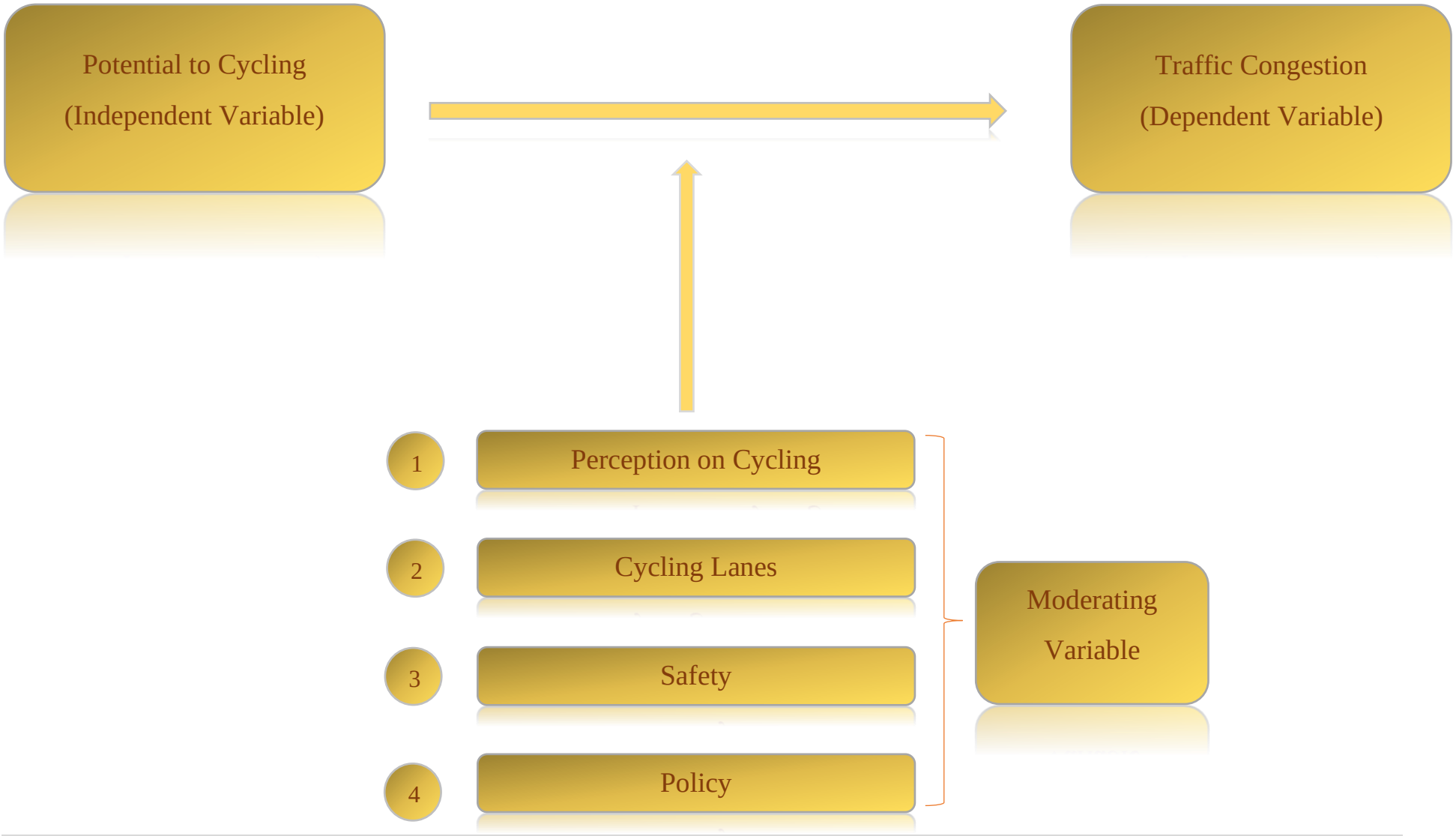
Cycling is considered a low-cost mobility though it has some impediments especially in cities which do not have well integrated infrastructure to cater for cyclists like Nairobi. As earlier stated in this research many cities around the world have recognized the importance of having an integrated urban transport system that incorporates cycling as a form of mobility such cities as Amsterdam, Groningen, Paris, and many others in Europe and around the world. Nairobi City has done little to march the progress that has been made by these cities towards having stringent policies in promoting urban cycling and creating proper infrastructure that makes cycling a safer and convenient mode of travel.

Further research on cycling infrastructure in Nairobi indicates that none of the Nairobi roads were originally designed to accommodate cyclists, except for Ngong Road. Cycling infrastructure along Ngong Road is infested with encroachment of small micro-business i.e., car bazaars and the continuous disjointed cycling lanes. This in turn forces cyclists to cycle along the already motor vehicle congested roads alongside careless driving especially from public transport vehicles. The condition of the bikeways in terms of intersection design is still very poor though and needs to be re-evaluated. With the aim of increasing transit along BRT line 3 cycling and walking are prioritized in the proposed transit-oriented development along the line stretching from prestige up to Mathare North in Eastlands.

On the contrary cycling is not that rosy if the planning and integration of its fundamentals are not well sought after by the urban planners or development practitioners. A case in point is India's Kolkata where cycling was banned in many of its streets as a result of congestion as it is bringing congestion into the city. This case indicates that urban planning requires a lot of variables to be taken into considerations ranging from people's attitude towards adoption of such mode of locomotion, (Joshi & Joseph, 2015)

With the majority of the Nairobi working class using NMT; walking 46% and Cycling 1% to their places of work or public means it would be therefore interesting to initiate walking and cycling in the city with construction of proper infrastructure that allows safe cycling and having clear guidelines that govern it. In order to achieve this, different stakeholders have to come in place and play their major role in ensuring that issues such as parking, safety or security-related issues, perception and cycle-oriented planning have to be well taken care of. This will encourage the paradigm shift from use of PrT to maximization of sustainable transport systems. Cycling in some major towns in Kenya is evident especially for commercial purposes for example in Kisumu but the biggest challenge still remains safety on the roads, (ITDP, Kisumu Sustainable Mobility Plan, 2020)

2.4 Conceptual Framework



This research is set to establish that cycling as a non-motorized means of travel can help with easing traffic on Nairobi Residential roads and the city at large. Its aim is to inform urban development and design policy through doing assessment of perception of the working-class adopting cycling as a means of transport to their places of work towards ensuring that this great city remains habitable for future generations by avoiding emissions that may have arisen from car traveling.

2.5 Summary

Extensive research needs to be done to explore the nature of traffic in major cities while exploring the underpinnings such as the road capacity and the number of lanes that need to be put in place to cover for the ever-increasing number of car users.

2.6 Research gaps

Policies around the safety of cyclists are not there and need to be formulated to help cover for cyclists who have been risking their lives cycling among the busy Nairobi roads. Policies that will also help in putting infrastructure and involving expertise on urban development in matters of city infrastructure would help alleviate conditions of roads that are all encompassing and catering for the needs of both the motorist, cyclist, and the pedestrians. Participant approach should be embraced by the new governorship by involving the public in planning for a sustainable city by bringing experts on board.

CHAPTER THREE – RESEARCH METHODOLOGY

3.1 Introduction

This chapter seeks to understand the various methods that were used to justify the hypothesis and clarify on the procedures for the next chapters. There are different methodologies that were used in the research based on their relevance to the topic. This research adds new information to the body of knowledge already in existence, thereby advancing it with the aid of research, observation, comparison, and experimentation.

3.2 Research Approach

This project research used two main research approaches, quantitative and qualitative approaches.

Quantitative Approach; Involved the creation of statistical data that were subjected to strict, systematic, and statistical examination. This included survey research in Nairobi South B Estate, and creating an artificial environment where the data needed could be produced.

Qualitative Approach; Involved with evaluating attitudes, beliefs, and behavior subjectively. The research methodology produced findings that were either non-quantitative or that did not undergo thorough quantitative analysis. Focus group interviews, projective techniques, and depth interviews were employed.

3.3 Research Design

The project research deployed two main research designs.

Explanatory Design; It was the initial phase of research, and the main goal was to have an insight on the traffic phenomena in South B Neighborhood. The intention was to identify the main issues for a more precise examination or for establishing a hypothesis. I also looked at prior studies or research.

Descriptive Design; Also known as statistical research, this describes phenomena as they exist. This design tried to answer the questions of what, who, where, how, and when. It was used to analyze the current circumstances in South B. This research uses the descriptive research designs. The descriptive research design is clear on how the traffic phenomenon is assessed and the impact it has had on the economy of the capital. It also focuses in identifying the specific problems around the traffic menace in Nairobi Residential Neighborhoods and the county at large and trying to come up with a spatial plan on how this can be solved or understood from a policy perspective.

3.4 Research Situs

The research area is located in South B Estate, within the administrative jurisdiction of the Nairobi Metropolitan Authority and within the service jurisdiction of Kenya National Highways Authority (KeNHA) and Kenya Urban Roads Authority (KURA). The Town is located in Nairobi South Ward, Starehe Constituency, Nairobi County.

3.5 Research Methods

The research used two main methods; Observational and Opinion-based methods. Observational methods included use of pictures, videos, sketches and notebooks for collecting data while opinion-based involved use of questionnaires, key informant interviews and public participation.

3.6 Data Collection Techniques

The research deployed both primary and secondary data collection techniques.

3.6.1 Primary Data Collection

These are data obtained from direct encounter with respondents and observations during site visits. The research deployed the following primary data collection techniques.

3.6.1.1 Transport Surveys

The study used three main types of transport survey methods.

Origin-Destination Survey;

The survey demonstrated the pattern and nature of travel by outlining who is traveling where, with whom, when, and via what mode and route. It also showed congestion routes, public transportation systems and infrastructure needs.

The survey focused mainly on residents from South B as they are the main occupants of the area. The researcher collected data on strategic routes such as along Kapiti road, along Mariakani road, along Mukenia-Mchumbi road and Daidai road.

Land-Use Surveys;

This research survey made it possible to pinpoint the precise location and degree/density of land-uses in South B. Additionally, it made it possible to establish travel demand and forecast future land-use growth in and around South B.

Traffic Volume Survey;

The survey helped to determine the quantity of vehicles and people utilizing a transportation system, determining the demand at the time, determining capacity of roads, identifying need for road expansion and rehabilitation, establishing traffic control systems, studying traffic accidents, and helped analyze transport costs. The research survey was done mainly through tallying and filling of check lists in various roads within the site. The main roads targeted were the high traffic volume roads such as the Kapiti road, Mariakani road, Mukenia road and Mchumbi road. Additionally, the survey also focused on the interesting boda-boda business that serves as a major transport means in terms of deliveries and the last mile connector to residents in South B.

3.6.1.2 Questionnaires

Done by filling of both open-ended and close-ended questionnaires. Respondents received the questionnaires physically in the field or by mail. The respondents included students, landowners, businessmen, drivers and the local authorities in South B. They were expected to read and comprehend the questions and to fill in the appropriate sections in the questionnaire.

3.6.1.3 Interviews

The oral-verbal stimuli were presented as part of the interview method of data collection, and respondents responded verbally. The research incorporated both personal and telephone interviews. Personal Interviews; Involved speaking to the respondents face-to-face while asking questions. Telephone Interviews; Busy but important key informants such as some landlords were called via the phone.

3.6.1.4 Observation

The planning research study used observation sheets for systematic planning, documenting, and subjecting to checks and controls on the validity and reliability of phenomena observed. This involved the use of sketchpads and notebooks

3.6.1.5 Photography

This technique involved taking different pictures of different phenomena in South B. The photos captured were used to explain the occurrence in the site. Involved the use of cameras.

3.6.2 Secondary Data Collection

Some of the secondary data reviewed and analyzed include:

3.6.2.1 Literature Review

Books, magazines, research papers, research journals, studies, blogs and publications were some of the sources from which the data for the research study was acquired. This gave a framework for assessing the study's applicability and contrasting the findings with other findings to direct planning analyses in the future. The researcher derived secondary data from key institutions such as the Ministry of Roads and Transport department of road and rail, the National Environment Management Authority (NEMA), the county government of Nairobi and the offices of the Chief (Mariguini).

3.6.2.2 Case Studies

The research study compared South B to any other areas that were similar to it. The best practices in sustainable transportation systems (Active mobility) and regulations were used to select case studies. Global and local case studies were studied in relation to the topic and for better adoption of transportation practices in the study area.

3.7 Sampling

Five sampling steps were used to identify the sample in for the research as shown in the table below;

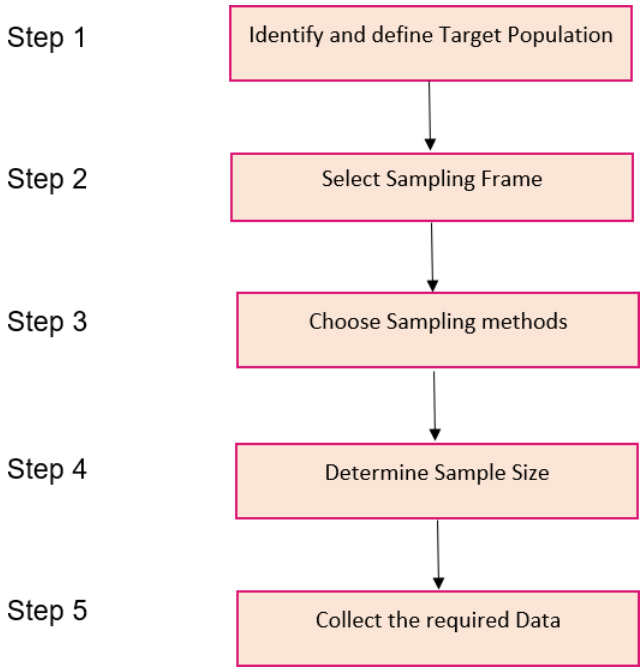


Table 1: Sampling Steps

3.7.1 Target Population

The target population in the study area were identified as the local residents and both public and private transport operators that are residing in the study area. The study was conducted in and along estate that lie close to the busiest roads within South B neighborhoods. Kapiti Estate – targeting Kapiti Road to the East and Daidai Road to the West, Mariakani Estate – targeting Mukenia Road to the West and Mariakani Road to the North and Shopping Centre which comprises mixed use developments. The research aimed to assess individuals aged between 18-35 given that this is the best demography that well describes the Kenyan job market, that is, both people on employment by government and other organizations and business people who operate within the neighborhood.

Number of people = Population Density * Study Area

Population Density = 6,748/km2

Study Area = 0.3 km2

Target Population = 6,748*0.3

= 2,024 People

3.7.2 Sampling Frame

The sampling frame comprised of a list of public-private transport operators, boda-boda riders, motorcyclists, pedal cyclist, residents who walk to work or school, business men, landlords and key informants that reside or work in South B.

3.7.3 Sampling Methods

The research survey mainly used simple random sampling, under probability sampling. The method ensured that every conceivable sample combination had an equal chance of being chosen and that every item in the population had an equal chance of being included in the sample. Every individual in South B had an equal chance of being selected in the sample size.

3.7.4 Sample Size

From the sampling frame. A small section was chosen using simple random sampling to come up with the sample size from which the research survey questions were asked.

n= N/1+N(e) 2

where; n = sample size N= Target population e= Allowable error

2024/ 1+2024(0.1)2 = 95 people.

3.7.5 Data Collection

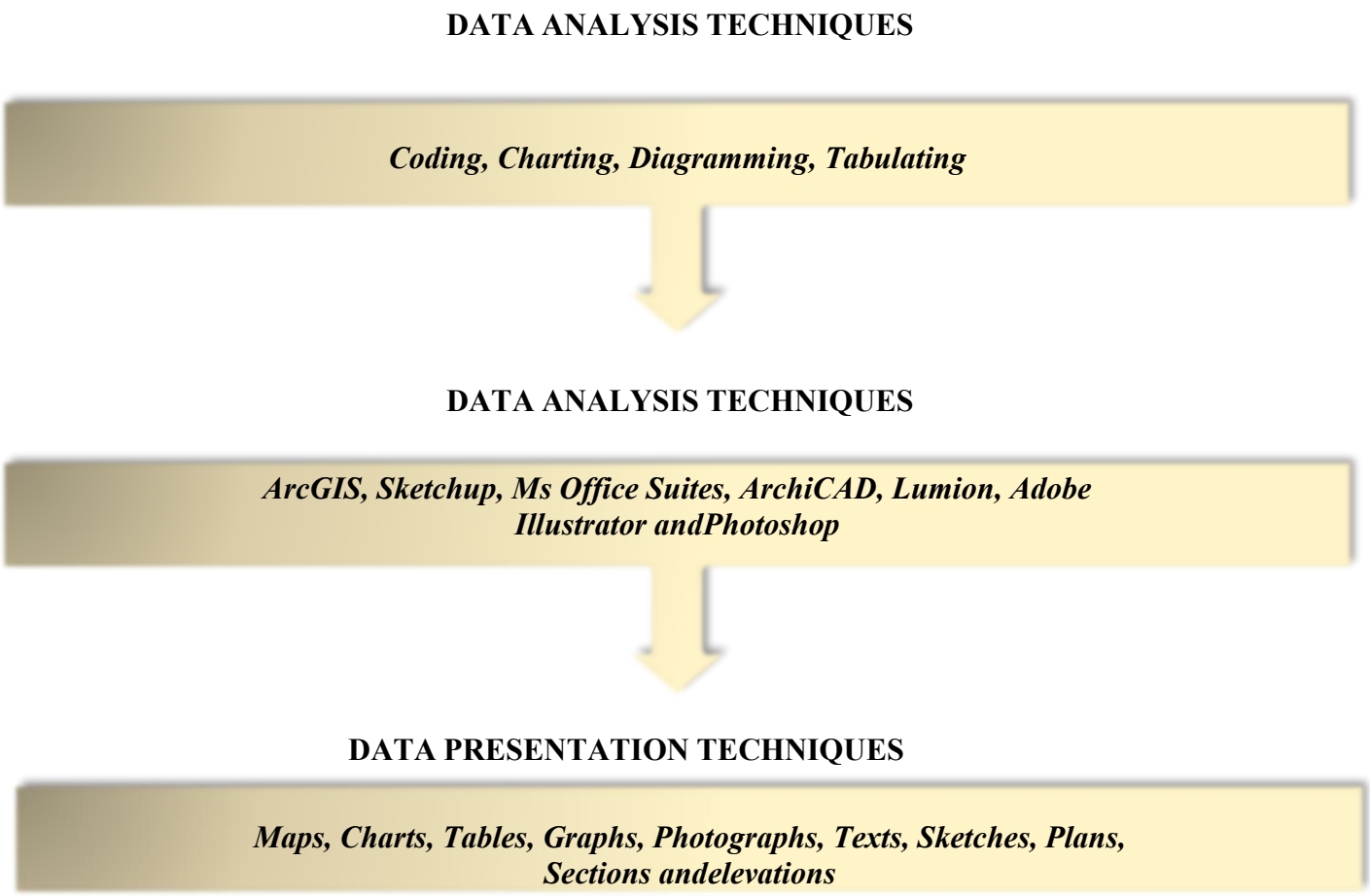
The required data were collected using primary data collection discussed above. The collection techniques included interviews and administering of questionnaires.

3.7.6 Data Collection Procedure

The study used a descriptive design approach. The traffic congestion was considered as an independent variable. The dependent variables included, cycling infrastructure, infrastructure, traffic congestion economic costs, policy framework and cycling experience. The descriptive method had certain advantages; the technique permitted one to measure a great number of variables and their interrelations simultaneously; it also provided information concerning the degree of relationship between variables being studied. In other words, the researcher did not manipulate the variables. Estimation of costs of traffic in running the city of Nairobi was done through secondary data research through visiting various websites such as The Nairobi City County Government, Kenya Bureau of Statistics, and other relevant agencies.

The qualitative aspect of this research therefore intended to assess the experience of the people of Nairobi towards the adoption of cycling as either an alternative to motorized transport system or a supplement in relation to both past and current experience on road usage. Self-administered questionnaires in collecting information were done through cyclists' social groups systemic observation also steered the qualitative aspect of this research.

3.8 Data Processing, Analysis and Presentation



Both primary and secondary data, as well as spatial and non-spatial data, were processed. After data collecting, the planning study project entailed a complex data processing process. Data were then analyzed and presented after being submitted to both qualitative and quantitative examination.

3.9 Pilot Study/ Reconnaissance Visit

The pre-visit was done in one day as the area is not very wide. It included meeting with relevant authorities in the area such as the Chief. It included analysis of the general land activities in the site that helped in preparing the actual 10-day survey schedule of the South B.

3.10 Research Ethics

The research adhered to all the six domains in research ethics; scientific integrity, institutional integrity, collegiality, protection of human rights, animal welfare and social responsibility.

In adhering to Scientific integrity, the study involved technical competence, data manipulation and statistical methods. The study was also done in collaboration with the Technical University of Kenya, Department of Spatial Planning and Design and therefore adhering to institutional integrity.

The study survey was done with human rights in mind. It involved protecting the residents of South B from harm, respecting the locals, providing justice, informed consents and assent.

Collegiality is the relationship among researchers. It was deployed in the research through peer reviews, authorships and data sharing.

Social responsibility was evident in the research through public educations of the locals in South B, advocacy, assessing the environmental impacts and defining research priorities in South B.

3.11 Work Plan and Timetable

The research study's work schedule was set within the 12 weeks of the academic semester. Through the creation of numerous outputs for the project report and project posters for presentation, many sections of the planning research project were successfully finished during this time. Table 3 below shows the work plan schedule.

Time (Week) / **Activity**	**Week 1**	**Week 2**	**Week 3**	**Week 4**	**Week 5**	**Week 6**	**Week 7**	**Week 8**	**Week 9**	**Week 10**	**Week 11**	**Week 12**	**Outputs**
Problem Identification													Research Topic
Introduction, Problem Statement & Objectives													Background of the Study
Justification of the Study													Problem Statement & Research Objectives

Basemap of the study area													Basemap
Literature Review													Literature review conceptual & Theoretical Framework
Methodology & Research Tools													Study methodology & Sampling
													Data Collection & Findings, Data & Situational Analysis
Analysis & Synthesis													Synthesis of design Issues, Case studies, Visioning & Concepts
													Structural Analysis
Plan Formulation													Structure Plan, Land Use Plan
													Proposed Master Plan
													PDP Sections, Views & Perspectives

Table 2: Work schedule

3.12 RESEARCH BUDGET

In order to complete each duty, the researcher managed and funded for the research. Table 3 below provides an illustration.

ACTIVITY	*ITEM*	*UNIT COST (Ksh)*	*NO. OF UNITS*	*EXPENDITURE (Ksh)*
1 Day Reconnaissance in South B	Bus fare to and from the site	220	1	220
Primary Data Collection for 10 days	Bus fare	220	10	2200
	Base map	100	3	300
	Questionnaires	25	30	750
	Checklist	10	5	50
Project Outputs	Printing of Project Report	2000	3	6000
	Binding of Project Report	300	3	900
	Printing of Project Posters	4500	1	4500
Total				**14,920**

Table 3: Research Budget

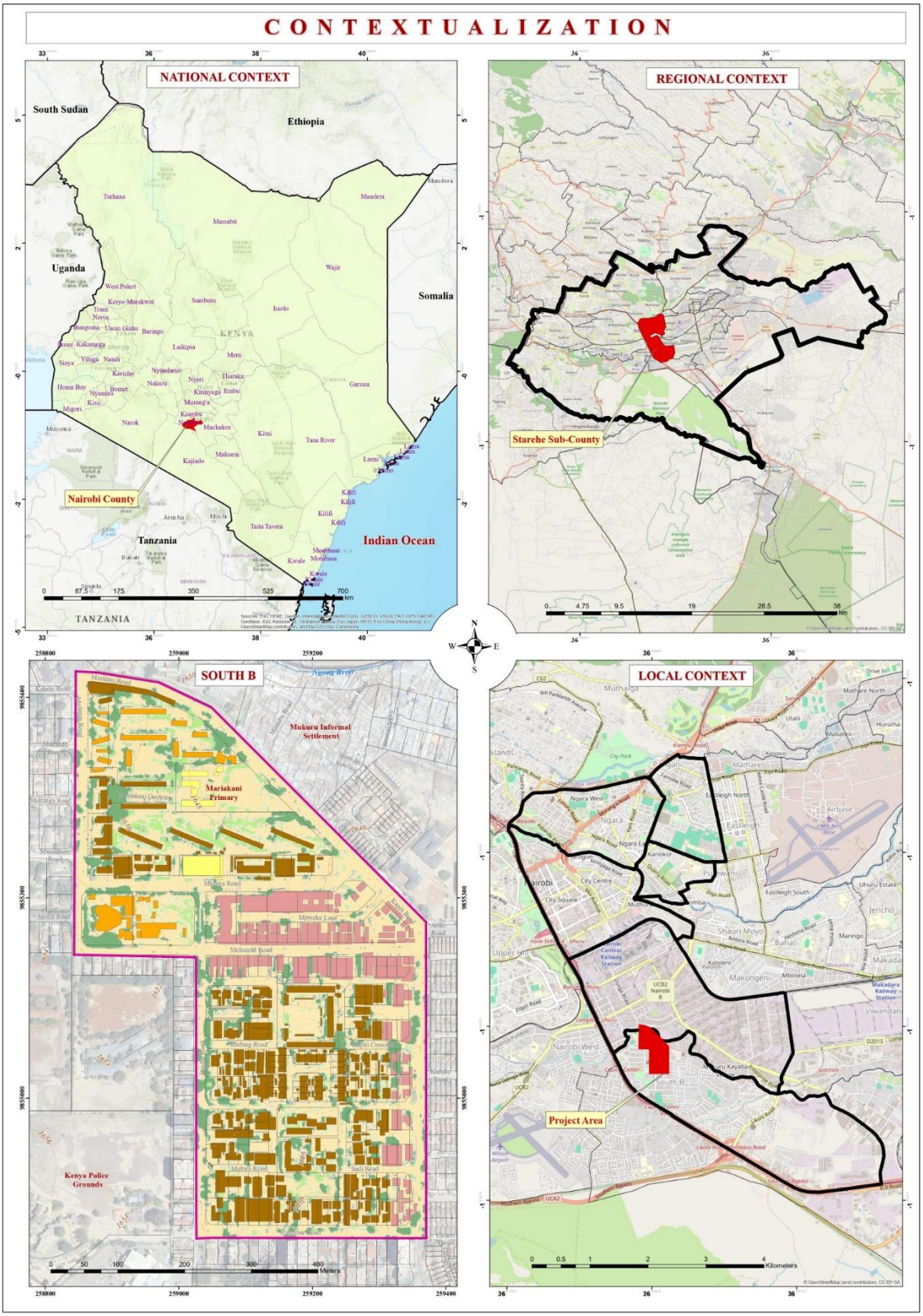
CHAPTER FOUR – STUDY AREA

4.1 Introduction

South B Neighborhood is characterized with mixed land uses comprising of Residential, Industrial/Commercial and Public purpose. This land uses have led to upsurge of the motorized population which has caused stress on the transport sector. Increased motorization has led to traffic problems completing short distances leading to delays in deliveries and transportation. This chapter seeks to have a diverse understanding of the trends and causes of traffic congestion within the study area. We analyze sites' location and context, historical developments, physiographical characteristics, infrastructural developments and institutional and legal frameworks.

4.2 Location and Context

The study area is located in Nairobi County, Starehe Sub-County, Nairobi South Ward, off the newly constructed Expressway along Mombasa Road. Major neighborhood landmarks are Expressway to the west, Masjid Mosque and Mukuru Kwa Njenga Slums to the north east of the study area. The study area is approximately 5 km from the CBD. See map 2 below;

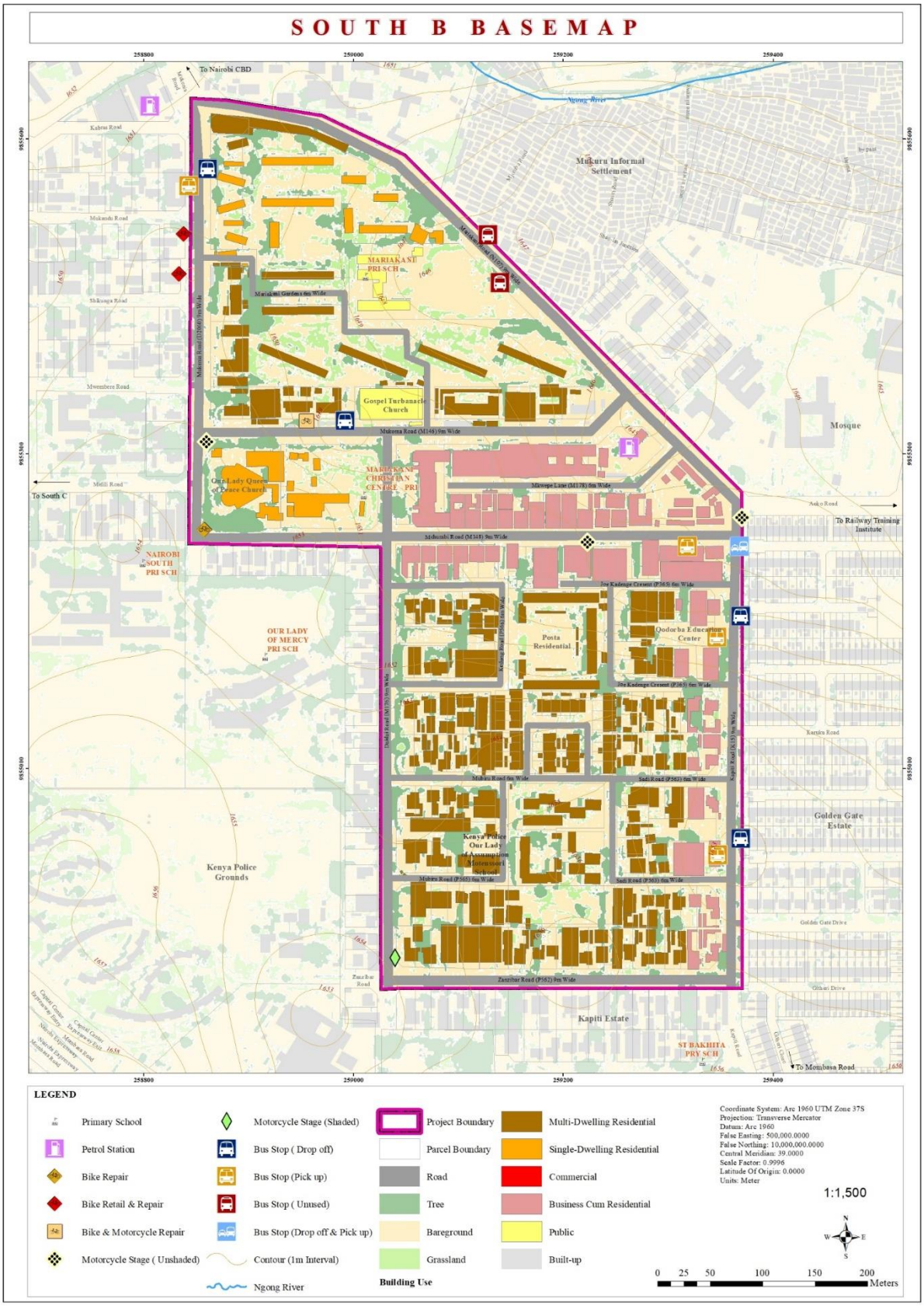


Map 1; Location Context,

Source; Author 2024

4.3 Basemap of the Study Area

The area is bounded by the following roads; Mariakani road to the north, Mukenia and Daidai road to the west, Mchumbi road to the south west and Zanzibar Road to the south. The total area is approximately 0.3km2. The area mainly comprises of residential, commercial and educational facilities. See map 3 below;



Map 2; South B Base Map

Source; Author 2024

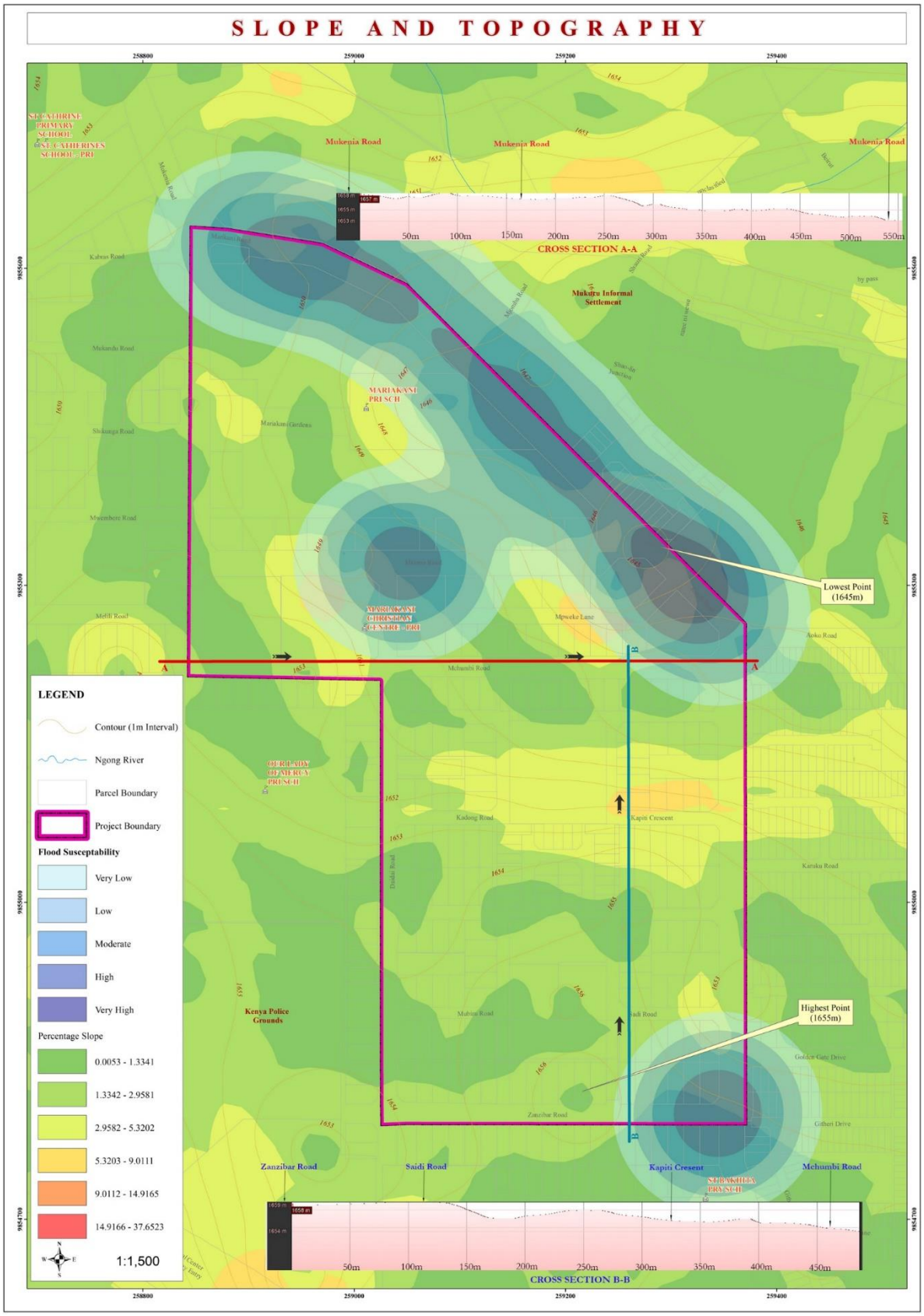
4.4 Historical Developments

South B is the immediate residential neighborhood after the Nairobi railways and Industrial area to the south of the CBD. As South B developed it attracted slum dwellers along the Ngong river who were mainly working in the industrial area and Mariakani estate built around the 1970s necessitated the need for public transport means. The public transport sector is served with route 11 matatus and minibuses. Recently, the area has experienced frequent traffic congestion attributing the cause to increased motorization from the residents (cars), and increased use of ride-hailing services i.e., uber and bolt in completing short trips within and out of site. With increase in population the housing demand have gone high and all these champions for investments on vertical developments with limited parking spaces causing. On the shopping areas they park on street and within the residential areas the driveway are used for parking. South B which is 5 km from CBD approximately travel time is 15mins by use of public transport now takes 30-45 min travel.

4.5 Physiographical conditions

4.5.1 Topography

The study area is gently sloping with the highest point at 1655m above sea level on the southern part of the site and the lowest point at 1645m above the se level along Mariakani road. The area therefore slopes from the southern part towards the north eastern part. The gentle sloping nature of the site makes it easy to construct road networks within the site and even circulation by foot, cycling and pushcarts. Road infrastructure developments such as construction of pedestrian walkways and cycling lanes, parking lots and bus stops can be easily constructed. On flood susceptibility the lowest part of the site along Mariakani road is prone to drainage overflow in cases of heavy rains and this disrupts the slum settlements. See map 4 below;



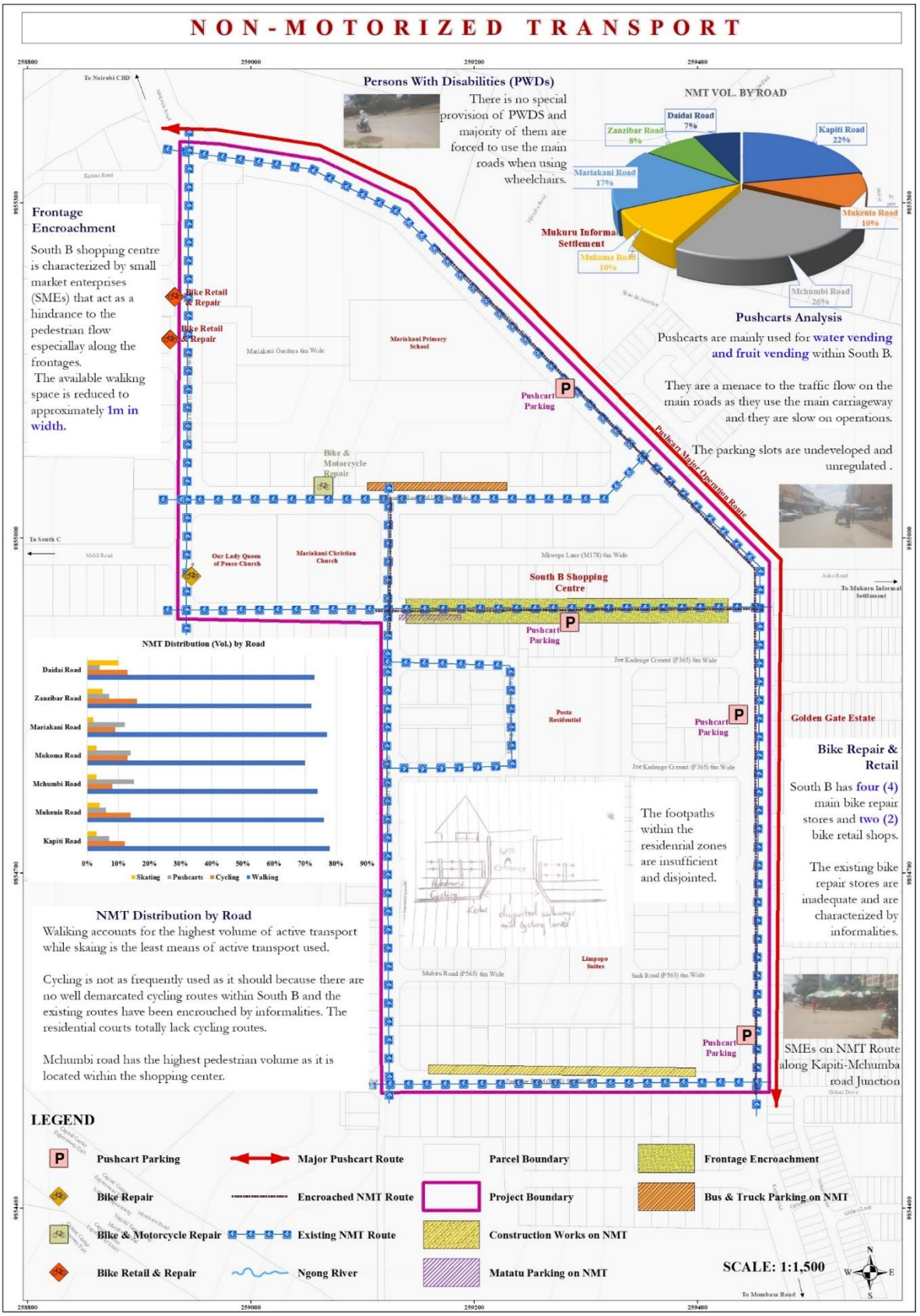
Map 3; Topography

Source; Author 2024

4.5.2 Transport

4.5.2.1 Non-Motorized Transport

The study area is bounded by Mariakani road to the north which neighbors Mukuru Slums. From the questionnaires administered to respondents who work within South B and its environs their trip origin is from the slums. Walking accounts for the highest modal share in the study area. This large human traffic is evident in the morning and evening and main roads in the site that provides for pedestrians circulation are Kapiti road and Mariakani road. The increase in demand for circulation routes through walking and cycling has led to vehicular-pedestrians, motorcycles-pedestrians and pedestrians-pedestrian conflicts evident on junctions, unmarked or not signalized intersections. Other NMT users involves PWDs, whose provisions in the road corridor are not catered for. Use of pushcarts also enjoys a good percentage in terms of NMT modal share. The are characterized for water vending, fruit-vegetables vending, transporting building materials and debris, and moving of housing utilities from one place to another. See the poster 1 below;

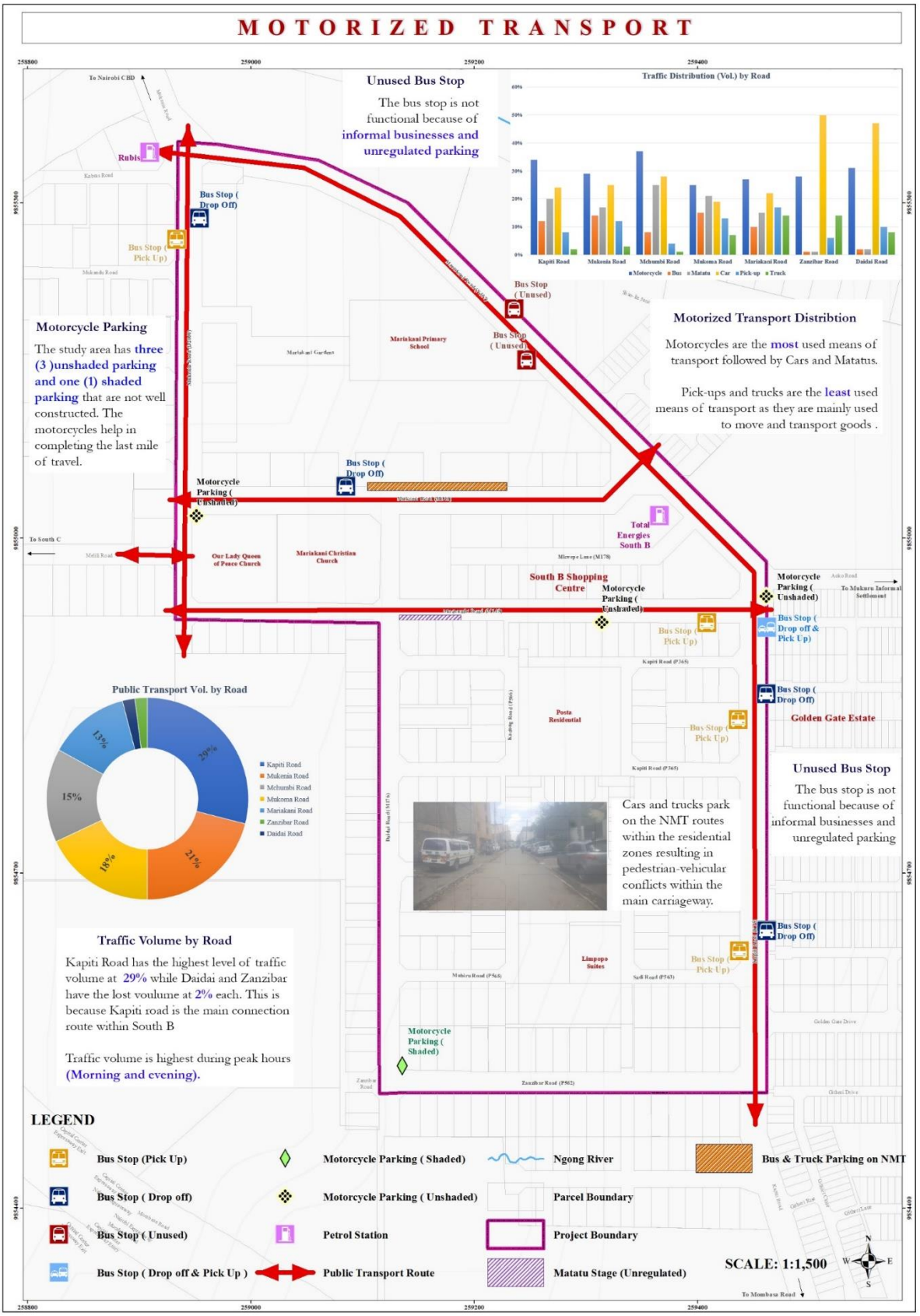


Poster 1: Non-Motorized Transport

Source; Author 2024

4.5.2.2 Motorized Transport

South B Estate is served by various means of transport not limited to public transport. Majority of workers in the study area work in the CBD and the other section works either within the study area or the industrial area who prefer to walk rather than board public transport. However, according to the traffic log sheet, private transport (PrT) account for majority of the vehicle. This overdependency in private cars results into traffic congestion. Motorcycles are mainly used to complete the last miles which are not provided to by the public transport. See the poster 2 below;

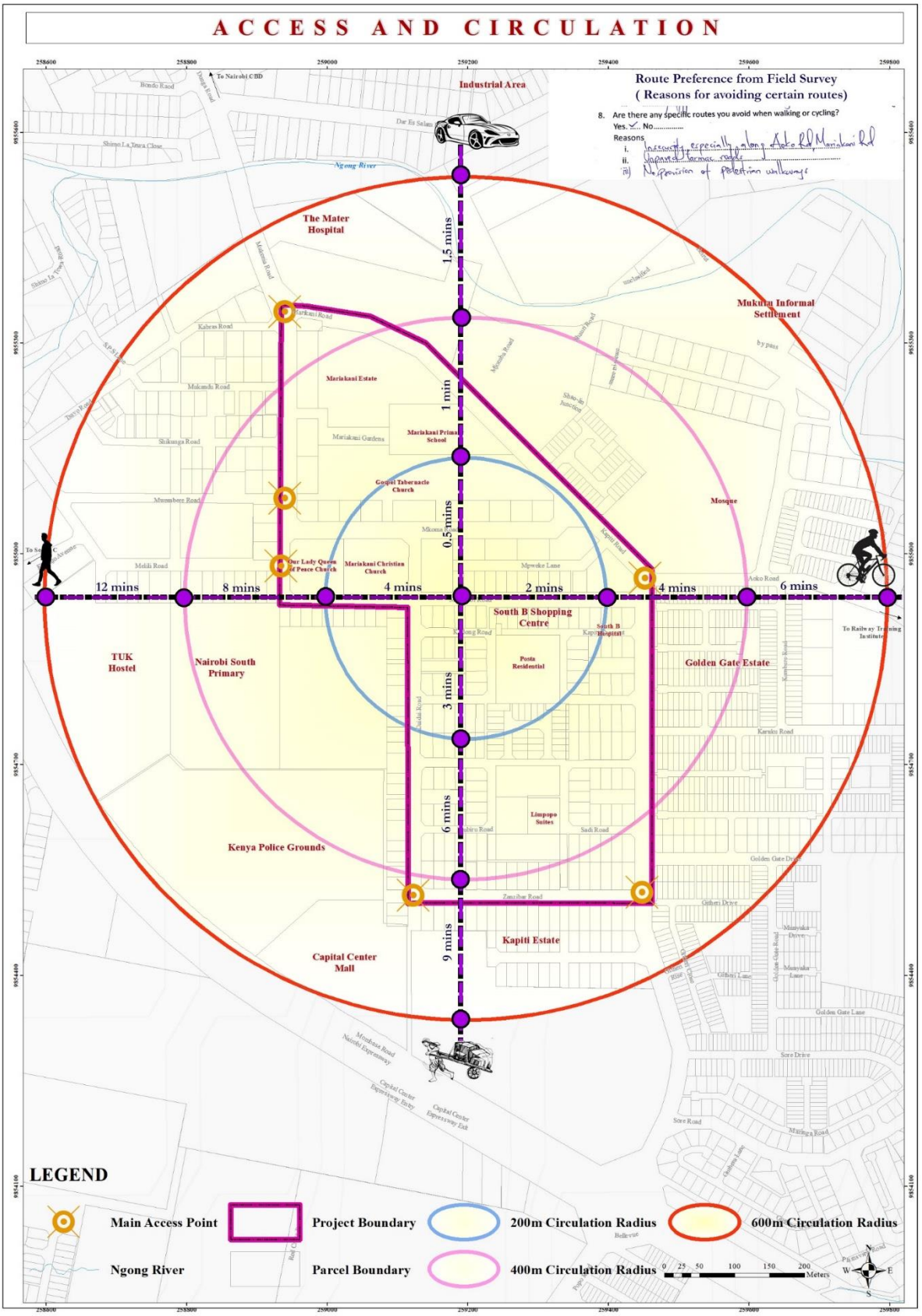


Poster 2: Motorized Transport

Source; Author 2024

4.5.2.3 Access and Circulation

The study area has six main access points cutting across major roads in the site. It has various junctions which are prone to traffic congestion. This is caused by the vehicular-vehicular and pedestrian-pedestrian conflicts which results to more delays. This various conflicts attributes to the recurrent traffic congestions in the study area. Walking across the longest stretch, that is, along Mchumbi road to South C through Melili road takes 12min, Cycling takes 6mins while driving takes 1.5min if there is no traffic congestion if there is its 3 times late. See the poster 3 below;



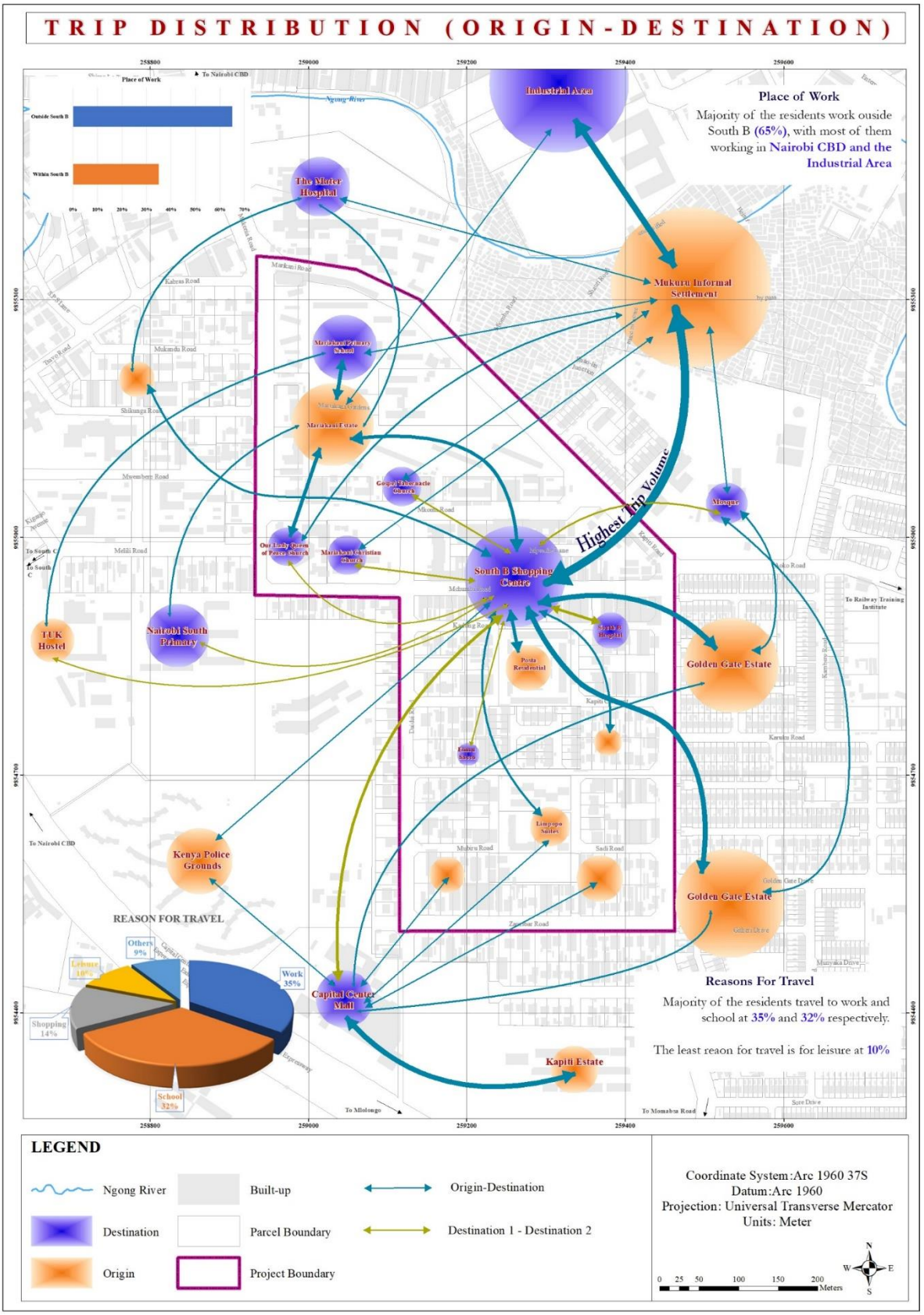
Poster 3: Access and Circulation

Source; Author, 2024

4.5.2.4 Trip distribution

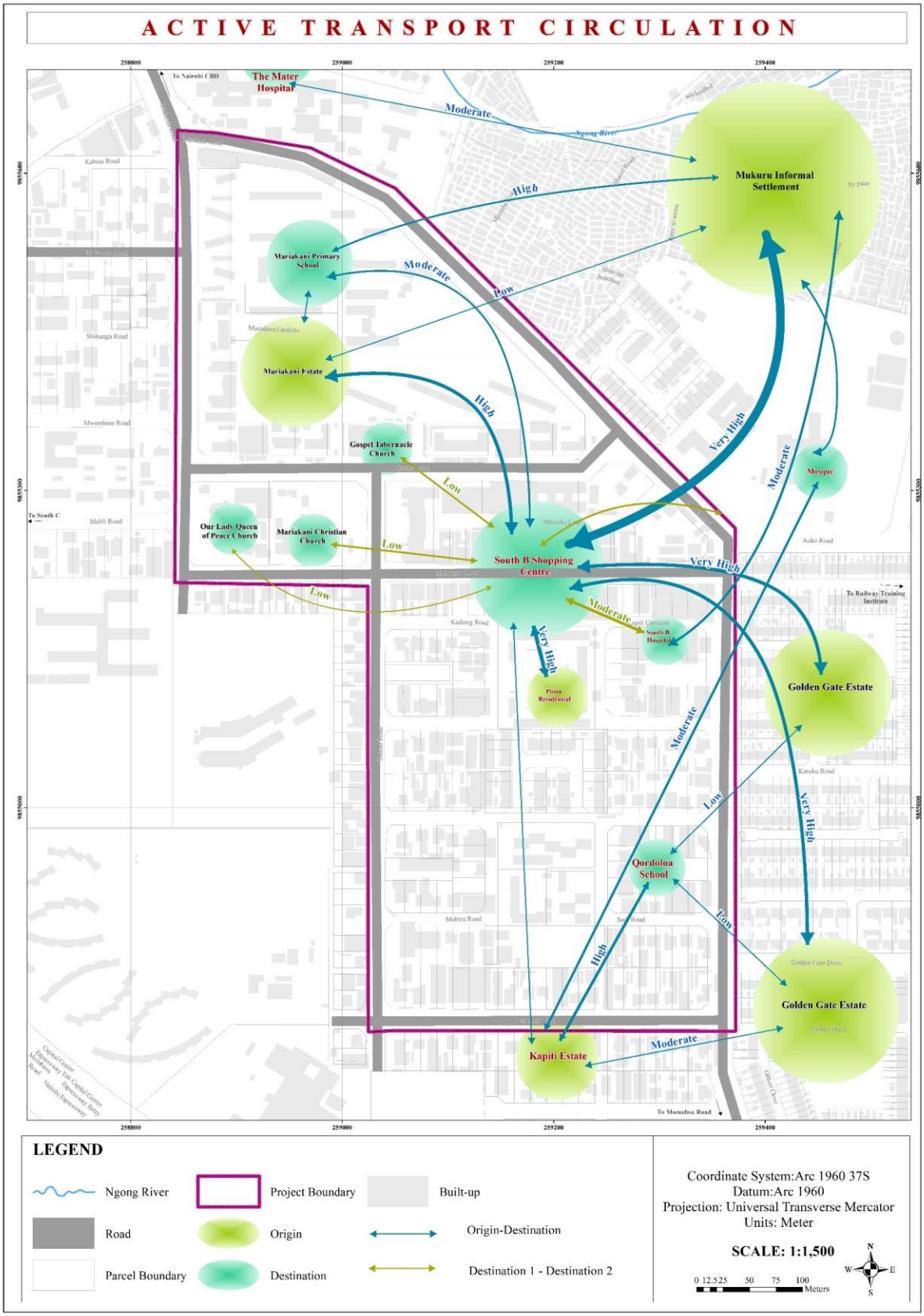
Trip distribution analysis was done through understanding the reasons for travel from the respondents. Other criteria used was the basic observations of the trend of movement within and out of the site during peak and off-peak hours along frequently used streets and junctions. The off-peak period included the weekends whereby residents completed trips to either recreational purposes or public purposes. From the survey, the researcher analyzed the preferred routes, trip purposes and modes and means of travel. See poster 4 below;

Further, trip distribution was done along the study area main roads, Mariakani road & Kapiti road. Most of the residents are slum dwellers and they walk to complete their trips and majorly they make trips to Shopping Center for commercial services and Industrial area for job. See poster 5 below;



Poster 4: Trip Distribution

Source; Author 2024



Poster 5: Active Transport Circulation

Source: Author 2024

4.6 Population

The population is generated according to Kenya Census 2019.

Number of people = Population Density * Study Area

Population Density = 6,748/km2

Study Area = 0.3 km2

Target Population = 6,748*0.3

= 2,024 People

4.6.1 Population Projection

To calculate population projection;

Pn = Po (1+r/100)n

Where; Po = Current Population r = Growth Rate n = Number of years

Current Population = 2024 people

Growth Rate = 4.1/100

Population Projection for 10 years 2034 = 20,323 people

POPULATION AND DEMOGRAPHY

TOTAL POPULATION

The population is generated according to Kenya Census 2019.

Number of people = Population Density * Study Area

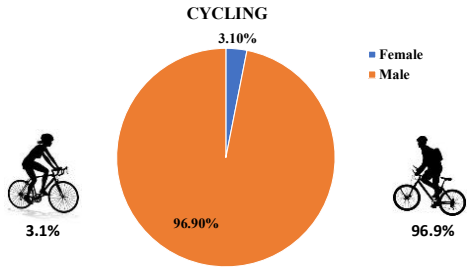
Population Density = 6,748/km2

Study Area = 0.3 km2

Target Population = 6,748*0.3

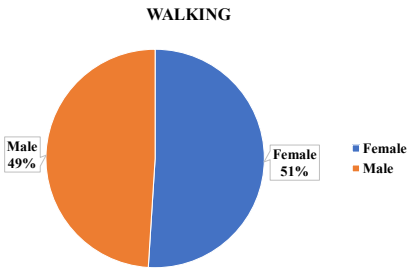
= **2,024 People**

UPTAKE OF ACTIVE MOBILITY BY GENDER



The gender disparities on cycling was tied to;

- Inadequate supporting cycling facilities and amenities
- Safety of cyclists on the road is not guaranteed



POPULATION DENSITY

Population Density = 6,748/km2

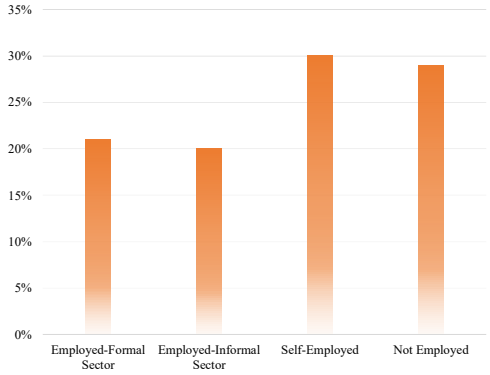
6,748

Source; KNBS, 2019

Most active age group

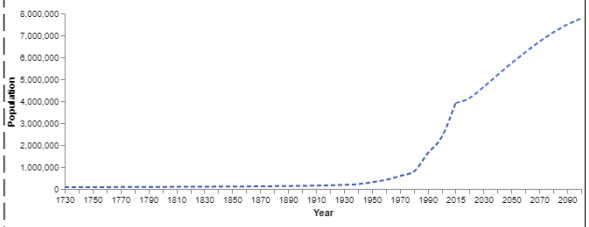
18-35 years

EMPLOYMENT RATIO



- Majority of the area residence are self-employed, at **29%.** This constitutes street vendors, bike repairs and carpenters
- Majority of the unemployed are students

POPULATION PROJECTION



Year	Est. Population	Avg 10 Year Growth %	Avg 10 Year Growth
2000	2,360,119	45.9%	742,799
2020	4,143,795	32.5%	891,838
2030	4,648,076	12.2%	504,281
2040	5,188,740	11.6%	540,664
2050	5,727,717	10.4%	538,977

Source; cityFacts

To calculate population projection;

$P_n = P_o(1+r/100)^n$

Where;

P_o = Current Population

r = Growth Rate

n = Number of years

Therefore,

The population in the area is projected to grow to 20,323 people by 2034

Poster 6: Population & Demography

Source: Author 2024

4.7 Policies, Legal and Institutional Framework

4.7.1 Policy Frameworks

4.7.1.1 Integrated National Transport Policy (2011)

Draft INTP has been prepared and its currently under review by different stakeholders not limited to the Ministry of Roads and Transport waiting for parliamentary approval. The policy provides for appropriate basic road infrastructure, furniture and other amenities including pedestrian crossing, walkways, footbridges and other facilities for Non-Motorized and Intermediate Means of Transport (NMIMTs).

4.7.1.2National Climate Change Action Plan (2018-2022)

Is a five-year plan guiding Kenya's Climate Change actions including the reduction of GHG emissions. The plan is a requirement by the Climate Change Act, 2016 which seeks to further Kenya's development goals by providing mechanisms and measures to achieve low carbon climate resilient development in connection with its objective of promoting efficient, safe and affordable public transport and constructing of at least 150km of NMT within urban areas.

4.7.2 Legal Frameworks

4.7.2.1 Physical Planning Handbook

Provides guidelines and minimum standards for physical planning for transport infrastructure. The handbook calls for dedicated pedestrians and bicycle facilities and adequate landscaping.

4.7.2.2 Urban Areas and Cities Act, 2011

Provides for the classification, governance, and management of urban areas and cities; the criteria of establishing urban areas; and the principle of governance and participation of residents. Parking, traffic control, public transport, and street lighting are among the listed requirements for classification of an area to be a city or a municipality.

4.7.2.3 Physical and Land Use Planning Act, 2019

Makes provision for planning, use, regulation and development of land. Transport has been identified as part of various development plans, and hence transport systems should be analyzed and developed to cater to future demand.

4.7.2.4 Constitution of Kenya, 2010

CoK establishes the devolved system of governance and the formation of county governments. The Fourth Schedule, part II, mandates County Governments with: planning, development, and maintenance of county roads; street lighting; traffic; and parking. Functions under the national government include the construction and operation of national trunk roads and the formulation of standards for road construction. Article 39 (1) guarantees all Kenyan citizens the right to freedom of movement. Further, its mandatory for public and private offices to respond to the

needs of vulnerable members of the society, including women, the aged, children, persons with disabilities, and minority/marginalized communities.

4.7.2.5 County Governments Act, 2012

According to this Act, counties must create a five -year County Integrated Development Plan, which serves as the foundation for sectoral plans. Further, department of Road and Transport must create a sectoral plan for the next ten years, including a mobility plan and guidelines for managing and budgeting for the transportation systems under their control.

4.7.2.6 Highway Code

The Highway Code provides rules and guidelines on how to use the road. All road users- pedestrians, cyclist and motorists – have a right to access the road but they should always act responsibly so as to ensure safety for all. Helmets and reflective gear are suggested for cyclists. All road users are required under the code to abide by traffic signs and signals.

4.7.2.7 Kenya Roads Act, 2012

Establishes KeNHA, KURA and KeRRA and stipulates their functions. Provides road classification, management, construction, and maintenance of public roads in Kenya.

4.7.2.8 National Motorcycle Regulations, 2014

Regulates the operation of two and three-wheeler vehicles in Kenya. The regulation mandates two-wheeler riders to have a valid license, carry one passenger at a time, have protective gear (i.e., helmet and reflective jacket), and observe all traffic rules.

4.7.2.9 Environmental Management and Coordination Act

Establishes the (NEMA) legal framework for the management of the environment and lists all major roads among projects to undergo Environmental Impact Assessment (EIA) before construction.

4.7.2.10 Climate Change Act of 2016

Kenya is promoting the shift to sustainable consumption and production patterns one of the global commitments to decarbonize the transport sector. It provides a framework for regulation to enable a better response to climate change

4.7.3 Institutional Frameworks

4.7.3.1 Ministry of Roads and Transport

The ministry is the overall policy making in the transport sector in Kenya comprising of all modes of transport i.e., road, rail, shipping and maritime and air. Under road there are the following road agencies Kenya National Highways Authority in-charge of all national trunk roads, Kenya Urban Roads Authority, Kenya Rural Roads Authority and Wildlife Reserve

Roads Authority which are all in charge of managing, developing, rehabilitating and maintaining roads within their jurisdiction.

4.7.3.2 Kenya Roads Board

Oversees the road network and coordinates its development, rehabilitation and maintenance by administering the Fuel Levy.

4.7.3.3 National Transport Safety Authority

Responsible for coordinating the activities of the road transport departments and overseeing the road transport sector to reduce the number of fatalities caused by car accidents and crashes. It has also developed a draft National Road Safety Action Plan which is yet to be launched.

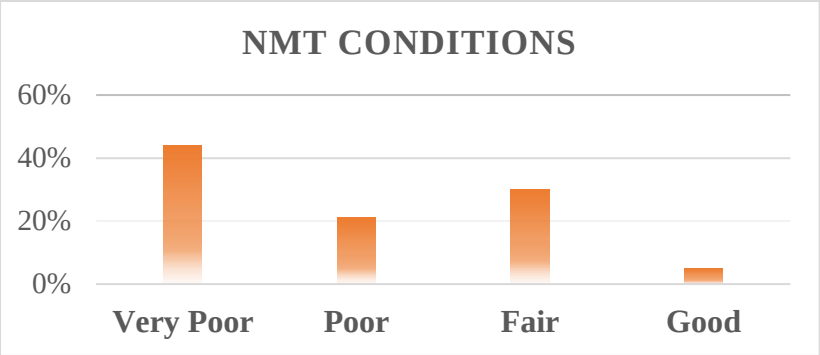
CHAPTER FIVE - DATA ANALYSIS AND DISCUSSIONS

5.1 Introduction

This chapter summarizes and discusses the data findings recorded through primary and secondary data sources. The data was not limited to, mode of transportation, reasons for travel to understand trips made, NMT routes and amenities provided, traffic volume by each road, and public transport verses private transport.

5.2 NMT Routes Conditions

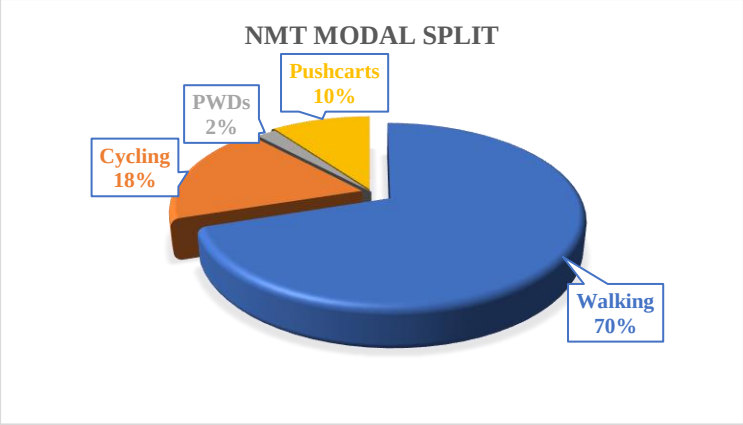
A cyclist respondent commented that, “cycle tracks end in abrupt curves, and you must dismount and carry your bike around the curve. Further, the pedestrian and cycling routes are encroached making them uncomfortable to walk and cycle on. Some NMT routes are in fair conditions but cyclist and pedestrians feel unsafe when they meet at the intersections i.e., Mukenia road. See the graph 1 below;



Graph 1; NMT Conditions

5.3 NMT Modal Split

From the analysis of the respondent’s feedback, walking accounts for approximately 70% of the modal split in the study area while cycling is approximately 18%. Other NMT users include the PWDs and use of pushcarts. See pie chart 1 below;

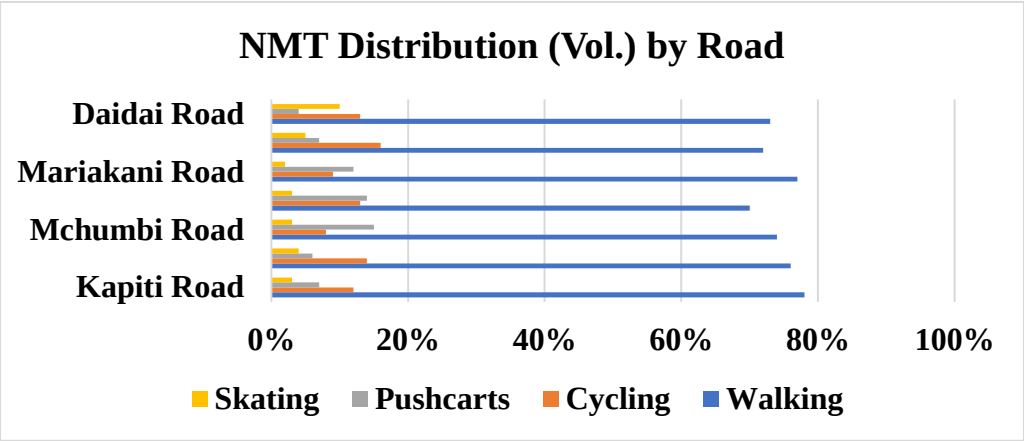


Pie Chart 1; NMT Modal Split

5.4 Traffic volume

5.4.1 Volume by road (non-motorized)

As stated above (NMT Modal Split), walking accounts for the highest percentage, 70% modal share. This is attributed to first and last mile travels. The PWDs infrastructure is not provided in the entire site i.e., ramps and skating infrastructure which accounts for the lowest percentage share on various roads in the site. Graph below shows NMT traffic by road;



Graph 2; NMT Vol. by road

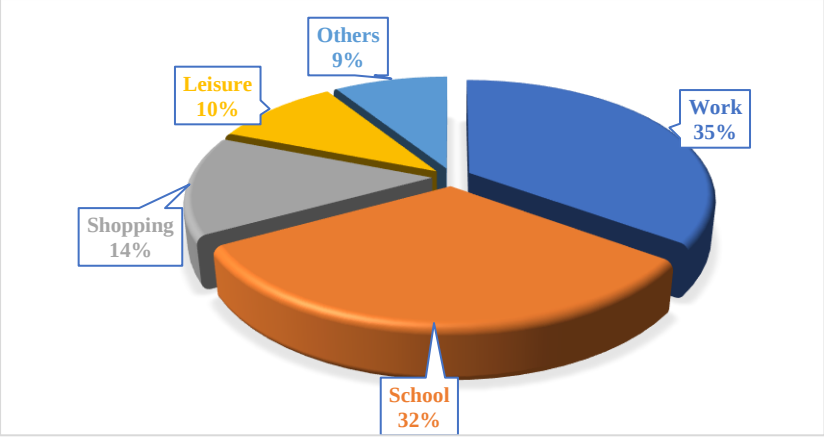
5.4.2 Volume by road (Motorized)

From the transport survey conducted for 3 days including one of the weekends, it was evident that Kapiti road has the highest traffic volume during peak and off-peak hour and days. Daidai road and Zanzibar road are the least used road in the study area by public transport considering the travel demand and no presence of bus stop for either pick up or drop off. Public transport routes used are the following in descending order; Kapiti road, Mchumbi road, Mukenia road, Mukoma road and Mariakani road.

Motorcycles account for the highest percentage of motorized transport followed by private cars in the study area.

5.5 Reason for travel

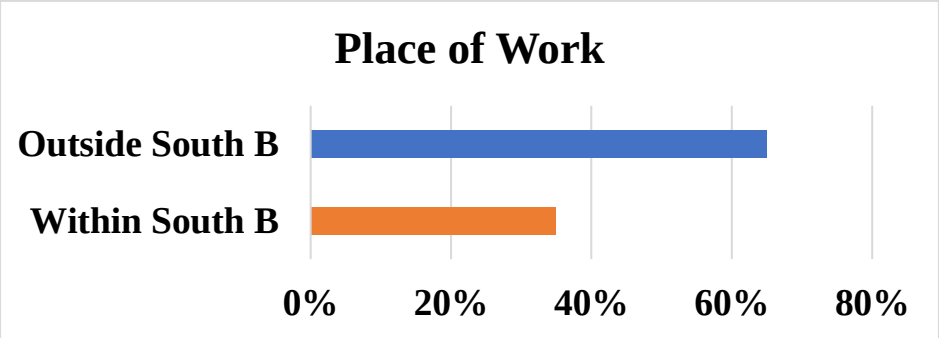
From the primary data collected on purpose for travel section, majority of the people travel either to school or work, accounting for 31% and 35% respectively. Majority of the population in the area is youths aged between 18-35 years. This population consists of vibrant youths in the mobility sector and purpose of movement, they either work or school. See the pie chart 2 below;



Pie Chart 2; Reason for travel

5.6 Place of work

Most people who were interviewed work outside the study area unlike 35% who work within the area. South B shopping center servers as a node for transport for the entire site for it harbors commercial a recreational facility. Graph 3 below shows distribution of work places;



Graph 3; Place of work

5.7 Public transport vs private transport.

From the traffic survey log sheet, public transport accounts for 42% while private transport approximately accounts for 58%. Onto passenger carrying analysis, it was concluded that public transport accounts for high passenger carrying capacity unlike private transport “one person one car.”

5.8 Summary of the findings

South B estate has the highest potential of actualizing transition in mode of transport. Each and every road within the site has pedestrian walkways provisions but they are encroached by street vendors, bike repairs and unregulated parking. Within the estates, residential roads and driveway are characterized with on street parking limiting circulation of pedestrians and cyclist. PWDs circulation in the site poses the highest risk since there is no provision of their facilities either on the roads or accessing of buildings and shops entrances. Their parking is not provided too. The recurrent traffic in the site is mainly contributed to high travel demand during the peak hours with private transport being the highest contributor.

This transport related issue can be alleviated through proper design of the estate street designs and incorporating it with either mixed-use developments or horizontal developments to enhance walking and cycling neighborhood which will limit private transport.

CHAPTER SIX – CONCLUSION AND RECOMMENDATION

6.1 Introduction

This chapter seeks to come up with vibrant conclusions and recommendations through the synthesis of the issues in the study area. Visioning, conceptualization, proposals and strategies were recommended to mitigate the traffic problem which informed structure plan and master plan.

6.2 SWOT Analysis

STRENGTHS	
Bike Retail & Repair	Availability of these facilities is evident that if cycling infrastructure is provided for, more people will adopt it as means of transport.
Terrain	South B is gently sloping which encourages cycling and pedestrian circulation with ease. The terrain also helps in natural draining of surface run-off.
Kapiti – Mariakani road	These are the major link roads in South B. Kapiti links South C to the South and Mariakani road links Mukuru Slums and Industrial Area to N. E & North respectively.
WEAKNESS	
Encroachment of sidewalks	All roads are in South B are characterized by encroachment contributed by Small Micro Enterprises and other informal economic activities limiting circulation of both, vehicles, PWDs. pedestrians and cyclist
No provision of special dedicated lanes for PWDs and Cyclists	Roads in the South B were not designed to cater for PWDs and Cyclists. Cycling on these roads' poses risk to crashes.
Congestion	Streets and driveway within Shopping Center and Estates are characterized by on-street parking, and human traffic which is recurrent throughout the day.

Poor drainage	There is no provision of proper drainage patterns along the roads which results to stagnant water limiting pedestrians and PWDs circulation.
OPPORTUNITIES	
TUK, KIMC & RTI	These institutions play important role in adoption of active mobility. Shopping Center act as a pull for various activities. Their circulation within the site can be enhanced through walking and cycling.
Mariguini Police Post	The station can be utilized to provide security within the site i.e., curbing vandalism of NMT facilities such as dustbin.
Use of Bicycles for deliveries	Presence of supermarkets, mall, eateries and retail shops; they have resolved to use bicycles for purposes of deliveries.
THREATS	
Narrow roads	i.e., Kapiti road cannot accommodate both, human traffic, vehicular traffic, street vendors and cycling traffic posing risks of casualties.
Poor waste management	Along Mariakani road, Mukuru Slums, solid waste are dumped on the sidewalks and drainage systems this discourages circulation due to unhealthy environment and disjointed sidewalks.

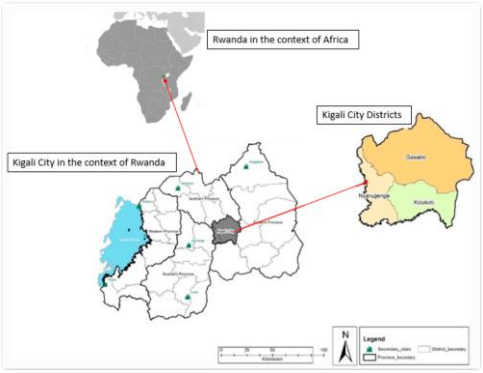
6.3 Case Studies

6.3.1 Local Case Study, Kigali, Rwanda

Kigali city over the years have promoted a walking and cycling environment within the city and its environs. Strategies deployed are not limited to car free days, car free zones, green corridors and defined cycling lanes. See poster 7 below;

LOCAL CASE STUDY-KIGALI, RWANDA

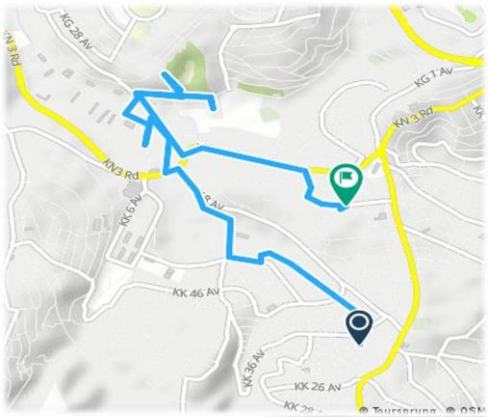
LOCATION AND CONTEXT



- Kigali is the capital city of Rwanda. It is the center of the country's road network, with paved roads linking the city to most other major cities and towns in the country. It is also connected by road to other countries in the East African Community.

DESIGN STRATEGIES

1. Defined Cycling Routes



- Rwanda launched Africa's first Public Bike Share Transport system with an aim to reduce the carbon emissions in the town, increase NMT use and to promote green transport.

2. Car-free Days

- Car-free days creates awareness on the need to reduce over dependence on motorized transport and embrace NMT.

3. Upgraded NMT Routes

- Kigali is striving towards providing sufficient and well established pedestrian and walkways to support mobility.
- The routes also have proper signages to direct both NMT and Motorized users.

4. Car-Free Zone

- Imbuga City Walk street provides fast connections from one point to the other and encourages walking through the city

5. Green Corridors

- The roads and streets in the city are characterized by well maintained grass lawns, flowers and trees that promotes a clean city, reduces pollution and heightens aesthetic values of the city.

Poster 7: Local Case Study

Source: Author 2024

6.3.2 International Case Study, Copenhagen, Denmark

Copenhagen is the capital and the most famous city in Denmark. Denmark has been rated as one of the most bicycle-friendly cities in the world since 2015, with bicycles outnumbering its inhabitants. Strategies deployed towards a success shift were, effective mobility policies, prioritizing bike over car parking & incorporation of car free neighborhoods/streets. See poster 8 below;

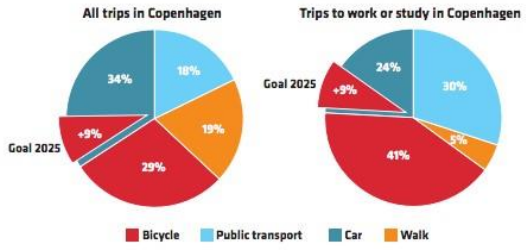
INTERNATIONAL CASE STUDY- COPENHAGEN, DENMARK

LOCATION AND CONTEXT

- Copenhagen is the capital and the most famous city in Denmark. Copenhagen has been rated as one of the most bicycle-friendly cities in the world since 2015, with bicycles outnumbering its inhabitants. Copenhagen aims to be the first carbon neutral capital by 2025

DESIGN STRATEGIES

1. Design Mobility Policies

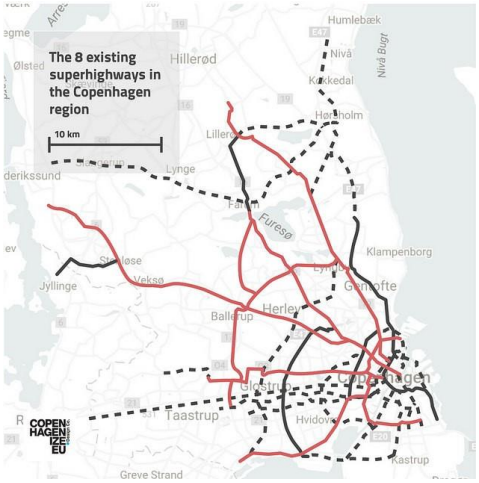


- Copenhagen embraces the 3/3 approach that demands that at least 1/3 of the trips must be by cycling, 1/3 by public transport and 1/3 by cars in the modal split.

2. Car – Free Streets/Neighborhoods

- Copenhagen's Stroget area is a world-renowned car-free zone that was created to protect pedestrians during their shopping and festivities.

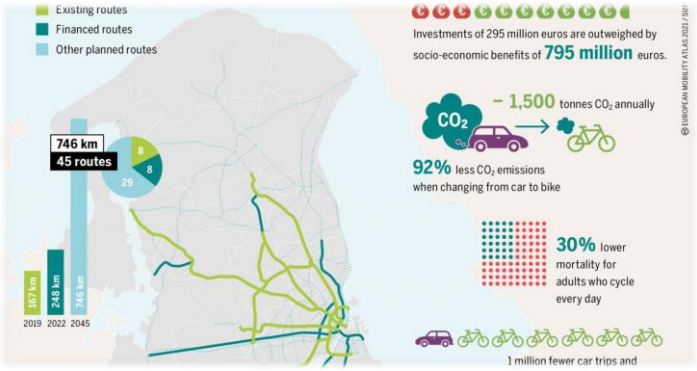
3. Elevated Cycling Super Highways



- The city has an elevated sole cycling highways for fast connectivity and to avoid conflicts with other modal splits

4. Prioritizing Bike over Car Parking

- Most car parking spaces in Copenhagen have been converted to public spaces and to bicycle parking spaces.



- The city's bicycle paths are extensive and well used, boasting 400 kilometers of cycling lanes not shared with cars or pedestrians, and sometimes have their own signal systems.

Poster 8: International Case Study

Source: Author 2024

6.4 Concept, Vision and Strategies

6.4.1 Concept New Urbanism

The concept advocates for walkable neighborhoods containing a mix of uses such as housing, shops, workplaces and schools. These identified locations must be accessible on foot in 10 min or less from either home or work. Walking and cycling is made enjoyable by a high-quality pedestrian network, a public realm, and a hierarchy of tiny streets and dedicated lanes for each respectively.

6.4.2 Principles of New Urbanism

Walkable Streets; streets are designed to be pedestrian and cyclists friendly with appropriate infrastructure and amenities linking them to other land use.

Mixed use development; homes, businesses, work places and other amenities are located within walking and cycling distance of each other

Environmentally Friendly; when everything is within 10min walking distance, it reduces the usage of automobiles hence enhancing environmentally friendly neighborhoods. i.e., free GHGs neighborhoods

6.4.3 Theme

"**Adopt, shift and Improve**"

Adopt

Adopt an effective mode of transport gradually that will reduce overdependence on private transport

Shift

Shift from private transport through an active mobility neighborhood and use of mass rapid transport system.

Improve

The public transport system (MRTS) can be improved by adopting e-buses while on cycling, uptake of e-Bikes can be advocated for. Adoption of complete streets, to create a pedestrian friendly environment.

6.4.4 Vision

"***An integrated active mobility neighborhood"***

See poster 9 below;

VISION, CONCEPT AND STRATEGIES

Vision;

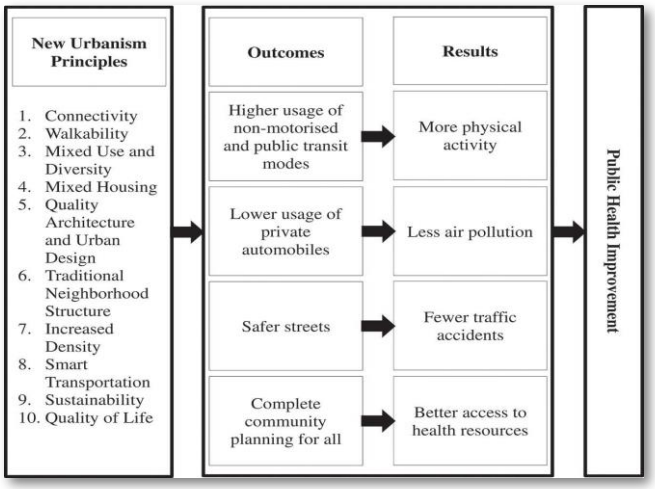
An Integrated Active Mobility

Theme;

Adopt, Shift and Improve

Concept;

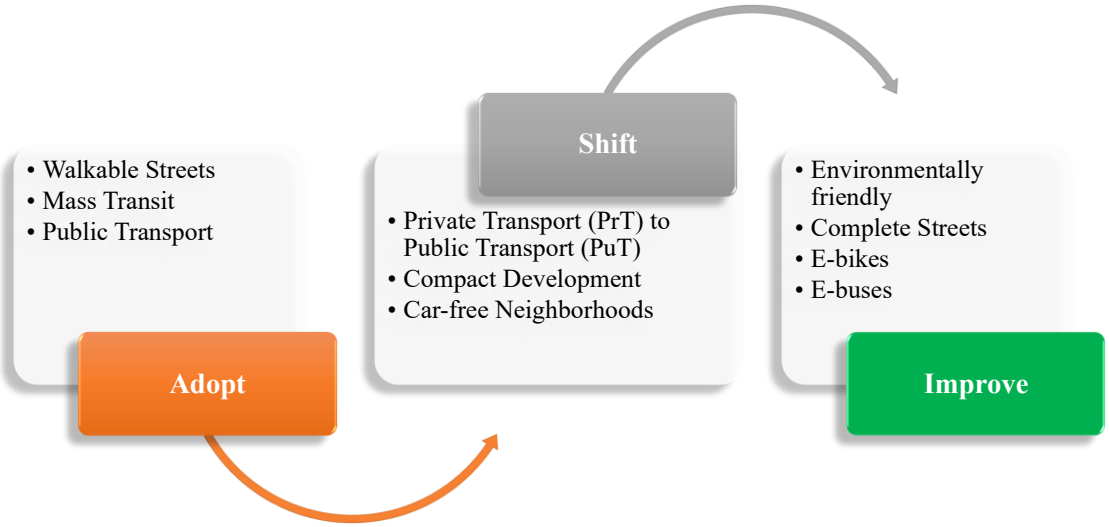
New Urbanism



Key Principles of New Urbanism

- **Walkability**; Communities should be able to meet all basic needs within walking distance of the residential zones.
- **Connectivity**; This implies that there must be a network of connected roads and streets that reduce traffic
- **Environmentally Friendly**; Ten minutes of walking distance to reduce the usage of automobiles. A better public transportation system, more bicycle use, and a reduction in the use of conventional fuels is of most priority.

Strategies;



Poster 9: Vision, Concept & Strategies

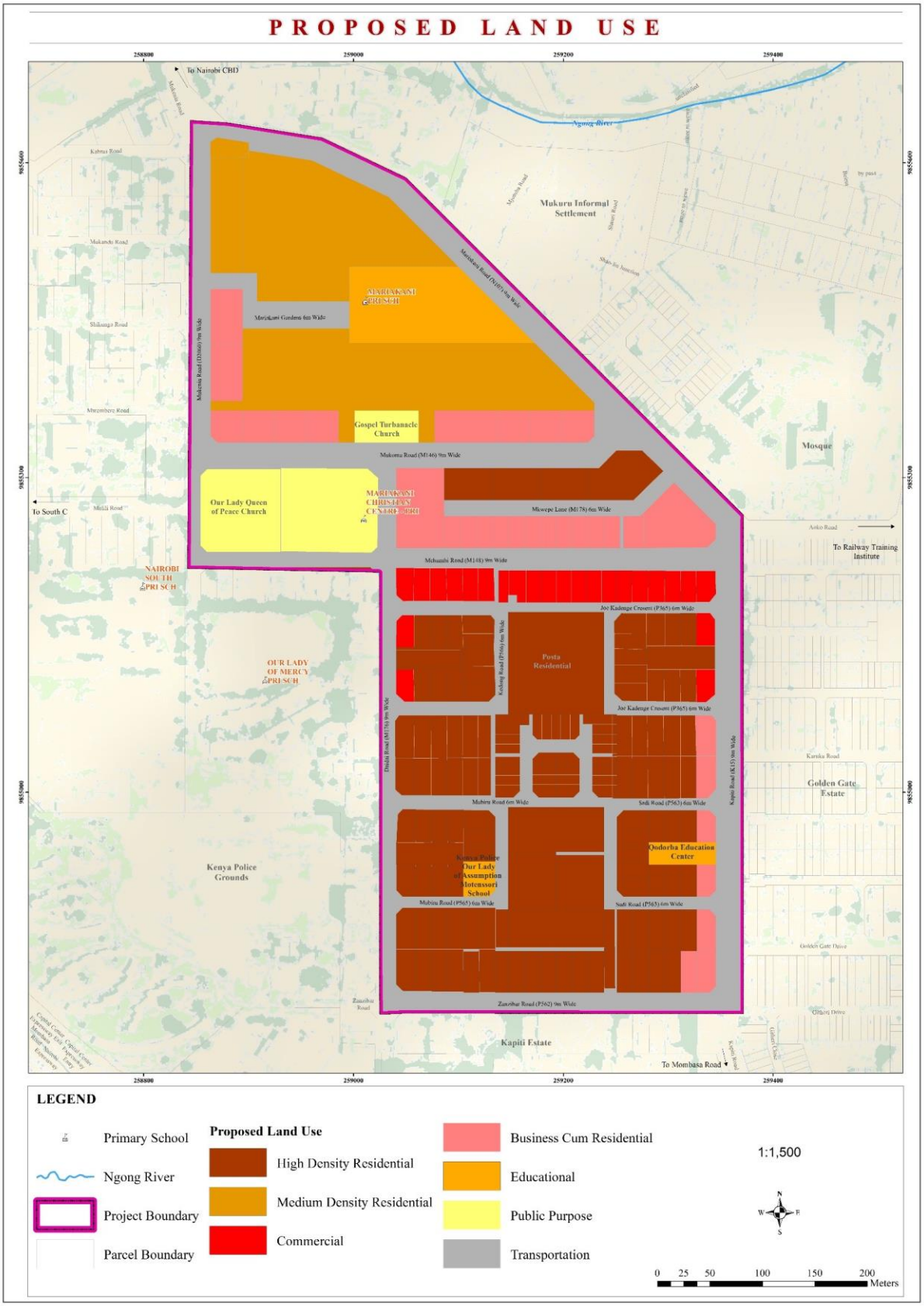
Source: Author 2024

6.5 Proposals and Strategies

STRATEGIES	PROJECT
Incorporation of car-free neighborhoods	Provision of narrow streets i.e., Shopping Center. It should be entirely accessed by walking and cycling.
Compact Developments	Promote development of mixed-use development which will help in creating short trips through KARA.
Improvement of NMT routes	Provision of complete streets; Cycling lane, sidewalks, street furniture etc.
Modal Shift	Formulate policies for effective modal shift from car centric to walking and cycling by offering incentives to cyclists i.e., bike parking for free and even provision of its facilities at school and work places
Green Infrastructure	Provision of drainage gardens which will increase pavement permeability with underground reservoir to help reduce flooding and improve safety and urban landscape
Improvement of Public Transport	• Introduction of ITS to enhance swift circulation of buses through Vehicular-vehicular communication and vehicular- Infrastructure communications and even commuters having the bus information. • Regulating the informal public transport system through licensing

6.6 Proposed Land Use

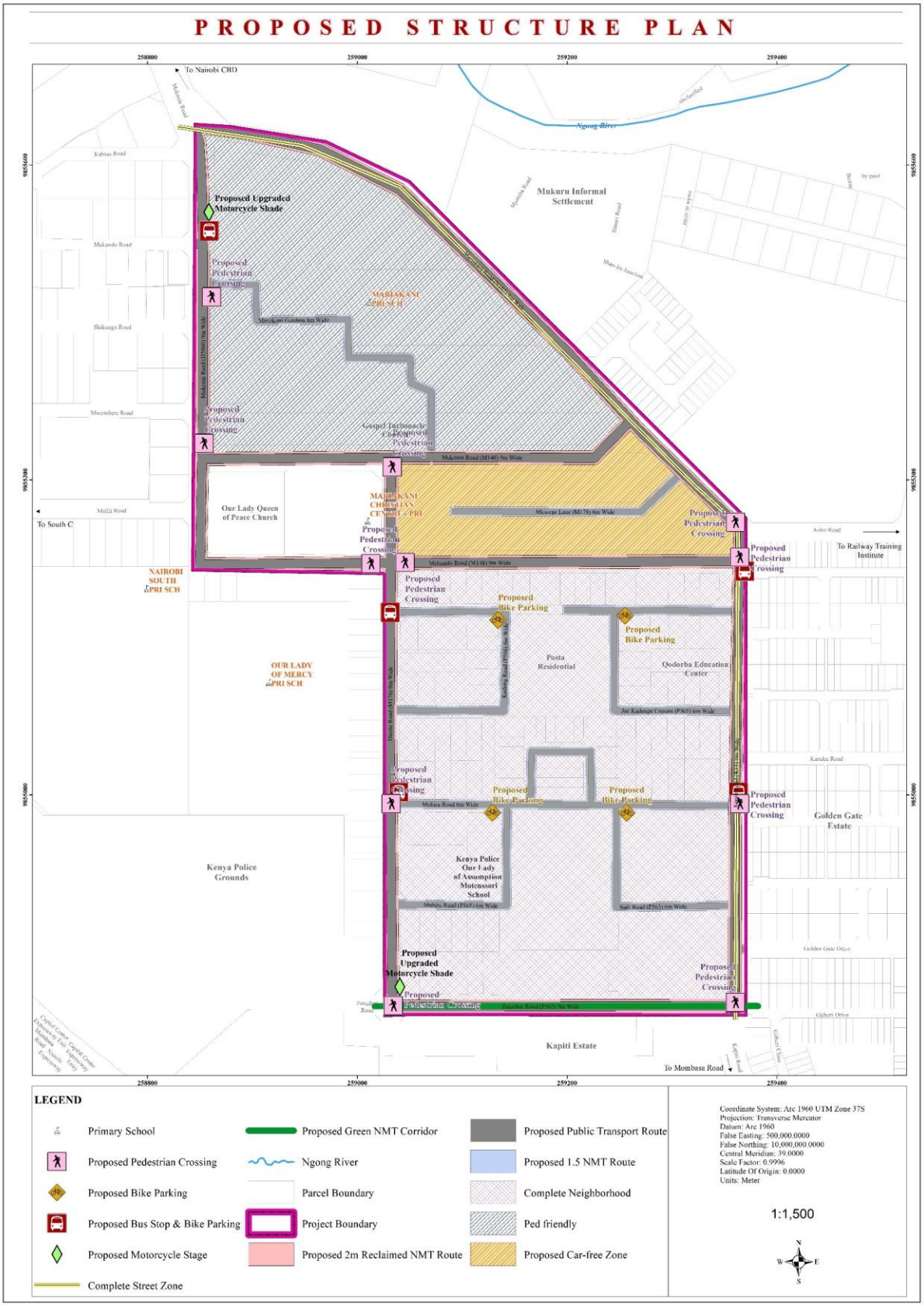
For effective movement and circulation within a neighborhood mode of transportation has to be harmonized with the mixed and compact developments, this will help initiate short distance trips which will encourage walking and cycling and having car free neighborhoods. The research opted for horizontal and vertical compact mixed-use development. See map 6 below;



Map 4: Proposed Land Use

Source: Author 2024

6.7 Proposed Structure Plan



Poster 10: Proposed Structure Plan

6.8 Proposed Master Plan

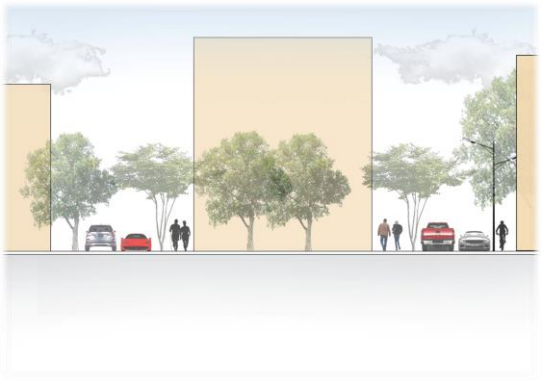
Poster 11: Proposed Master Plan

6.9 Master Plan Perspectives & Sections.

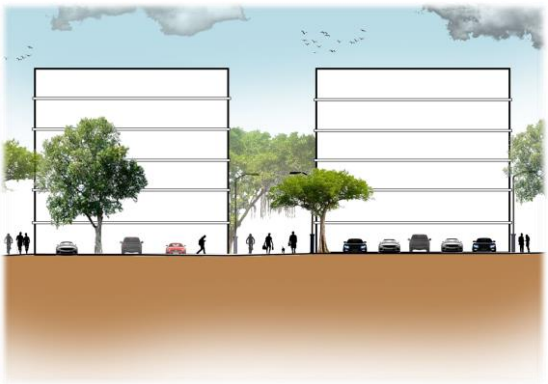
The sections and perspectives give detailed view of the streets and how it relates with human traffic including those walking and cycling. See the poster 11 below;

MASTER PLAN SECTIONS & PERSPECTIVES

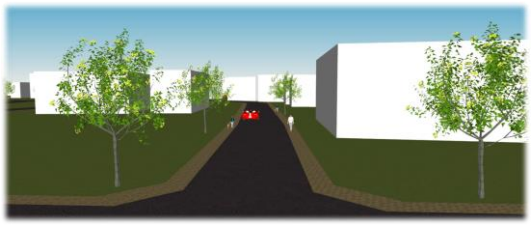
- Cross section along Daidai road showing the generally flat terrain and high rise buildings within South B.



- Cross section showing Sadi road. The NMT is complete with tree shades and lighting.



- A cross section of Mkwepe lane showing a complete car-free street.



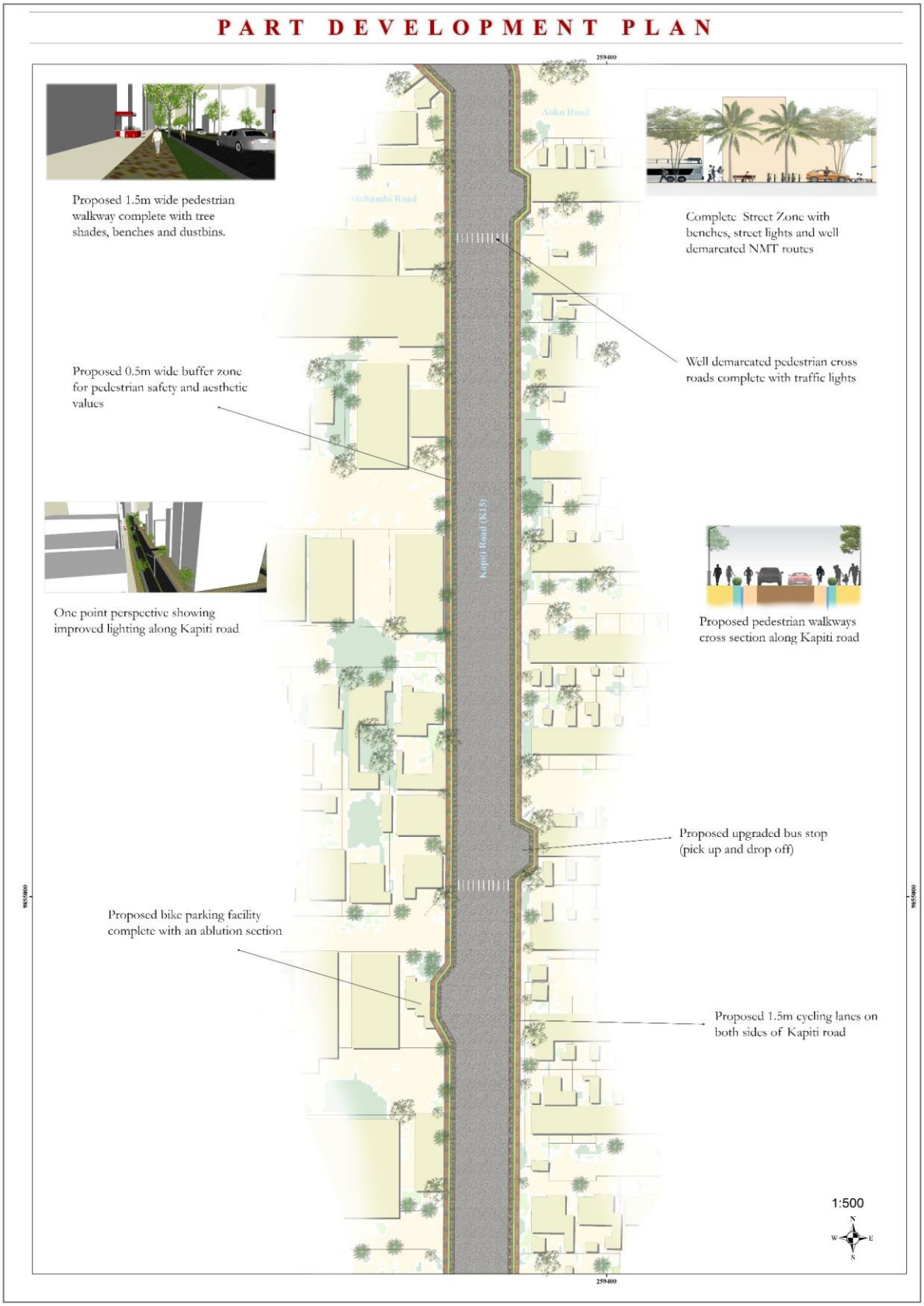
- A one point perspective showing the general different transport means within South B.

Poster 12: Master Plan Perspective and Sections

Source: Author 2024

6.10 Part Development Plan

Detailed street design was done along Kapiti Road and the intersection of Mchumbi road, Kapiti Road, Mariakani road and Aoko road a high vehicular-vehicular and pedestrian-vehicular conflicts. See the poster 12 below;



Poster 13: Part Development Plan

Source: Author 2024

6.11 Policy Action and Justification

6.11.1 Policy Recommendations

Area licensing scheme

Upon actualization of a car free neighborhoods and Shopping Center, a policy should be developed to enforce parking within the restricted area. For cases of charges if found obstructing the law is should be high and payment be made through electronic pricing schemes

Parking incentives

The employers and government should incentivize workers who ride bicycles i.e., availability of ablution facilities within the work premises for freshening up and bike parking facilities

Public transport operators training policy

Operators like drivers and touts should undergo refresher studies on nurturing their behavior and upskilling them on the importance of respecting other road users and use of electric vehicles paradigm shift

Sustainable Development Goals

SDG No. 11 which advocates for sustainable cities and urban areas. Cities and urban areas should adopt sustainable urban transport systems

Nairobi NMT Policy

The policy should take into account other areas within Nairobi for purposes of NMT construction unlike concentrating on CBD. This development should also incorporate principles of complete streets i.e., bike parking facilities and street furniture.

6.12 Implantation Matrix

STRATEGIES	PROJECT	Duration	Term	Amount (million)	Financier	Actor
Car-free neighborhoods	Provision of narrow streets to promote cycling & walking. Provision of bike parking facilities Formulation	2-3	Long term	100	Africa Development Bank	KURA & NCCG
Compact Developments	Development of mixed-use development (phases 1)	2-3	Long term	300	National Govt & European Union	State Dept. for housing & Planning
Improvement of NMT routes	Provision of complete streets; Cycling lane, sidewalks, street furniture.	1-2	Short term	100	International Development Association	NCCG
Modal Shift	Formulate policies and plans and designs for effective modal shift from car centric to walking and cycling Mass rapid transit system.	1-2	Short term	300	European Investment Bank	NaMATA & KURA

	Introduction of Intelligent Transport System					
Green Infrastructure	Provision of drainage gardens (urban landscape) Green corridors	1-2	Short term	50	County Government	NCCG & KURA

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Appendices

Household Questionnaire

TECHNICAL UNIVERSITY OF KENYA
Education and Training for the Real World

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

SCHOOL OF ARCHITECTURE AND SPATIAL PLANNING

DEPARTMENT OF SPATIAL PLANNING AND DESIGN

DESIGN RESEARCH PROJECT

EVALUATING THE ROLE OF ACTIVE MOBILITY IN ALLEVIATING TRAFFIC CONGESTION. A CASE STUDY OF SOUTH B, NAIROBI COUNTY

The information you provide will be treated with utmost confidentiality and will be used for educational purposes only.

SECTION A: Interviewer

Name of the interviewer……

Date……

Location……

Code…….

SECTION B: Respondent's Background details

1. Name of the respondent (optional)……

1. Age: ……. years

2. Gender: Male ☐ Female ☐

3. Marital status: Single ☐ Married ☐

SECTION C: Educational Level

1. Highest level of education:

None Sch. ☐ Primary Sch. Dropout ☐ Completed Primary ☐ Secondary ☐

2. Tertiary;

Certificate ☐ Diploma ☐ Degree ☐ Post Graduate ☐

SECTION D: Employment

1. Employment:

Unemployed □ Government □ Private organization □ Parastatal organization

□ Self-employed (Specify):
…….

□ Other (specify):
……
……

2. If employed, place of employment?

□ Within the South B

□ Industrial Area

□ City Centre (Nairobi, CBD)

□ Other areas within Nairobi
(Specify)……..……

□ Other areas outside the region
(Specify)…….……

SECTION E: Transportation

1. Main Modes of Transport and Purpose of travel

Mode of Transport	Tick where applicable	Purpose of travel (School, Work, Recreation, Shopping & Others)
Walking		
Cycling		
Public transport		
Private transport		
Boda-boda		
Motorcycle		

2. What is the average travel cost per day?
   ……
   …… ……
3. What are your main travel destinations across the day? (e.g house-school-shopping-house)
   ……
   ……
4. NMT Infrastructure Conditions (walking and cycling lanes/paths)

Good	
Fair	
Poor	
Very Poor	

SECTION F: GENERAL HABITS

1. How often do you walk and for what purpose (e.g., errands, leisure)?

Purpose of trip	**Frequency of walking**				
	Never	Rarely (once)	Occasionally (2-3 times a week)	Frequently (4-5 times a week)	Daily
School					
Work					
Leisure					
Errand i.e., Shopping					

2. How often do you cycle and for what purpose?

Purpose of trip	**Frequency of Cycling**				
	Never	Rarely (once)	Occasionally (2-3 times a week)	Frequently (4-5 times a week)	Daily
School					
Work					
Leisure					
Errand i.e., Shopping					

3. Do you use any other forms of active mobility (e.g., scooters, skateboards)? If yes, please specify and indicate frequency
    - ……
    - ……...
4. In your neighborhood, which roads do you prefer cycling and walking on? And state the reason(s) for your preference
    - Name of the Road ……
    I. …….
    II. …….
    III. …….
5. What is the waiting time for other modes of transport you use other than walking and cycling? Answer if you use public mode of transportation or private mode of transportation (i.e., matatus, private cars, Uber, Bolt etc.)
    - ……
    - ……
6. With the choice of mode of transportation chosen above (in No.5) how long do you take to commute to your destination?
    - 15-30min

- 31-45min
- 46-60min

7. What factors typically influence your choice of transportation for everyday trips? (Select all that apply)
    - Convenience
    - Time
    - Cost
    - Distance
    - Availability of safe infrastructure
    - Personal preference
    - Other (please specify)

SECTION G: PERCEPTIONS AND SAFETY:

1. How safe do you feel while walking in your neighborhood?
    - Very safe
    - Somewhat safe
    - Neutral
    - Somewhat unsafe
    - Very unsafe
2. How safe do you feel while cycling in your neighborhood?
    - Very safe
    - Somewhat safe
    - Neutral
    - Somewhat unsafe
    - Very unsafe
3. What are the biggest challenges you face when using active mobility options? (Select all that apply)
    - Lack of dedicated lanes or sidewalks
    - Poor condition of infrastructure (e.g., potholes, uneven surfaces)
    - Unsafe intersections
    - Traffic congestion
    - Lack of parking facilities for bicycles
    - Feeling of vulnerability to traffic

- Weather conditions
- Other (please specify)

4. What improvements would encourage you to use active mobility more often? (Select all that apply)
    - Creation of dedicated lanes or sidewalks
    - Improved maintenance of existing infrastructure
    - Safer intersections with traffic signals
    - Reduced traffic congestion
    - More secure bicycle parking facilities
    - Public awareness campaigns promoting active mobility
    - Educational programs on safe cycling practices
    - Financial incentives (e.g., subsidies for bicycles)
    - Other (please specify)

SECTION F: CYCLING GROUPS

1. Do you belong to a cycling group
    - Yes
    - No
2. If yes, what is the name of your cycling group?.....
3. What are the advantages of joining a cycling group ride/cycling group?
    I. ……
    II. ……
    III. ……
    IV. ……

SECTION G: PERCEPTION ON CYCLING

1. Is the cycling system being supported consistently by the law with active participation of local government, the police and other community organizations?
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly Disagree
2. Is cycling seen and treated as a strategic component of the city's overall sustainable development strategy

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly agree

3. Is the cycling program and city cycling generally fairly treated by the media?
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly agree
4. How do drivers and the community at large regard urban cyclists?
    I. …….
    II. …….
    III. …….
    IV. …….

Key Informant Interview

SECTION H: Nairobi City County Transport Planner/Engineer

Date	
Respondent's name	
Designation	

a) What are the policies and guidelines provided for active mobility (walking and cycling)?

b) What are the current challenges facing the City in the provision of walking and cycling infrastructure in the City?

c) What are the current project plans for development of walking and cycling infrastructure in the city and in particular any plans for South B estate?

d) What are the current regulations in place to help develop a mixed-transportation land use?

e) What are the political hurdles that face your department in provision of safe walking and cycling infrastructure?

SECTION I: KURA

Date	
Respondent's name	
Designation	

a) What are the policies and guidelines provided for active mobility (walking and cycling)?
b) What are the ongoing and proposed road projects in the South B area?
c) Is there provision for walking and cycling in the proposed projects?
d) What challenges does your department face in the provision of walking and cycling infrastructure in the City and in particular South B Estate?
e) What are the goals of these projects?

Transport Survey

SECTION J: TRANSPORT SURVEY

Transport Survey (Traffic Log Sheet)

a) Interviewer …… c) Interview Day……
b) Site Coordinates…… d) Interview site location……

(e.g., Traffic count is within the time interval of 15min off either peak or off-peak hours)

Time	**Morning Peak (8:00-9:00) am**							
Time Interval	**Vehicle type/Mode of Movement**							
	Pushcarts	**Walking**	**Bicycles**	**Prt (Cars)**	**Matatu 14 Seat**	**Pick Up**	**Bus**	**LGV 2 axles**
8:00-8:15								
8:16-8:30								
8:31-8:45								
8:46-9.00								
Total								
Mid-Day Off-peak (12:00noon-1:00pm)								
12:00-12:15								
12:16-12:30								
12:31-12:45								
12:46-1:00								
Total								
Evening Peak (5:00-6:00) pm								
5:00-5:15								
5:16-5:30								
5:31-5:45								

5:46-6:00								
Total								

Notes……

…...……

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