PART III

ENVIRONMENT
AND
SOCIAL CONSIDERATION

CHAPTER 13

STRATEGIC ENVIRONMENTAL ASSESSMENT APPROACH

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13.1 ENVIRONMENTAL APPROACH TO THE MASTER PLAN STUDY

13.1.1 Strategic Environmental Assessment Approach

(1) General

Strategic environmental assessment (SEA) is a systematic and comprehensive process to assess environmental impact of policies, plans and programs and to incorporate the environmental concerns into higher level decision-making than is possible by project-level EIA. The scope of SEA is generally broader than that of project-level EIA in terms of both geographic extent of possible impact and options to be considered for both structural and non-structural measures. SEA gives at least equal weight to environmental and social objectives as given to economic objectives in formulating any policy, plan or program. Refer to Appendix 13 for the EIA and SEA of Kenya.

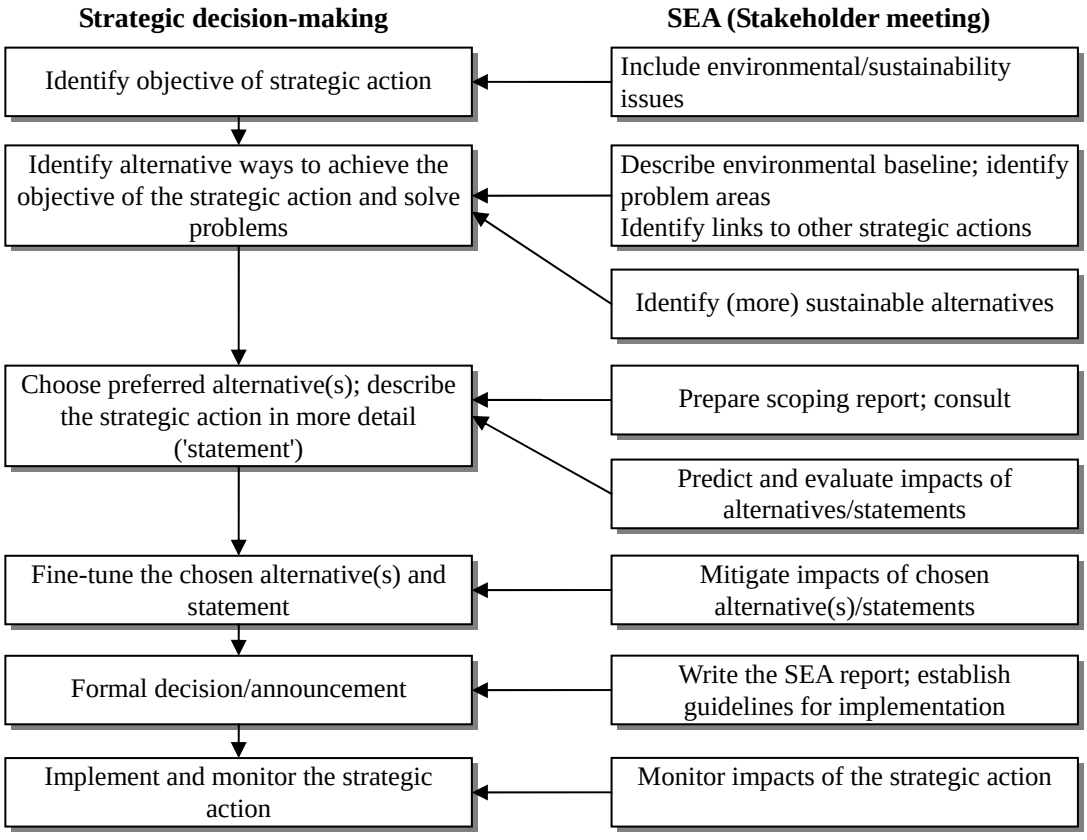


FIGURE 13.1-1 PROCEDURE OF SEA APPROACH

Essential features of the SEA process are (1) to make all the information related to decision-making on any development initiative open to the public and based on it, (2) to cultivate social consensus on the development initiative through a series of meetings with a

wide range of stakeholders in order to ensure transparency and accountability of the decision-making process. The new JICA guidelines outlined above are generally in line with the SEA approach.

The general procedure of SEA is shown in Figure 13.1-1.

(2) Application of SEA approach to Nairobi Urban Transport Planning

In line with the growing international consensus that SEA could be an effective tool to reflect environmental and social concerns into higher level decision-making, SEA is applied to the Nairobi urban transport planning. In applying SEA, the environmental laws and regulations in Kenya shall be properly referred to as well as the new JICA guidelines so that the national policy of Kenya will be reflected in the planning for poverty alleviation, optimum use of natural resources and people's welfare.

The SEA process is effected through various tasks adopted for planning by the JICA Study Team in close collaboration with the Kenyan counterpart and by holding a series of stakeholders meetings to disseminate and exchange information. At the initial planning stage, a problem structure analysis and a stakeholder analysis were conducted to set up a proper framework for the subsequent tasks and stakeholders meetings.

13.1.2 Initial Analyses for SEA

(1) Problem structure analysis for the Nairobi Urban Transport

Problem structure analysis

The Nairobi Metropolitan Area currently faces various problems related directly and indirectly to transportation. They include serious traffic congestion, increasing traffic-related pollution and accidents, and degrading urban environment. The traffic congestion is caused by many interacting factors, including inadequate public transportation, improper parking, squatters and slum areas and the increase in private cars. While economic growth tends to increase the use of private cars, traffic congestion undermines the economic growth through high transaction costs and waste of fuels and travel time. The constrained economic growth has varying effects on different income classes, often resulting in widening disparities.

These and other problems are interrelated to one another. A problem structure analysis is a method to examine these interrelationships in a macroscopic way without getting into details. The analysis is usually conducted at an early stage of development planning to identify more significant problems to be alleviated through planned development efforts and to clarify more important interactions. The analysis is used to establish objectives and basic strategy for the planned development.

Problem structure of the Nairobi urban transport

The problem structure analysis is applied to the Nairobi urban transport. All the problems are enumerated first and some problems are combined to define larger problems expressed in generic terms. Interrelationships between identified problems are examined in a macroscopic way. A problem structure is constructed by using only the more important interactions between identified problems.

A problem structure of the Nairobi urban transport is constructed as shown in Figure 13.1-2. In this figure, more fundamental problems (problem factors) are placed to the left and more observable problems (problem phenomena) are placed to the right. Problem factors and phenomena are interrelated through a complexity of various problems, and only the more important interrelationships are shown in the figure.

(2) Establishing objectives and strategies

Objectives

Objectives for the Master Plan are defined on the basis of problem phenomena identified by the problem structure analysis. Based on the idea of the Strategic Environmental Assessment (SEA), major problem phenomena are identified in economic, social and environmental aspects. These are low economic growth and widening disparities in economic levels, increasing urban crimes and aggravating urban poverty in social aspects, as well as increase in traffic related pollution and increasing pressure on the Nairobi National Park and other reserves in environmental terms.

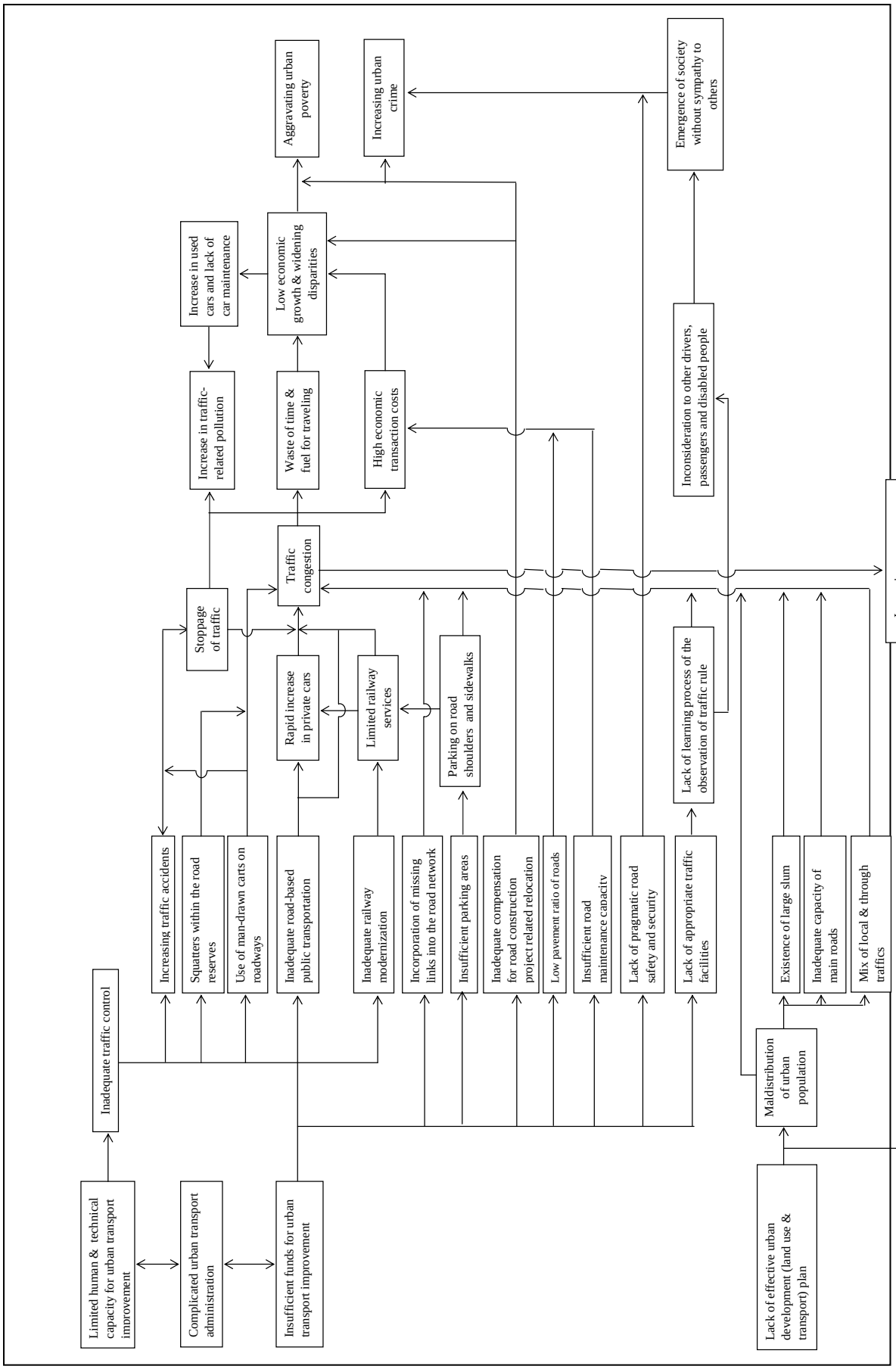


FIGURE 13.1-2 PROBLEM STRUCTURE OF THE CURRENT NAIROBI URBAN TRANSPORT

Corresponding to these problem phenomena identified in economic, social and environmental aspects, objectives for the Master Plan are established also in the economic, social and environmental sectors. They may be defined as follows:

- Economic objective
  Contribute to the economic growth of the Nairobi Metropolitan Area through reducing the waste of time and fuels for travelling and the high economic transaction costs due to the serious traffic congestion particularly at roundabouts and during peak hours.
- Social objectives
  Enhance social capacity and stability of urban community and achieve poverty alleviation and reduction of urban crimes and traffic accidents in the NMA through the improvement of urban transportation.
- Environmental objectives
  Improve the quality of living environment in the Nairobi Metropolitan Area through the reduction of traffic–related pollution and ensuring preservation of the Nairobi National Park and other reserves by planned urban development with appropriate land use and transport network.

Each of these objectives should be emphasized equally in formulating the Master Plan for urban transport in the Nairobi Metropolitan Area. This is the basic idea of SEA. Pursuing these objectives is in line with the national policy for poverty reduction, optimal use of natural resources and people's welfare, and contributes to the national goal of sustainable development. The structure of objectives and strategies of SEA is shown in Section 13.2 of Appendix 13.

Basic strategy

More effective measures should be formulated to improve the Nairobi urban transport system by addressing more fundamental problems at the root of various problems. The basic strategy for the Master Plan, therefore, should be established to guide the formulation of specific measures based on the problems factors identified by the problem structure analysis. These factors are limited to human and technical capacity, insufficient fund and complicated administration for urban transport improvement, including outdated urban development (land use and transportation) plan for the Nairobi Metropolitan Area. Therefore, the basic strategy for the Master Plan may be established on the basis of the following three components:

- Establishment of spatial development structure of the Nairobi Metropolitan Area to minimize generation of long distance trips and mixture of local and through traffics,
- Enhancement of human and technical capacity for urban transport management to improve road – based public transportation and traffic control, and

- Promotion of coordinated planning and implementation of cost – effective measures to improve the urban road network by related agencies having limited funds, respectively.

Transport objectives, targets and strategies

Under the overall objectives established, more specific transport objectives are derived, and expected levels of attainment for the transport objectives specified. Specific measures to attain these target levels are formulated. In formulating any measures, it is clarified how they will contribute to the different overall objectives (economic, social and environmental) to varying degrees.

In line with the basic strategy, transport strategies are established, and specific measures formulated under these strategies. The basic strategy will ensure that complementary measures are formulated for realistic and cost effective improvement of the Nairobi urban transport system.

(3) Stakeholder Analysis

Purpose and scope

Any development initiative involves a range of stakeholders – those who would be affected positively or negatively by the implementation of the initiative. A stakeholder analysis is conducted to clarify meaningful ways of participation by different stakeholders in the formulation and implementation of any development initiative. The stakeholder analysis on a development project can serve the following purposes:

- to draw out interests of stakeholders in the project and its effects,
- to identify conflicts of interests between stakeholders involved in the project implementation,
- to help identify such relations between stakeholders that may enable cultivation/strengthening of project sponsorship, ownership and cooperation, and
- to help assess appropriate types of participation by different stakeholders in project planning and implementation.

A simple stakeholder analysis is conducted here for the Master Plan to identify a specific range of stakeholders to be involved first, in the master planning stage, and to clarify how they should participate in the planning process. These stakeholders will initially form the stakeholders' forum, which will be the main venue for public consultation and information dissemination for the Study.

Identification of stakeholders

Ultimate stakeholders for the Master Plan are Kenyan people in general and residents of Nairobi city and its environs. Their interests are represented at different administrative levels and by chief executives and personnel of central and local governments. Their interests are affected, positively or negatively, by many others.

An initial list of stakeholders for the Master Plan was prepared by the Kenyan Counterpart Team. The list was expanded through discussion between the JICA Study Team and the Kenyan Counterpart Team. The identified stakeholders have been classified into primary stakeholders consisting of more direct and less direct stakeholders, and secondary stakeholders. Primary stakeholders are those ultimately affected by the implementation of the plan. Secondary stakeholders are further classified into (1) road agencies and sub agencies, (2) Central Government agencies, (3) other public institutions, (4) business communities, and (5) intermediaries such as NGO's and aid organizations. They are listed in Table 13.1-1.

Assessment of stakeholders' importance and influence

The identified stakeholders are assessed for their importance and influence with respect to the realization of planned projects and, their effects. Influence is the power which stakeholders have over decisions to be made related to the projects. It is the extent to which stakeholders are able to persuade or coerce others into making decisions. Importance indicates the priority given to satisfying stakeholders' needs and interests through plan implementation of the projects.

For each stakeholder identified above for the Master Plan, assessment of importance and influence is made into three classes: high, medium and low. Results are also shown in Table 13.1-1.

Appropriate participation of different stakeholders

From the assessment of importance and influence of stakeholders, four groups have been identified for different combinations of assessed levels of importance and influence. These groups are summarized in Table 13.1-2. For each group, appropriate participation is indicated in Table 13.1-3.

TABLE 13.1-1 IDENTIFICATION OF STAKEHOLDERS AND ASSESSMENT

Stakeholders	Assessment* Importance	Influence
1 Primary Stakeholders		
1a. More direct stakeholders		
・ Nairobi City Council	H	H
・ Municipalities of Kiambu, Thika, Limuru and Mavoko	H	L
・ Nairobi CBD Association	M	M
・ Matatu Welfare Association	H	M
・ Kenya Bus Services	H	M
・ Intermediate Technology Development group, East Africa (ITDG – EA) - Non Motorized Group	H	L
1b. Less direct stakeholders		
・ Town Councils of Machakos, Kajiado and Naivasha	M	L
・ Kenya National Council for Women in Employment	M	M
・ Kenya Private Sector Advocacy Group	M	M
・ Kenya Alliance of Residents Association	L	L
・ MP's (8 of them in the Nairobi area)	H	H
2 Secondary Stakeholders		
2a. Road agencies and subagencies		
・ Roads Department, MRPW	H	H
・ District Road Committees	H	M
・ Kenya Wildlife Services	M	M
・ Urban Development Departments, MOLG	H	M
2b. Central Government agencies		
・ Ministry of Tourism and Wildlife	M	M
・ MOLG	H	H
・ MRPW	H	H
・ Ministry of Planning	M	M
・ Ministry of Finance		
・ Ministry of Transport		
・ Ministry of Lands and Housing		
・ Ministry of Environment and Natural Resources		
・ National Environmental Management Authority		
・ KRB	H	H
2c Other public institutions		
・ Commissioner of Police	M	L
・ Provincial Commissioner (Central)	M	M
・ Kenya Railways	L	L
・ Kenya Airports Authority	L	L
・ University of Nairobi – Urban Dev't & Civil Engrg. Dept.	M	M
・ Kenya Institute for Public Policy Research and Analysis	M	L
2d. Business communities		
・ Automobile Association of Kenya	M	M
・ Kenya Association of Manufacturers	M	L
・ Kenya Association of Tour Operators	M	L
2e. Intermediaries		
・ National Organizations of NGO'S	M	H
・ ATS – CLDA, KBS-GTZ, COTU KFW	M	M
・ EC, WB, ILO, AFD	H	M
・ GTZ, SIDA, CIDA, JICA	M	M
・ Media	M	H

TABLE 13.1-2 IDENTIFICATION OF STAKEHOLDER GROUPS BASED ON IMPORTANCE AND INFLUENCE

Group	Stakeholders
Group 1 (H,H)	Nairobi City Council MP's Roads Department, MRPW MOLG MRPW KRB NEMA EU, WB, ILO, AFD
Group 2 (H, M/L)	Municipalities of Kiambu, Thika, Limuru and Mavoko ITDA – EA – Non Motorized Group Matatu Welfare Association Kenya Bus Services Ministry of Lands & Housing Ministry of Environment and Natural Resources Urban Development Department, MOLG
Group 3 (M/L,H) (M,M)	Media National Organizations of NGO's Nairobi CBD Association Kenya National Council for Women in Employment Kenya Private Sector Advocacy Group Kenya Wildlife Services Ministry of Tourism and Wildlife Ministry of Planning Ministry of Finance Ministry of Transport Provincial Commissioner (Central) University of Nairobi Automobile Association of Kenya ATA-CIDA, KBS-GTZ, COTU, KFW GTZ, SIDA, CIDA, JICA
Group 4 (M,L)	Town Councils of Machakos, Kajiado and Naivasha Commissioner of Police Kenya Institute for Public Policy Research and Analysis Kenya Association of Manufacturers Kenya Association of Tour Operators

* H: high, M: medium, L: low

TABLE 13.1-3 ASSESSMENT OF APPROPRIATE PARTICIPATION

Group	Assessment		Appropriate Participation
	Importance	Influence	
1	H	H	Need to establish good working relationships for effective collaboration and support
2	H	M or L	Need to be treated carefully so that their interests will be protected and their needs satisfied
3	M or L M	H M	Need to be well informed and consulted to reduce risk of their negative intervention
4	M L	L L	Need to be informed of possible involvement in the subsequent stage

13.2 STAKEHOLDERS MEETINGS

13.2.1 Preparation of Stakeholders Meetings

(1) Schedule of the stakeholders meetings

Stakeholder meetings are organized jointly by the JICA Study Team and the Ministry of Roads and Public Works (MRPW), through public announcements. The announcement for the initial stakeholder meeting was made on 24th August 2004 and on the19thof January 2005 for the second and third stakeholder meetings. The schedule of stakeholder meetings and its preparation works are shown in Figure 13.2-1. Announcements were made through three Kenyan newspapers and other media such as radio. Because of time constraint, preparation works for the second and third stakeholder meetings were carried out at the same time. A number of organizations and individuals responded to the announcement and expressed their interest to attend the stakeholder meetings. The MRPW then finalized the list of participants and sent out invitation letters to all of them.

(2) Participants of the First Stakeholder Meeting

The number of participants who were invited to the first stakeholder meeting was 155. 81 people participated in the first stakeholder meeting, and 88 people in the second while the third meeting attracted 61 participants.

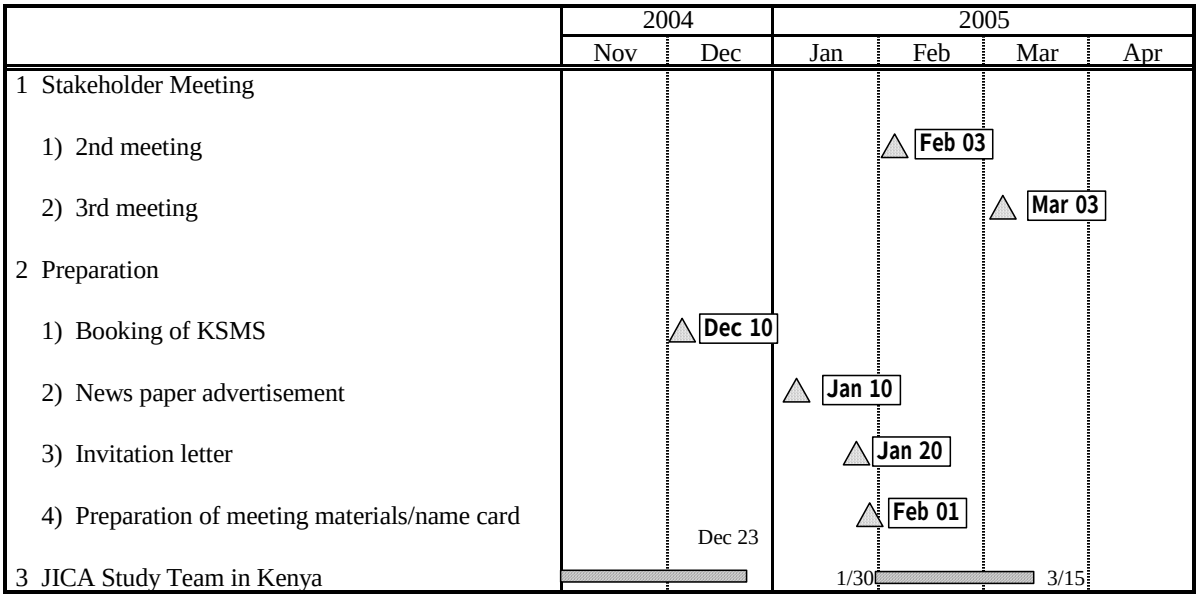


FIGURE 13.2-1 SCHEDULE OF STAKEHOLDERS MEETING

13.2.2 Discussions of the Stakeholder Meetings

(1) Meeting Programme

The Programs of the first to third stakeholder meetings are shown in Section 14.4 of Appendix 14. A set of presentation material for each of the stakeholder meeting was prepared by the JICA Study Team and distributed to all the participants of the respective meetings at the time of registration.

(2) Summary of Stakeholder Meetings

Minutes of the first to third stakeholder meetings are shown in Section 14.5 of Appendix 14. Contents of the first to third stakeholder meetings are summarized as follows:

- Lack of road maintenance is a contributor to the transport problems;
- Bus bays should be appropriately constructed so as to accommodate more vehicles;
- Facilitation of public transportation including railway is considered necessary;
- Road shoulders and NMT facilities need to be improved;
- Environmental Impact Assessment (EIA) should be carried out for the Southern Bypass Construction Project before construction and EIA also undertaken on the effect of construction of the Ngong Road on the Forest as well as the local society;
- Security and safety is the key in transport;
- Slum demolition should be carried out with a more humanistic approach;
- A metropolitan land use plan should be well developed to check the uncontrolled developments that are currently taking place;

- There is a need to improve security and parking areas in the CBD; and
- Construction of missing links is very important to implement.

13.2.3 Reflections of the Results of Stakeholder Meetings

(1) Discussions with Individual Stakeholders

During the first stakeholders meeting, a number of organizations expressed their concerns over the traffic issues of Nairobi Metropolitan Area. Their comments appear to be valid such that they would make appropriate contributions to the Master Plan Study. Therefore the Study Team invited individual organizations for separate stakeholder meetings. The following is a summary of the results of these meetings:

- Safety, comfort and convenience of commuters by bus, matatu and railway should be considered as high priority;
- Traffic rules are largely ignored by most road users. Thus, discipline and capacity building to teach traffic rules should be considered;
- Appropriate parking areas in CBD are essential;
- Traffic safety for non-motorised mode of transportation should be ensured;
- Decongestion of traffic with particular attention to the quiet areas of Nairobi should be considered and that double carriage way does not necessary lead to decongestion of traffic;
- Environmental impact assessment of the Southern Bypass Project should be duly carried out; and
- At any rate, the existing road facilities including bus bays, traffic signals, sidewalks, street lighting, pedestrian crossings, etc. should be duly updated and/or improved.

(2) Scope of IEE Study

Based on the discussions of the first stakeholders meeting, the scope of Initial Environmental Examination is elaborated as follows:

- Obtaining information on the basic data on social and natural environment relevant to the traffic issues of the Study Area;
- Interview survey of key informants of the traffic issues prevalent in the Study Area;
- Carry out survey on the extent of resettlement if in relation to the construction of missing links and railway rehabilitation;
- Carry out survey on the forest and any other conservation areas affected by the implementation of bypass projects;
- Generate suggestions on the improvement of the traffic issues in the Study Area in terms

of motorised and non-motorised mode of transport including road networks, public transportation systems, public health and any other social considerations relevant to the Master Plan; and

- Carry out initial environmental examination in the format relevant to the Master Plan.

Accordingly therefore, an initial environmental examination was carried out by local consultants.

13.2.4 Effectiveness of the Stakeholder Meeting

The following outcome is noted as a result of stakeholder meetings held during the study period:

- During the initial stage of the Master Plan Study, stakeholders concerned that the terms broadly and loosely defined;
- The second and third meetings provided a more explicit picture of the Master Plan to the stakeholders;
- Active participation of the general public at the stakeholder meetings was well achieved because of the information dissemination through media;
- Contents of the discussions of stakeholder meetings are incorporated as much as possible into the Master Plan Study; and
- The stakeholder meeting influenced the thinking of some organizations to participate more actively.

It is noteworthy that a number of NGOs and international organizations showed their interest in the Master Plan Study. Among them was UN-Habitat, one of the UN organizations based in Nairobi that possesses expertise on transport issues and its relationships to the urban poor, which is a part of their Kibera Slum Up-grading Project. After the first stakeholders meeting, UN-Habitat went on to seek a possibility to form a tripartite agreement with JICA and MRPW in order to get actively involved in the Master Plan Study. Accordingly, improvement on the conditions of transportation systems in Kibera slum were incorporated with the Master Plan Study. Furthermore, the expertise of UN-Habitat is shared with the government agencies related to the Master Plan Study and the JICA Study Team. UN-Habitat is likely to play an important and continuous role into the future as an effective tripartite agreement is realized.

CHAPTER 14

INITIAL ENVIRONMENTAL EXAMINATION

CHAPTER 14 INITIAL ENVIRONMENTAL EXAMINATION

14.1 PROCEDURE OF IEE

The scope of Initial Environmental Examination (IEE) was established and its TOR was prepared based on the discussions at the first stakeholder meeting on 11 November 2004. An IEE survey was started in December 2004 and its results are summarised in Appendix 14.

14.2 ENVIRONMENTAL LEGISLATION AND REGULATIONS IN KENYA

14.2.1 Environmental Management and Coordination Act of 1999

(1) Enactment of Environmental Management and Coordination Act

A large number of environmental action plans have been studied and reported in Kenya during the past decades. These have been the main policy for sustainable development and protection of the environment. Based on them, the Environmental Management and Coordination Act (EMCA) of 1999 was made effective on 14th January 2000. The Act has established the legal procedure for the environmental impact assessment which functions as a tool to control economic development projects causing significant environmental damage. Also the National Environmental Management Authority (NEMA) was created to oversee the EIA procedure of development projects. Section 3 of the EMCA provides that every citizen in Kenya is entitled to a clean and health environment and has a duty to enhance the environment.

(2) Procedure of EIA License Application

Under the EMCA of 1999, legislative supplement No.31 for EIA guidelines was gazetted on June 13, 2003. Based on the legislative arrangement, all major roads and those roads in scenic, wooded or mountainous areas and wetlands are subject to an EIA study. For a road construction project or any project that should take place involving the existing road, the project proponent should take the legislative procedure of EIA.

(3) Strategic Environmental Impact Assessment (SEA) in EMCA of 1999

The EMCA of 1999 provides for strategic environmental impact assessment. It is a procedure to study alternatives for any development initiative well in advance. In order to take effect of the SEA, the EIA guidelines stipulate under Section 17 that the evidence and adequacy of consultation and public participation are necessary. Specifically they require that there must be “at least three public meetings with the affected parties and communities to explain the project and its effects, and to receive their oral or written comments.”

The existing EIA legislation and guidelines have no explicit provision of resettlement action plan

(RAP). For the internationally funded economic development projects, project-affected persons (PAPs) should be adequately compensated if resettlement is involved. In November 2003, the MRPW produced a framework for the provision of roadside amenities, resettlement action plan and resettlement policy for the Northern Corridor Road Improvement Project as a precondition for the World Bank support.

Under the present EIA legislation and guidelines, action plan for involuntary resettlement cannot be explicitly studied nor carried out. Thus a framework for the provision of resettlement, such as the one elaborated for the Northern Corridor Road Improvement Project, should be made within the framework of the NUTRANS if any of it's components involve resettlement of the local residents.

14.2.2 Environmental Management System of the Government of Kenya

The environmental management system of the Government of Kenya is a centralized system that emphasizes that any projects undertaken should refer to the relevant ministries of the Government. Other than CCN, district governments must follow the chief's act enacted for any particular locality.

14.2.3 Other Laws and Regulations of the GOK Related to the Master Plan

At present, the Forest Act is undergoing major changes. The Land Acquisition Act, the Forest Act, the Wildlife Conservation Act and the Land Planning Act, to name but a few, are the major laws and regulations related to the Master Plan.

14.2.4 JICA Guidelines for Environmental and Social Considerations

JICA introduced its guidelines for environmental considerations in 1990, and used them to conduct screening of its projects that may have significant impact on the environment and the regional community, and to identify areas or aspects of more significant impact (scoping). As concerns on environment have broadened and diversified, and needs are recognized to make development and environment-related decision-making more accountable and related information open to the public. The revision of the guidelines has been contemplated.

The basic principle of environmental and social considerations, as stipulated in the new guidelines, is to ensure meaningful participation of a wide range of stakeholders and transparency of decision-making based on the regard for basic human rights and the democratic system of governance. It reflects the Japan's ODA policy to pursue equity in development through proper consideration of the socially weak or deprived, income and inter-regional disparities within a developing country, and impact of ODA projects on the environment and the society of the developing country.

Two essential conditions to reflect environmental and social considerations under the new JICA guidelines are (1) disclosure of related information to the public, and (2) public consultation with local stakeholders. These are basically the same as the SEA requirements.

14.3 SCOPING FOR INITIAL ENVIRONMENTAL EXAMINATION

Initial Environmental Examination (IEE) is carried out as part of the Master Plan. The scope of IEE is determined for different types of projects/ programs to be included in the master plan. Table 14.3-1 summarizes the scoping for IEE for seven different types of interventions. Some prospective projects/ programs are expected to generate positive impact as shown, whereby possible adverse impact and issues are highlighted below for consideration in the master planning.

Missing Link Construction Works:

- A number of locations are occupied by illegal structures, and their demolition may become a delicate social issue;
- Large size structures in expensive residential areas and business districts may be in existence, and compensation costs may be relatively high; and
- A series of stakeholder meetings with the local business and residential organizations will have to be held for appropriate communication between the government and the general public.

Intersection Improvement:

- Depending on the location where a business district encompasses the intersection, traffic jam during the construction period is expected, i.e. business in the area would have to slow down to a large extent; and
- A series of stakeholder meetings with the local business and residential organizations will have to be held for appropriate communication between the government and the general public.

Road Widening

- Depending on the location where road widening is considered necessary, large size structures in expensive residential areas may be in existence leading to exorbitant compensation costs in comparison to the cost of road widening works; and
- A series of stakeholder meetings should be held with the local business and residential organizations where significantly large areas are involved in the road widening.

Bypass Construction Works

- Where the route of road passes through, local households making use of the significant amount of the endowment of forest areas are negatively affected;
- Depending on the route and the feeder/link road to the bypass, a large number of local residents would have to be resettled; and
- A series of stakeholder meetings should be held with the local resident organizations and NGOs working for conservation of the natural environment as significantly large natural areas are involved in the route of bypass construction works.

Non-motorized Transport (NMT)

- There is no explicit government policy for provision of the infrastructure development for NMT system; and
- Less-privileged general public with very low income are still in need of NMT.

Bus and Matatu Route Development

- The past development of matatu fuelled traffic congestion; and
- Alternative route development for matatu and bus, and the reduction of the number of matatu and increase of the number of buses would introduce, to some extent, noise and exhaust gas pollution in the area where there was none or very little.

Railway Rehabilitation

- As long as the present railway reserve is used, there would be no significant social environment impacted by railway rehabilitation; and
- Maintenance works should create a relatively large number of job opportunities.

TABLE 14.3-1(1) SCOPING OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS (1/7)

a. Resolving missing links in Nairobi City

	Aspect of environment	With Project		Without Project	
		Rating*	Explanation	Rating*	Explanation
Social environment	1. Resettlement	A	Many small squatter shops occupy the road reserve.	A	Small squatter shops increase to occupy the road reserve.
	2. Regional economy	B	Removal of squatter shops will affect the local economy.	B	Contribution to the local economy continues.
	3. Transport & life facilities	B	Improvements on transport/life facilities associated with the road are expected.	B	No improvement of the present traffic issues.
	4. Regional communities	B	A new local community may replace the existing one.	B	Local community should continue to grow.
	5. Archeological & cultural resources	D	No important resource is known to exist.	D	No important resource is known to exist.
	6. Water right & communal land	D	No such right/common is known to exist.	D	No such right/common is known to exist.
	7. Health & sanitation	C	Inflow of construction workers may have negative effects.	B	Increase of undisciplined squatters may increase hazard on public health.
	8. Solid wastes	C	Construction debris needs to be properly treated.	B	Increase of undisciplined squatters may increase solid waste.
	9. Disaster risk	B	Improper designs or construction methods may increase the risk of riverbank breaking.	D	Not applicable
Natural environment	10. Topography & geology	D	No significant underground or earth works are expected.	D	No part of it is affected.
	11. Soil erosion	B	Minor erosion of riverbanks may occur.	B	Depending on the location, soil erosion increases.
	12. Groundwater	C	Bridge piers will not be deep enough to affect groundwater.	D	No part of it is affected.
	13. River & surface water regime	C	River crossing will not affect the river flow itself.	B	Increase of unmanaged solid waste may clog the drainage system.
	14. Coast & marine areas	D	No such areas are involved.	D	Not applicable
	15. Fauna & flora	B	Several common trees may need to be removed.	D	No part of it is affected.
	16. Meteorology	D	Project scale is small.	D	Not applicable
	17. Landscape	B	Road and bridge designs need to be appropriate and greenery provided to compensate for removed trees.	D	No part of it is affected i.e. no maintenance works are carried out and the landscape should slowly deteriorate.
Pollution	18. Air pollution	B	Air pollution will temporarily increase by construction vehicles.	B	Uncontrolled air pollution should prevail.
	19. Water pollution	B	River water may be contaminated by construction.	D	Not applicable
	20. Soil contamination	D	No such possibility is foreseen.	D	Not applicable
	21. Noise & vibration	B	Noise will increase due to increased traffic.	B	Uncontrolled noise and vibration pollution should prevail.
	22. Land subsidence	C	Light structure would not cause land subsidence.	D	Not applicable
	23. Offensive odor	B	Vehicle emission will cause some offensive odor.	B	Uncontrolled air/oror pollution should prevail.

* A: Significant impact expected; B: Some impact expected; C: Impact unknown;
D: Little or no impact (not subject to IEE or EIA)

TABLE 14.3-1(2) SCOPING OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS (2/7)

b. Improvement of intersections

	Aspect of environment	With Project		Without Project	
		Rating*	Explanation	Rating*	Explanation
Social environment	1. Resettlement	B	No involuntary resettlement is involved but some shops/residents may move out of the area.	B	No part of the local community is affected by the project but chronicle traffic congestion is not solved at all.
	2. Regional economy	A	Small shops and stalls need to be relocated.	B	Past trend of regional economy will prevail and may lose the change to modernize.
	3. Transport & life facilities	A	Crosswalks should be improved.	B	Past trend of transport and utitily should prevail.
	4. Regional communities	B	Some shops/residents may move out of the area to avoid heavier traffic.	B	Regional communities may not be significantly developed and will become too late to do any development intervention in the future.
	5. Archeological & cultural resources	D	No such resources are known to exist.	D	Not applicable.
	6. Water right & communal land	D	No such right/common is known to exist.	D	Not applicable.
	7. Health & sanitation	C	Inflow of construction workers may have negative effects.	B	Air polution may worsen at intersections.
	8. Solid wastes	C	Construction debris needs to be properly treated.	D	Not applicable.
	9. Disaster risk	D	Traffic accidents may increase.	B	Traffic congestion should chronically congest further.
Natural environment	10. Topography & geology	D	No effect is foreseen.	D	Not applicable.
	11. Soil erosion	D	Minor erosion during construction may occur.	D	Not applicable.
	12. Groundwater	D	No effect is foreseen.	D	Not applicable.
	13. River & surface water regime	D	No effect is foreseen.	D	Not applicable.
	14. Coast & marine areas	D	No such areas are involved.	D	Not applicable.
	15. Fauna & flora	B	A few common trees may need to be removed.	D	Not applicable.
	16. Meteorology	D	Project scale is small.	D	Not applicable.
	17. Landscape	A	Roundabout with greenery will be removed or affected.	B	Hitherto familiar landscape of roundabout would be maintained.
Pollution	18. Air pollution	B	Air pollution will temporarily increase by construction vehicles.	B	No change should take place i.e. chronicle air pollution should prevail in the future.
	19. Water pollution	D	No effect is foreseen.	D	Not applicable.
	20. Soil contamination	D	No such possibility is foreseen.	D	Not applicable.
	21. Noise & vibration	B	Noise may increase due to increased traffic.	B	No change should take place i.e. chronicle air pollution should prevail in the future.
	22. Land subsidence	D	No effect is foreseen.	D	Not applicable.
	23. Offensive odor	B	Vehicle emission will cause some offensive odor.		No change should take place i.e. chronicle air pollution should prevail in the future.

* A: Significant impact expected; B: Some impact expected; C: Impact unknown;
D: Little or no impact (not subject to IEE or EIA)

TABLE 14.3-1(3) SCOPING OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS (3/7)

c. Widening of existing roads

	Aspect of environment	With Project		Without Project	
		Rating*	Explanation	Rating*	Explanation
Social environment	1. Resettlement	B	Widening will be within the road right-of-way.	D	No resettlement is involved.
	2. Regional economy	B	Roadside stalls may be removed or relocated; transactions along the lanes may be facilitated.	B	No effect of project should take place i.e. regional economy may suffer from congested roads.
	3. Transport & life facilities	A	Positive effects are expected.	B	No effect of project should mean regional economy may not grow in the future.
	4. Regional communities	B	Local communities may be enlivened by increased transactions along the lanes.	B	Regional communities may not look at Nairobi as growth center.
	5. Archeological & cultural resources	D	No such resources are known to exist.	D	Not applicable.
	6. Water right & communal land	D	No such right/common exists within the road right-of-way.	D	Not applicable.
	7. Health & sanitation	C	More pleasant walks and bicycle rides may have positive health effects.	D	Not applicable.
	8. Solid wastes	B	Solid wastes may be generated by shops/stalls along the lanes.	D	Not applicable.
	9. Disaster risk	B	Increased non-motorized transport may decrease or increase casualties of traffic accidents.	D	Not applicable.
Natural environment	10. Topography & geology	D	No change is expected.	D	No significant changes of urban topography should take place.
	11. Soil erosion	B	Paved lanes will reduce soil erosion.	B	Present soil erosion should prevail.
	12. Groundwater	D	No effect is expected.	D	Not applicable.
	13. River & surface water regime	C	Reduced soil erosion will have positive effects on surface water quality.	D	Not applicable.
	14. Coast & marine areas	D	No such areas are involved.	D	Not applicable.
	15. Fauna & flora	D	No significant involvement is expected.	B	Depending on the location, portions of the existing greenery should be lost.
	16. Meteorology	D	No effect is expected.	D	Not applicable.
	17. Landscape	B	Paved lanes will improve the visual appearances of roads.	D	No significant changes of urban landscape should take place.
Pollution	18. Air pollution	B	Paved lanes will reduce the dust.	B	No change should take place i.e. present air pollution should prevail.
	19. Water pollution	C	Reduced soil erosion will have positive effects.	D	Not applicable.
	20. Soil contamination	D	No effect is foreseen.	D	Not applicable.
	21. Noise & vibration	D	No effect is foreseen.	B	Present noise and vibration should prevail.
	22. Land subsidence	D	No effect is foreseen.	D	Not applicable.
	23. Offensive odor	D	No effect is foreseen.	B	Present air/odor pollution should prevail.

* A: Significant impact expected; B: Some impact expected; C: Impact unknown;
D: Little or no impact (not subject to IEE or EIA)

TABLE 14.3-1(4) SCOPING OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS (4/7)

d. Construction of bypasses

	Aspect of environment	With Project		Without Project	
		Rating*	Explanation	Rating*	Explanation
Social environment	1. Resettlement	A	Alternative routes to avoid the forest areas may involve some resettlement.	D	No resettlement will be involved.
	2. Regional economy	B	Economic development may be induced along the new road.	B	Chronicle congestion should hamper the growth of economy.
	3. Transport & life facilities	B	The new road will induce new facilities along the road.	B	Chronicle congestion should prevail and worsen over time.
	4. Regional communities	A	The new highway will divide the existing communities and obstruct the nomadic movements.	B	No chage should take place i.e. community members chronicily suffer from the traffic issues.
	5. Archeological & cultural resources	C	Some cultural resources may be affected.	D	Not applicable.
	6. Water right & communal land	C	Detailed surveys are necessary.	D	Not applicable.
	7. Health & sanitation	C	Infectious diseases may spread due to long-haul transporters.	D	Not applicable but the country wide campaign of the elimination of AIDS may lose momentum to a limited extent.
	8. Solid wastes	C	Construction debris needs to be properly treated.	D	Not applicable.
	9. Disaster risk	B	Traffic accidents may increase.	D	No significant change should take place.
Natural environment	10. Topography & geology	B	Topography may change in some road sections.	A	No significant change should take place i.e. present conditions are maintained.
	11. Soil erosion	B	Soil erosion may increase due to improper designs and construction methods.	B	Present soil erosion should prevail.
	12. Groundwater	C	The topographic change may affect the shallow groundwater regime.	D	Not applicable.
	13. River & surface water regime	C	The topographic change and roadside drainage may affect surface water runoff.	B	No significant change should take place i.e. present conditions are maintained.
	14. Coast & marine areas	D	No such areas are involved.	D	Not applicable.
	15. Fauna & flora	A	The road through forest areas will affect the fauna and flora; the highway will affect movements of small animals.	A	No significant change should take place i.e. present conditions are maintained.
	16. Meteorology	D	No effect is expected.	D	Not applicable.
	17. Landscape	B	The topographic change and the visual appearance of the road affect the landscape.	B	No significant change should take place i.e. present conditions are maintained.
Pollution	18. Air pollution	B	Air pollution will increase along the new road.	D	No significant change should take place i.e. present conditions are maintained.
	19. Water pollution	C	The change in surface water runoff will affect the water quality.	D	Not applicable.
	20. Soil contamination	D	No effect is expected.	D	Not applicable.
	21. Noise & vibration	B	Increased traffic especially of heavy vehicles will increase noise and vibration.	D	Not applicable.
	22. Land subsidence	D	No effect is foreseen.	D	Not applicable.
	23. Offensive odor	B	Increased vehicle emission will cause some offensive odor.	D	No significant change should take place i.e. present conditions are maintained.

* A: Significant impact expected; B: Some impact expected; C: Impact unknown;
D: Little or no impact (not subject to IEE or EIA)

TABLE 14.3-1(5) SCOPING OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS (5/7)

e. Non-motorized Transport

	Aspect of environment	With Project		Without Project	
		Rating*	Explanation	Rating*	Explanation
Social environment	1. Resettlement	D	Does not occur unless sidewalks are occupied by illegal structures.	D	Not applicable.
	2. Regional economy	B	Improved access to commute working places would have positive effects.	B	Not previleged class may be put in the present situation over time.
	3. Transport & life facilities	B	Great improvement is expected as bicycles and man-drawn carts are separated from vehicles. For the pedestrians, present walking time would not be significantly improved.	B	Present conditions un-kind to the not-privileged class should prevail.
	4. Regional communities	C	New communities and activities may develop as sidewalks are improved.	C	No significan change should take place but subject to further study.
	5. Archeological & cultural resources	D	No significant impact is expected.	D	Not applicable.
	6. Water right & communal land	D	No effect is foreseen.	D	Not applicable.
	7. Health & sanitation	B	Cleanliness is improved on the sidewalks.	D	Not applicable.
	8. Solid wastes	D	No significant impact is expected.	D	Not applicable.
	9. Disaster risk	C	Traffic flow would be greatly improved as bicycles and man-drawn carts are separated i.e. faster flow of traffic is expected to cause different types of traffic accidents than they have been experiencing. For the pedestrian, sidewalk and intersection crossing improvement would become more controlled than it is now i.e. disaster risks are greatly reduced.	B	Lack of road facilities such as pedestrian crossing, sidewalks bicycle lanes, etc. for non-motorised transport chronicly suffer them and put them in the un-privileged status for long time.
Natural environment	10. Topography & geology	D	No significant impact is expected.	D	Not applicable.
	11. Soil erosion	B	Soil erosion will be minimized by proper design and construction.	B	At places, present soil erosion may be continued.
	12. Groundwater	D	No effect is foreseen.	D	Not applicable.
	13. River & surface water regime	D	No effect is foreseen.	D	Not applicable.
	14. Coast & marine areas	D	No such areas are involved.	D	Not applicable.
	15. Fauna & flora	D	No significant involvement is expected.	B	Depending on the design, roadside greenery may increase.
	16. Meteorology	D	No effect is expected.	D	Not applicable.
	17. Landscape	B	Improved landscaping is expected as sidewalks are designed to cater for not only to walk through but to stand and sit.	D	Not applicable.
Pollution	18. Air pollution	B	Improved traffic flow is considered to reduce pollution.	D	Not applicable.
	19. Water pollution	D	No effect is foreseen.	D	Not applicable.
	20. Soil contamination	D	No effect is foreseen.	D	Not applicable.
	21. Noise & vibration	D	No effect is foreseen.	D	Not applicable.
	22. Land subsidence	D	No effect is expected.	D	Not applicable.
	23. Offensive odor	D	No effect is expected.	D	Not applicable.

* A: Significant impact expected; B: Some impact expected; C: Impact unknown; D: Little or no impact (not subject to IEE or EIA)

TABLE 14.3-1(6) SCOPING OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS (6/7)

f. Bus and Matatu Route Development

	Aspect of environment	With Project		Without Project	
		Rating*	Explanation	Rating*	Explanation
Social environment	1. Resettlement	D	No effect is foreseen.	D	Not applicable.
	2. Regional economy	A	Improved access to the working places with improved public transportation would have significant positive effects.	A	Chronicle congestion on the roads should prevail and the economic growth will be held up to some extent in the future.
	3. Transport & life facilities	A	With the improvement of public transport system, enhancement of new facility development may take place for further conveniences.	A	Chronicle congestion on the roads should prevail and the economic growth will be held up to some extent and that the investment for improvement on life facilities will not be extensive.
	4. Regional communities	B	New communities may be developed as improved public transportation should enhance regional economy.	A	Community growth of the region will be held up while population growth will not be held up i.e. chronicle congestion of traffic ever worsons.
	5. Archeological & cultural resources	C	Some cultural resources may be enhanced.	D	Not applicable.
	6. Water right & communal land	D	No effect is foreseen.	D	Not applicable.
	7. Health & sanitation	D	No effect is foreseen. However, improvement of vehicular inspection for reducing emission is still necessary.	B	Public health induced by air pollution will prevail over time.
	8. Solid wastes	D	No effect is foreseen.	D	Not applicable.
	9. Disaster risk	C	Reducing the number of matatu may reduce the rate of road accidents while increasing the size of matatu/bus may involve relatively a large number of people per accident.	B	Road accidents may not be reduced.
Natural environment	10. Topography & geology	D	Existing roads will be utilized.	D	Not applicable.
	11. Soil erosion	D	No effect is foreseen.	D	Not applicable.
	12. Groundwater	D	No effect is foreseen.	D	Not applicable.
	13. River & surface water regime	D	No effect is foreseen.	D	Not applicable.
	14. Coast & marine areas	D	No such areas are involved.	D	Not applicable.
	15. Fauna & flora	D	No significant involvement is expected.	B	Depending on the extent of air pollution, some plant species may be damaged over time.
	16. Meteorology	D	No effect is foreseen.	D	Not applicable.
	17. Landscape	D	No effect is foreseen.	D	Not applicable.
Pollution	18. Air pollution	C	Depending on the routes, increase of bus/matatu cause pollution to the area where there is less air pollution with exhaust fumes.	B	Current level of air pollution should worsen over time.
	19. Water pollution	C	No effect is foreseen.	D	Not applicable.
	20. Soil contamination	D	No effect is foreseen.	D	Not applicable.
	21. Noise & vibration	C	Depending on the routes, increased number of bus/matatu cause pollution to the area where there is less noise and vibration at present.	B	Current level of noize and vibration may parevail and may worsen over time.
	22. Land subsidence	C	Depending on the quality of road, introduction of large size vehicles to relatively smaller roads may cause damages to the road including subsidence and development of potholes.	D	Not applicable.
	23. Offensive odor	C	Depending on the routes, increase of bus/matatu cause pollution to the area where there is less air pollution with exhaust fumes.	B	Current level of air/odor pollution should prevail.

* A: Significant impact expected; B: Some impact expected; C: Impact unknown; D: Little or no impact (not subject to IEE or EIA)

TABLE 14.3-1(7) SCOPING OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS (7/7)

g. Rehabilitation of the existing railway

	Aspect of environment	With Project		Without Project	
		Rating*	Explanation	Rating*	Explanation
Social environment	1. Resettlement	B	Squatters along the railway need to be resettled.	B	Squatters along the railway may increase over time.
	2. Regional economy	A	Improved access to job opportunities would have positive effects.	B	What the railway can take over of the load of road traffic is not achieved i.e. chronicle road traffic congestion should hamper the growth of the regional economy.
	3. Transport & life facilities	A	New facilities may be provided along the railway lines.	B	Current traffic congestion should prevail and decceleration of economy should hamper the investment for life facilities.
	4. Regional communities	B	New communities may develop around railway stations while some old ones may be replaced.	B	Lack of the development of regional economies should hamper further development of the communities.
	5. Archeological & cultural resources	C	Some cultural resources may be affected.	D	Not applicable.
Natural environment	6. Water right & communal land	D	No effect is foreseen.	D	Not applicable.
	7. Health & sanitation	B	Removal of squatters would have positive effects.	D	Not applicable.
	8. Solid wastes	B	Some solid wastes may be newly generated around the stations.	D	No significant effect is foreseen.
	9. Disaster risk	B	Railway accidents may increase.	D	No significant effect is foreseen.
	10. Topography & geology	D	Existing rail tracks will be utilized.	D	Not applicable.
	11. Soil erosion	C	Soil erosion will be minimized by proper design and construction.	D	No significant effect is foreseen.
	12. Groundwater	D	No effect is foreseen.	D	Not applicable.
	13. River & surface water regime	D	No effect is foreseen.	D	Not applicable.
	14. Coast & marine areas	D	No such areas are involved.	D	Not applicable.
	15. Fauna & flora	D	No significant involvement is expected.	D	No significant involvement is expected.
	16. Meteorology	D	No effect is expected.	D	Not applicable.
	17. Landscape	B	Improved railway lines and stations will have positive effects.	D	No significant effect is foreseen.
Pollution	18. Air pollution	C	Increased train services may increase air pollution locally.	D	Not applicable.
	19. Water pollution	C	Wastewater discharge from train may increase.	D	Not applicable.
	20. Soil contamination	D	No effect is foreseen.	D	Not applicable.
	21. Noise & vibration	B	Increased train services and speed will increase noise and vibration.	D	Not applicable.
	22. Land subsidence	D	No effect is expected.	D	Not applicable.
	23. Offensive odor	C	Some problem may occur associated with train-generated air pollution.	D	Not applicable.

* A: Significant impact expected; B: Some impact expected; C: Impact unknown;
D: Little or no impact (not subject to IEE or EIA)

CHAPTER 15

EXPECTED ENVIRONMENTAL IMPACTS OF THE MASTER PLAN

CHAPTER 15 EXPECTED ENVIRONMENTAL IMPACTS OF THE MASTER PLAN

15.1 MISSING LINK CONSTRUCTION WORKS

Major Impacts

There are six major features common to all the missing links as follows:

- There are temporary housing units which are nearing to become permanent housing units, and there are also kiosks and fencing for garages and other business areas that occupy the road reserves;
- There have been a number of tree planting areas or naturally grown trees during the past decade;
- Front gardens/yards of residential buildings and apartment houses are developed within the road reserve;
- Urban farming areas have been developed in the road reserve;
- Urban migrants occupying road reserves are growing from one place to the other and year to year. Thus numbers of temporary housing units given in Appendix 15 are subject to change over time; and
- Air and noise pollution will increase due to increased traffic.

Details of anticipated social and natural impacts are shown in Appendix 15. Locations of missing links and photographs of these missing links are shown also in Appendix 15.

Environmental Impacts During the Construction Period

The common impacts to all the construction works of the projects of the Master Plan are as follows:

- During the construction period, noise, vibration and dust to the ambient environment are emanated;
- Construction practices in Kenya tend to cause severe traffic congestion; and
- Traffic congestion to the present traffic flow does not occur where heavy traffic does not exist.

Environmental Impacts After the Project Implementation

Generally the following positive impacts are anticipated with the project implementation:

- Upon completion, traffic congestions are generally reduced;
- Comfort of commuter traffic is improved as projects are implemented; and
- Road accidents are reduced with improved road conditions. On the other hand, as travelling speed is expected to increase with improved road, accidents may increase in certain places.

15.2 INTERSECTION IMPROVEMENT

There are 48 intersection improvement projects identified in the Master Plan. Major impacts of intersections are noted as follows:

- There is no significant natural environment affected by intersection improvement except that, where there are roundabouts, part of gardening of the roundabouts would be lost;
- Cultural landscape of the present intersection familiar to Nairobi residents is changed;
- Air pollution and noise will increase due to increased traffic; and
- Impacts during and after the construction period which are generally common to all other projects that involve construction works will occur.

Details of major impacts are presented in Appendix 15.

15.3 ROAD IMPROVEMENT

Road improvement projects should take place within the road reserve. Thus no significant environmental impact is expected to take place. However, Limuru Road widening project should affect a portion of Karura Forest, currently gazetted as a conservation area. In this case the impact on the natural environment would be relatively high. Air and noise pollution will increase due to increased traffic.

Impacts during and after the construction period which are generally common to all other projects that involve construction works will occur as presented in Appendix 15.

15.4 BYPASS CONSTRUCTION WORKS

15.4.1 Northern Bypass

The Northern Bypass passes through the estate areas developed on the mountain slope of Ruiru to Kiambu generally following Nairobi city's north boundary. Land acquisition for sections of the road has been in progress. The following are noted as major impacts:

- There is no gazetted forest area affected by the project. However, natural forest areas remaining among agricultural estates do exist and would be affected;
- Much of the route could trace on the existing rural road;
- Because of the width of the road of 60m, major land acquisition on the agricultural areas together with a large number of resettlement of the local population is involved; and
- Air and noise pollution will increase due to increased traffic.

Impacts during and after the construction period which are generally common to all other projects that involve construction works will occur as presented in Appendix 15.

15.4.2 Southern Bypass

Detail design works are currently being undertaken and the following points are noted:

- The section from Mombasa Road to the intersection with Missing Link No.12, or Bypass Link Road, passes through dry savannah and there is a place where rare cactus species grow near Carnivore Restaurant;
- The section from the intersection with Missing Link No.12, or Bypass Link Road, to Kikuyu passes through forested areas of Ngong Road Forest and Dagoretti Forest that require full EIA study;
- The section from Kikuyu to Limuru passes through Ondiri Swamp that requires full EIA study;
- The section from Ngong Road Forest to Dagoretti Forest passes through quiet and expensively developed housing areas where noise, vibration and high travelling speed of vehicles might become hazardous to the local population until such time that they would get accustomed to it; and
- Air and noise pollution will increase due to increased traffic.

Impacts during and after the construction period which are generally common to all other projects that involve construction works will occur as presented in Appendix 15.

15.4.3 Eastern Bypass

From the southern part of Nairobi where industrial area has been developed to eastern area of Nairobi where flat grassland of former cattle ranch dominates the landscape, there is no significant natural environment to be affected by the project. It appears that the land acquisition of the road has been done in the past decades. Thus, almost no land acquisition or no resettlement of the local households is involved. Impacts during and after the construction period which are generally common to all other projects that involve construction works will occur as presented in Appendix 15.

15.4.4 Bypass Link Road

This is the road linking the Northern Bypass to the Southern Bypass Missing Link No.7 and No.12 and the following is noted:

- It appears that land acquisition for a large portion of the road to the north of Waiyaki Way has been in progress;
- Environmental impact of Missing Link No.7 and No.12 is described in Appendix 15,

i.e. land acquisition and resettlement of the local households are the major impacts; and
- Air and noise pollution will increase due to increased traffic.

Impacts during and after the construction period which are generally common to all other projects that involve construction works will occur as presented in Appendix 15.

15.5 NON-MOTORISED TRANSPORT

There is no significant natural environment affected. Upon implementation, convenience of pedestrians should greatly increase i.e. the comfort should contribute indirectly to increased economic productivity in general.

There will be no serious impacts during and after the construction period because of a small scale of construction works.

15.6 BUS AND MATATU ROUTE DEVELOPMENT

There is no significant natural environment affected by bus and matatu route development. Depending on the route, however, the following social impacts are noted:

- In the area where there was no bus and matatu in operation, traffic congestion associated with noise and vibration as well as exhaust fumes would generally be increased;
- Bus stop construction works would have to be implemented i.e. the construction works would contribute to traffic congestion at least for a limited period;
- Behaviour of bus and matatu drivers should be improved so as not to cause havoc on the traffic in the areas where new routes would be developed. If not, it might become one of the social issues raised by the residents along the new routes; and
- Upon implementation, convenience of commuters should greatly increase.

15.7 RAILWAY REHABILITATION

No significant impact on the natural environment is envisaged. Furthermore, railway rehabilitation programme in terms of increasing the number of commuter train services itself does not cause significant environmental impacts on the natural and social environment since the programme takes place within the current railway reserve. However, increased number of trains, including increased level of the speed of trains, would have to be associated with increasing number of accidents, and significant security measures to those living along the railway lines will be required.

During the past decades, encroachment of migrants to Nairobi increased significantly. The railway reserve, which is 60 m wide, has been one of the target areas of encroachment by the urban migrants. There are more than 4,000 households living within the railway reserve at present. Table 15.7-1 shows the areas which have high concentration of encroachment.

TABLE 15.7-1 RAILWAY RESERVE WITH HEAVY ENCROACHMENT

Area	No. of Units
Kibera	2,309
Embakasi	999
Kwa Reuben	274
Kware	91
Uchumi	313
Soweto	171
Total	**4,157**

Kenya Railway Service is pursuing solutions to these problems. However, it is very likely that a large number of households would move to other areas within Nairobi. The then unoccupied road reserves and other unoccupied land would thus become the areas of such temporary resettlement. This trend is usually repeated until there is no more land to resettle. Such vicious circle of urban development would prevail for the decades to come unless they are given legitimate places to live. It is therefore imperative that the issue be solved by both the railway rehabilitation programme and the urban development programme as a whole. For this purpose, Slum Up-grading Program in collaboration with GOK and UN-Habitat as a holistic approach developing program is currently undertaken and Kenya Railway is one of the participants to the programme. A photograph showing the railway encroachment in Kibera Slum area is available in Appendix 15.

15.8 IEE FOR ALTERNATIVE 3 SCENARIO

Among the proposed six scenarios, Alternative 3 has been selected as a feasible option (See IEE results in Section 15.3 of Appendix 15). The following points are noted:

- Bypass and their link road projects would involve a number of resettlements such as Kibera Slum area. Thus, a stakeholders meeting with the local residents should play a very significant role within the framework of EIA during the feasibility study. The impact on fauna and flora in and around the bypass and their link road projects would be minimal. Air and noise pollution will increase due to increased traffic;
- Some of the portions of missing link construction works are heavily encroached by licensed and unlicensed kiosks/slum units as well as street vendors who do not own

kiosk structures. Thus, a stakeholders meeting with them should play a very significant role within the framework of EIA during the feasibility study. Air and noise pollution will increase due to increased traffic;

- Road improvement works would involve land acquisition at the sections where there is no road reserve. Thus, a stakeholders meeting with the local residents should play a very significant role within the framework of EIA during the feasibility study. Air and noise pollution will increase due to increased traffic;
- Signalization of intersections should be carried out along with educational campaigns of the use of signals;
- NMT works would create traffic congestion during the construction period. Measures on the safety of pedestrians, cyclists and man-drawn carts should also be ensured during the construction period;
- Public transport policy framework including LRT project would need further study in order to identify socio-economic impacts. However, railway up-grading project would explicitly involve removal of encroachment within the railway reserve; and
- Traffic management would need further study in order to identify socio-economic impacts.

15.9 ENVIRONMENTAL IMPACTS OF HIGH PRIORITY PROJECTS

15.9.1 Natural Environment

(1) Missing Links

Missing Link No.3

No significant natural environment is affected.

Missing Link No.6

No significant natural environment is affected.

Missing Link No.7

No significant natural environment is affected.

(2) Circumferential Arterials

C-2 Ring Road

No significant natural environment is affected.

C-3 Ring Road

No significant natural environment is affected.

(3) Radial Arterials

Ngong Road Improvement

No significant natural environment is affected.

15.9.2 Social Environment

(1) Missing Links

As shown in Appendix 15, Missing Link Construction Project involves relocation of kiosks as follows:

Missing Link No.3

- There are 75 units of kiosks concentrating in the northern portion; and
- There are a number of gardening areas belonging to apartment complexes and office buildings.

Missing Link No.6

- There are 19 units of kiosks, most of which concentrate in the mid section; and
- There are a number of gardening areas belonging to apartment complexes and private houses.

Missing Link No.7

- There are 152 units of kiosks and 10 street vendors concentrating in the southern portion; and
- There are a number of gardening areas belonging to apartment complexes and office buildings.

(2) C-2 Ring Road

As shown in Appendix 15, C-2 Ring Road Construction Project involves resettlement of permanent and semi-permanent structures as follows:

- Two units of apartment complexes within the University of Nairobi Campus are subject to resettlement;
- The road goes across the garden area of State House;
- Depending on the alternative route, there are a number of permanent and semi-permanent structures subject to resettlement;
- A large number of apartment complexes, office buildings and a church building would be involved in resettlement in the Ngong Road area; and
- A large number of kiosks and market shelters are subject to relocation in Bondeni – Kamukunji area.

(3) C-3 Ring Road

As shown in Appendix 15, C-3 Ring Road Construction Project involves resettlement of permanent and semi-permanent structures as follows:

- The Eastern portion goes through an area heavily congested with kiosks occupying the road side and the slum area occupied by slum units that are a mixture of kiosks and residential structures. The total number of such structures is 374 units i.e. the number families subject to relocation would be more than 1800;
- The Southern portion goes through Kibera Slum and 429 units are subject to relocation i.e. the number of families subject to resettlement would be more than 2000; and

- The Northern portion goes through a wooded portion of the Nairobi City Park including 14 permanent structures of apartment complex and office buildings.

(4) Ngong Road Improvement

As shown in Appendix15, Ngong Road Improvement Project involves resettlement of kiosks and street vendors as follows:

- There are 116 units of kiosks and street vendors including plant vendors and used-car dealers display areas, gardening areas as well as farming plots which would be subject to relocation.

15.9.3 Pollution

Air and noise pollution will increase due to increased traffic on Missing Links, C-2 Ring Road, C-3 Ring Road and Ngong Road Improvement projects.

15.10 SCOPE OF EIA FOR THE HIGH PRIORITY PROJECTS

15.10.1 Natural Environment

Since there are a large number of grown trees on the road reserves of the high priority projects, a study on the species and quantity of these trees subject to felling should be carried out in EIA of the feasibility study.

15.10.2 Social Environment

(1) Resettlement Action Plan (RAP)

There is no explicit provision on a resettlement action plan in the guidelines of EIA prevailing in Kenya. Thus a study on resettlement action plan for the projects subject to feasibility study is needed if involuntary resettlement is involved. Section 15.5 of Appendix 15 shows suggested study components of resettlement action plan. Within the framework of the Master Plan Study, the following are noted:

Resettlement action plan should be carried out as a general procedure for those involved in the involuntary resettlement scheme. A number of kiosks occupying road reserves are also subject to relocation. A majority of them are with temporary licenses which are renewable yearly at a payment ranging from Ksh 3,000 – 8,500 depending on the type of business. There are a number of street vendors who pay the license fee on a daily basis. It costs Ksh 25 per day. While these licenses do not provide for residential permit, some of the structures under temporary kiosk license are used for residential purposes.

Upon road construction works, they are given 30 days notice issued by City Council of Nairobi for evacuation. It is a condition for the issue of temporary kiosk licenses. Those

kiosks with an "X" mark on the wall have already been abandoned although the cost of the demolition of kiosk structure is borne by the owner. Depending on the location and the number of kiosks, there is an organization of the kiosk owners. In such areas, relocation would be much delayed. In addition to the general resettlement action plan for those who are holding permanent landholding and residential rights, a provision of resettlement action plan for the kiosk owners would have to be elaborated. Not limited to but the following as a guide for feasibility study is therefore suggested for this undertaking:

- Carry out socio-economic survey using questionnaire and sample 10 – 20 % of the project-affected persons (PAPs);
- Classify the PAPs into legally licensed, temporary kiosk license owners and street vendors with daily basis license;
- Estimate the number of PAPs who would agree and would not agree on physical and financial assistance for resettlement;
- Elaborate an explicit policy framework of resettlement action plan for the kiosks occupying road reserve as follows:
  - Discuss with kiosk owners or the representative of kiosk owners association during the feasibility study of the project for policy frameworks of RAP;
  - Elaborate and locate relocation sites for the kiosk owners;
  - Discuss and obtain general agreement on resettlement action plan;
  - Discuss with temporary kiosk license owners if they would come back to their original location upon completion of the project;
  - Study on the provision of resettlement for street vendors and obtain an agreement with them in terms of assistance for relocation
- Hold a number of stakeholders meetings with legally licensed and not legally licensed PAPs identified by the socio-economic survey; and
- Where land acquisition and compensation for structures including the improvement on land are involved within the framework of the Project, the following is noted:
  - The Commissioner of Lands of the Ministry of Lands and Housing is the sole authority for valuation of the cost of land acquisition. Valuation of land is carried out only at the time of project implementation. Therefore the land is valued at such time at the market value; and
  - The City Inspectorate of the City Council of Nairobi is the sole authority for valuation of assets, which is carried out at the time of project implementation. Therefore the assets for compensation are valued at such time at the market value.

The general procedure of land acquisition, based on Land Acquisition Act, Chapter 295 of the Laws of Kenya, Revised Edition 1983 (1970), is shown in the Figure 15.10-1.

15.10.3 Pollution

There is no provision of the measures related to mitigate pollution in the guidelines of EIA of the GOK. It is therefore necessary to carry out the study on the conditions of air pollution before and after the project implementation and it should be incorporated into EIA of the feasibility study.

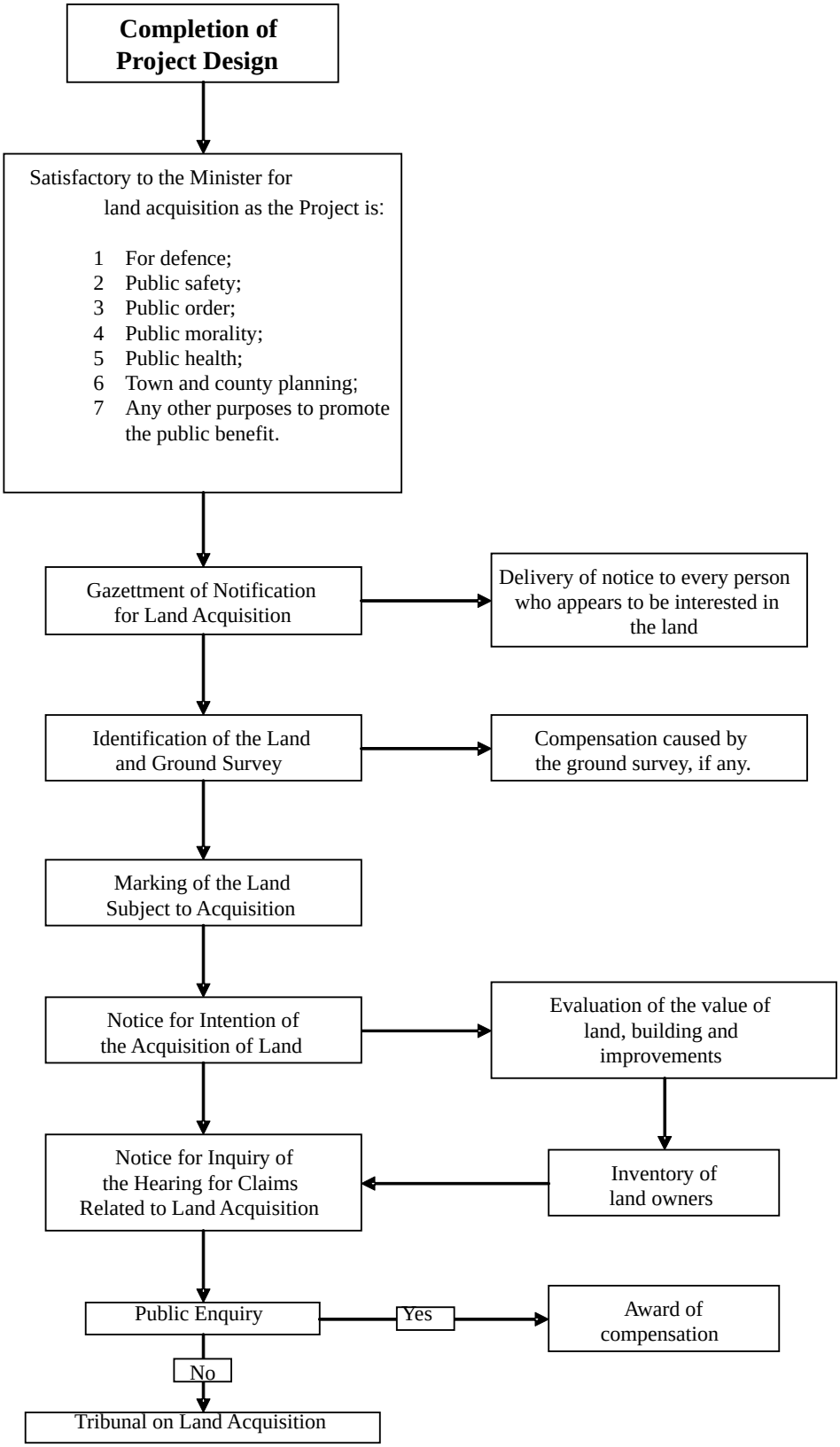


FIGURE 15.10-1 PROCEDURE OF LAND ACQUISITION

TABLE 15.10-1 SUMMARY OF IEE FOR ALTERNATIVE 3

Selected Projects	Code	Term of Solution [1]			Anticipated Impacts - Social Environment		Anticipated Impacts - Natural Environment		Anticipated Impacts - Pollution	
		Short	Medium	Long	Level of Impact	Descriptions	Level of Impact	Descriptions	Level of Impact	Descriptions
I. Road Improvement										
1. Bypass and Link Roads										
1.1 Bypass Roads	B			○	A	Explicit resettlement action plan is necessary.	A	Fauna and Flora may be impacted by projects.	A	Air pollution and noise will increase.
1.2 Link Roads	LR			○	A	ditto	A	ditto	A	ditto
1.3 Link Road Extension	LE			○	A	ditto	A	ditto	A	ditto
2. Missing Links										
2.1 Missing Links (Arterials)	MA	○			A	Explicit resettlement action plan is necessary.	D	No significant natural environment is affected.	A	ditto
2.2 Missing Links (Collectors)	MC		○		A	ditto	D	ditto	A	ditto
2.3 Missing Links (Local Roads)	ML		○		A	ditto	D	ditto	A	ditto
3. Radial Roads										
3.1 Radial Roads Inside C-3	RC	○			B	For the road construction works the following is noted: - Where there is no road reserve, land acquisition is involved - Traffic congestion during the construction period would increase i.e. measures to control it is important. - Smooth traffic flow is expected upon completion **of the Project**	C	Specific natural impacts are subject to further study.	A	ditto
3.2 Radial Outside C-3 (South-West)	RS			○	B		C	ditto	A	ditto
3.3 Radial Outside C-3 (North-East)	RN		○		B		C	ditto	A	ditto
3.4 Proposed New Radial Roads	RP			○	B		C	ditto	A	ditto
4. Circumferential Road										
4.1 Circumferential Road C1 & C2	C2			○	B		C	ditto	A	ditto
4.2 Circumferential Road C3	C3		○		B		C	ditto	A	ditto
5. Secondary Arterial Roads										
5.1 Secondary (South-West)	S-S			○	B		C	ditto	A	ditto
5.2 Secondary (North-East)	S-N			○	B		C	ditto	A	ditto
6. Signalisation										
6.1 Signalisation (Stage 1)	SG-S	○			B	For the signalization works the following is noted: - Educational campaign for the use of signal before and after **would be necessary.**	D	No significant natural environment is affected.	C	Pollution is subject to further study.
6.2 Signalisation (Stage 2)	SG-M		○		B		D	ditto	C	ditto
6.3 Signalisation (Stage 3)	SG-L			○	B		D	ditto	C	ditto
7. Non Motorised Transport (NMT)										
7.1 NMT (South & West)	NMT-S		○	○	B	Measures to control traffic congestion during the construction period would be necessary.	D	ditto	D	Significant pollutants are not discharged.
7.2 NMT (North & East)	NMT-N	○			B		D	ditto	D	ditto
8. Uhuru Highway Improvement										
8.1 Widening	UW	○	○		A	Historically important parks and churches are subject to relocation.	A	Specific natural impacts are subject to further study.	A	Air pollution and noise will increase.
8.2 Grade Separation	UGS		○	○	C	Specific social impacts are subject to further study.	C	ditto	A	ditto
II. Public Transport										
1. Bus Incentive Policy	BI	○			C	Specific social impacts are subject to further study.	D	No significant natural environment is affected.	D	Significant pollutants are not discharged.
2. Bus Priority Policy	BP									
2.1 Bus Lane	BL		○	○	C	Specific social impacts are subject to further study.	D	ditto	D	ditto
2.2 Bus Way	BW			○	C	Specific social impacts are subject to further study.	D	ditto	D	ditto
3. Upgrading of Existing Rail	ER	○	○	○	A	Kenya Railways is undertaking a program for elimination of encroachment into railway reserve.	D	ditto	D	ditto
4. LRT [2]	LRT				C	Specific social impacts are subject to further study.	D	ditto	D	ditto
III. Traffic Management										
1. Traffic Circulation in City Centre	TC	○			C	Specific social impacts are subject to further study. However, rather positive effects are expected.				
2. On Street Parking	OP	○			C	Specific social impacts are subject to further study. However, rather positive effects are expected.	D	ditto	D	ditto
3. Enforcement	EN	○			C	Specific social impacts are subject to further study. However, rather positive effects are expected.	D	ditto	D	ditto
4. Public Education	PE	○			D	No significant social impact is expected.	D	ditto	D	ditto
IV. Traffic Institution										
1. Human Resource Capacity Building	CB	○			D	No significant social impact is expected.	D	ditto	D	ditto
2. Institutional Development	ID	○			D	No significant social impact is expected.	D	ditto	D	ditto

Note:
1) Short Term is 2005-2010, Medium Term is 2011-2015, and Long Term is 2016 - 2025.
2) LRT is considered necessary beyond 2025.

Legend:
A - Significant impact expected; B - Some impact expected; C - Impact unknown;
D - Little or no impact (not subject to IEE or EIA)

PART IV

URBAN TRANSPORT MASTER PLAN

CHAPTER 16

TRANSPORT DEVELOPMENT POLICY AND TARGET

PART IV URBAN TRANSPORT MASTER PLAN

CHAPTER 16 TRANSPORT DEVELOPMENT POLICY AND TARGET

16.1 APPROACH

Figure 16.1-1 demonstrates the procedural flow of transport master plan formulation which is briefly discussed below.

(1) Assessment of Future Transport Issues

The future transport issues were assessed based on the assessment of present transport situation and issues, and analysis on the future traffic demand in the target year of 2025.

(2) Future Land Use and Socio-economic Framework

Since no future land use plan is available, the development pattern of urban structures are examined and proposed. It was then used as the basis of formulation of future socio-economic framework.

(3) Transport Development Policy

The Government of Kenya authorized "Recommendations on Integrated National Transport Policy", prepared by the Ministry of Transport and Communication, which was used as the basic policy for the Study. Consequently, the sector policy for road development, public transport and transport demand policy are prepared.

(4) Strategy and Target

The strategy and target are proposed based on the basic policy to technically draw up the direction of the Study.

(5) Generation of Master Plan Alternatives

In accordance with the policy, strategy and targets, several alternatives of the master plan are prepared with different combinations of measures for the sector for the purpose of comparative evaluation.

(6) Comparative Evaluation of Master Plan Alternatives

The prepared alternatives are comparatively evaluated with regard to such factors as engineering aspects, environmental aspects and social acceptance in the target year of 2025.

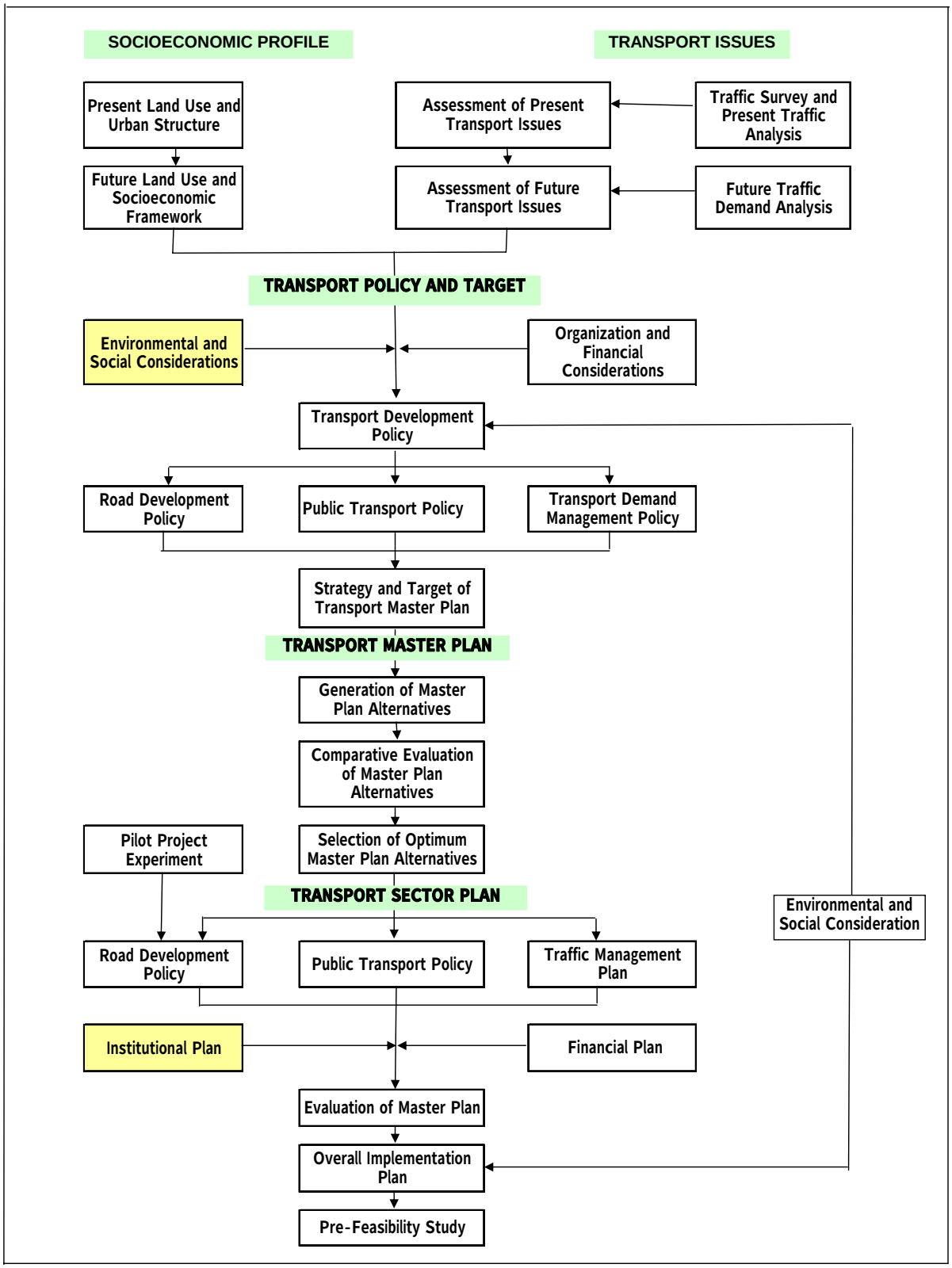


FIGURE 16.1-1 PROCEDURE OF TRANSPORT MASTER PLAN FORMULATION

(7) Selection of Optimum Master Plan Alternative

The optimum plan was selected through the comparative evaluation.

(8) Transport Sector Plans

In line with the optimum plan selected, the concrete plan for each sector is prepared. In preparing the sector plan, the environmental and social consideration on the proposed projects and measures were worked on, and mitigation measures are proposed in cases where negative impacts existed.

(9) Evaluation of Master Plan

The Master Plan including sector plans is further examined in its appropriateness, taking into consideration the optimum implementation timing and stage implementation in the year of 2010, 2015 and 2025.

(10) Overall Implementation Plan

The practicable implementation plan covering each sector is prepared as a guide of the actual implementation, considering the implementation capacity for each sector including the organizational and financial resources.

16.2 PRESENT TRANSPORT ISSUES

16.2.1 Urban Structures

The present urban structure is discussed in Chapter 3, the issues of which are summarized from the viewpoint of urban transport as follows:

(1) No control / guide of land use

Presently, no land use plans have been developed prompting a disorderly and low density outward expansion of urban area development pattern. Uncontrolled urban development has led to high urban density in the limited areas, urban sprawl, inadequate access to transport especially by the urban poor, long travel time and high transport costs. It should be noted that land use plans play a vital role in reconciling transport issues with land use development.

(2) Concentration of Urban Activities in City Center

The urban activities are concentrated only inside the CBD or the city center where traffic congestion is serious. A well-ordered partial distribution of urban structure and activities is recommended. The transport demand from residential / suburban area to work place / city centre should be met with an efficient transport network such as a radial and circumferential road network.

(3) Constraint to Economic Development

The existing road network in the urbanized area can not accommodate the passenger and freight transport demand. To respond to such demand in the future, an efficient and effective network should be developed including bypass and link road system in the influence area.

16.2.2 Road Network and Conditions

Chapter 4 assessed the road condition and efficiency of the present road network, which is summarized as follows:

(1) International Corridor

The international highways (Mombasa Road A109, Nakuru-Muranga Road A104, Thika Road A2, and Nguni Road A3) seem to be substandard in terms of mobility and serviceability in accordance with the international standards.

Uhuru Highway (the section of Mombasa Road in the urbanized area of Nairobi City) plays both roles as one of the main components of the through traffic and local street resulting to heavy congestion.

(2) Road Network in Urbanized Area

- The hierarchy of the road network systems is not well developed, thus mobility on arterials is seriously disturbed by local traffic. This resulted to poor level of service.
- There are many missing road links that affect the serviceability of collector roads. Mobility and accessibility are limited partly due to this incomplete road network.
- The local streets are not functionally connected to collector roads. This results to limited access to adjoining service areas. In addition, pavement condition is poor and there is no or only limited available space for non-motorized transport.

(3) Road Network in Sub-urban Area

- The main road network connecting Nairobi City to sub-urban centres is reasonably developed.
- The pavement condition of these roads has deteriorated in some sections which hampered the activities of people in the influence area.
- The traffic condition on arterials as of 2004 is still below standards (average speed is 25.5 km/hr and average VC ratio is 1.5), while the traffic condition on collectors and local streets are reasonably well (average speed is 19.5km/hr and average VC ratio is 1.7), in accordance with the international standard required for such road classes.

16.2.3 Public Transport

The issues in public transport are presented in Chapter 5, and summarized below:

(1) Inefficient Network of Buses and Matatu

No regulation is implemented to clearly distinguish the role of bus and matatu which are presently operated only on the high demand corridor with tight competition and poor infrastructure. The co-existence of bus and matatu by having their own role is recommended, i.e. bus on arterials and matatu on collectors.

(2) Non-Incentives to Private Sectors

Private sectors manage the public transport services from a business perspective, thus operate only on high-demand transport routes and sacrificing the value of public service, safety and security.

(3) Railway Service

The existing railway is under utilized. The ridership is low while the infrastructure is poorly maintained. Upgrading the existing railway system as a modern commuter system in the urbanised area is recommended. It should be noted that the introduction of a new rail system may be necessary in extremely high-public transport corridors in the future.

16.2.4 Other Issues

Transport related issues on traffic management, environment, legislation and funding are assessed in the previous Chapters, and the identified problems are summarized as follows:

(1) Traffic Management

- Lack of traffic management system
- Traffic accidents and insecurity
- On-street parking in the city centre
- Lack of parking spaces in the urbanised area

(2) Environment

- Increase of slum population
- Restoration of forest areas
- Poor roadside amenity (unpaved sidewalks, no pedestrian facilities)
- Lack of space for non-motorised transport
- Inadequate provision of bus bay for safe riding
- Increasing level of air and noise pollution

(3) Legislation and Organization

- Unclear management responsibility
- Uncoordinated transport infrastructure
- Inappropriate planning mechanism for development and maintenance

(4) Finance for Transport Infrastructure

- Inadequate, fragmented and arbitrary allocation of funds
- Lack of innovative ways of generating funds

16.3 TRANSPORT DEVELOPMENT OBJECTIVE AND POLICY

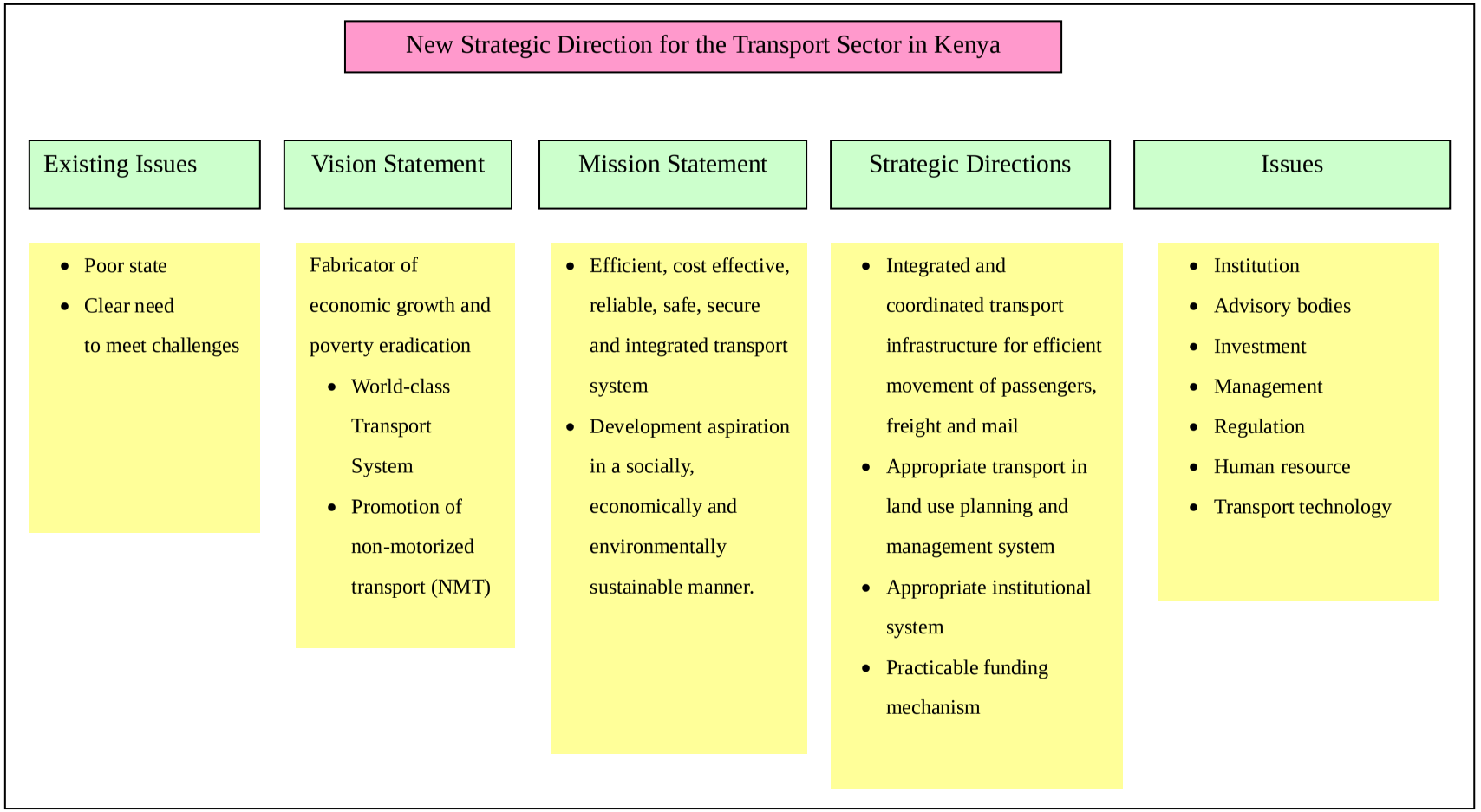
16.3.1 National Transport Objective and Policy

The Government of Kenya recognizes the transport sector as a facilitator of rapid economic growth and reconstruction, poverty eradication and wealth creation for the country. To enable the transport sector effectively play its role, the Ministry of Transport and Communication (MOTC) formulated "Recommendation on Integrated National Transport Policy" in February 2004, which was recognized as the national transport policy. The synopsis of its recommendation related to urban transport in Nairobi Metropolitan area is briefly discussed. Figure 16.3-1 shows the National Transport Objectives and Policy.

(1) Highlights of the Policy Principles

The vision statement of the Integrated National Transport Policy is to produce a world-class transport system that is integrated and responsive to the needs of people and industry. The highlights of the policy principle are, among others, as follows:

- Clarification of the roles of the central and local government, non-government bodies and the private sector.
- Users' pay and polluter pay principles to facilitate economic efficiency.
- Stakeholders' consultation in setting of tariffs and other prices.
- Financing of economic infrastructure through user charge or cost recovery from direct users.
- Financing of social and strategic infrastructure through subsidisation on declining basis over time.



Source: Recommendation on Integrated National Transport Policy
Ministry of Transport and Communication, February 2004

FIGURE 16.3-1 NATIONAL TRANSPORT OBJECTIVES AND POLICY

The Policy proposals recognize the importance of Non–Motorized and Intermediate Means of Transport (NMIMT) in addressing the mobility needs of the poor as well as in promoting the health of the population. In this regard, integration of NMIMTs in the design, development and operation of all modes of transport is recommended.

(2) New Strategic Directions

The mission statement of new strategic directions for the transport sector is to develop, operate and maintain an efficient, cost effective, reliable, safe, secure and integrated transport system and link transport policy with other sectors in order to achieve national and regional development aspirations in a socially, economically and environmentally sustainable manner.

The objectives of the new strategies are, among others, as follows:

- Integrate transport with national and regional socio-economic demands;
- Establish appropriate institutional systems for transport sector management, coordination and regulation;
- Develop and maintain an integrated and coordinated transport infrastructure for efficient movement of passengers, freight and mail and support disaster management efforts;
- Develop appropriate transport in land use planning and management systems;
- Deliver efficient and effective sector operations to enhance national productivity;
- Enhance investments in the transport sector; and
- Apply ICTs in transport planning, operations and management to enhance sector efficiency.

(3) Issues Covered by the Policy

The Policy review covers issues related to transport infrastructure planning, development and management, legal, institutional and regulatory frameworks. The followings are covered by the policy review:

- An overview of the transport sector in Kenya;
- New strategic direction for the transport sector in Kenya;
- Legal, institutional, and regulatory framework for transport;
- Optimal planning framework and maintenance of transport infrastructure;
- Optimal planning and provision of transport materials;
- Enhancing transport safety and security;
- Competition and complementarily for effective transport delivery;
- Land use planning and mitigation of environmental effects of transport;
- Health and transport sector;
- Integrating transport services with the national and regional economy;
- Information and communication technologies for transport;

- Transport research and development;
- Human resource development for the transport sector;
- Funding framework to support transport inventory growth; and
- Policy implementation, monitoring and evaluation framework.

16.3.2 Proposed Urban Transport Policy

In line with the National Transport Policy, the urban transport development policy for the Study is formulated by assessing the present issues to be addressed.

(1) Road Development Policy

Policy 1; International Level of Improvement

Nairobi is the capital city of Kenya, which should also be the center in the East African Region. It is, therefore, recommended that the level of transport facilities and services be superior and to the international standard (especially for the international facilities).

Policy 2; Development of Hierarchical Road Network System

The hierarchy of road network system composed of strategic arterials, principal arterials, secondary arterials, collectors and local streets should be efficiently developed.

(2) Public Transport

Policy 3; Promotion of Bus Transport

A shift to high occupancy vehicles by public transport operation is one of keys in solving urban transport issues as well as offering services to transportation of the poor. It is recommended that a policy be exercised to encourage private operator.

Policy 4; Upgrading of Railway Transport

The services of the existing railway operation do not cater the needs of passengers due to aging infrastructure and facilities. The upgrading of the existing system is therefore imperative. It is also recommended that the possibility of introducing a new railway in high - demand corridors should be pursued.

(3) Special Policy

Policy 5; Widespread Use of Non – Motorized Transport

The use of motor vehicles is generally limited and largely unaffordable to the majority of the low income individuals and households. Given the important need to reduce travel time and burden, the development of NMT should be encouraged along with other transport modes to increase accessibility of household and community.

Cognisant with the modal share of NMT and its safety, the facilities for NMT should be developed together with widening of the existing roads or as independent improvement projects.

- Construction of footpath and bicycle lanes along selected roads to be simultaneously done with road improvement
- Provision of NMT facility to access transport facilities such as bus stops, railway stations, etc.

Policy 6; Enhancement of Transport Safety and Security (Traffic Control Management)

The safety and security on all modes of transport are the major concern of passengers. This principle shall be enhanced encompassing the following:

- Safety of NMT;
- Security of passengers;
- Establishment of effective traffic control/ management systems;
- Introduction of traffic signal systems;
- Regulation of on-street parking; and
- Sustainable implementation of traffic safety education and campaign.

Policy 7; Study on Traffic Demand Management

The study on the implementation of traffic demand control is recommended including the following items:

- Guiding land use, urban structures and building regulation;
- Colour coding;
- Park and ride;
- Differentiated community hours, flex time;
- Management of vehicle ownership (tax, license and inspection system);
- Control of vehicle usage (fuel tax, parking facilities and fares);
- Introduction of share-ride system; and
- Promotion of transport between different modes of public transport.

This policy may, however, hamper urban development and socio-economic activities, depending on measures of reduction or adjustment of traffic demand. Therefore, only the Study is recommended to cope with special /urgent cases.

Policy 8; Emphasis on Environmental and Social Consideration

The strict enforcement of the regulation of the Republic of Kenya and international lending institutions for particular projects is an absolute prerequisite in planning, designing and implementing urban transport infrastructure and services.

16.4 TRANSPORT DEVELOPMENT STRATEGY

In compliance with the development policy recommended by the MOTC and the proposed

urban transport policy, the development strategy of urban transport infrastructure and services for the Study was proposed, covering the following sectors:

- Road Transport
- Public Transport
- Public Transport (Rail)
- Urban Expressway System

Strategy 1; Rebirth of Nairobi as the Hub for Road Transport in the East African Region (Improvement of International Highways)

The International highways connecting to neighbouring countries shall be redesigned to offer international standard services in terms of transport mobility.

- Uhuru Highway
- Mombasa Road (A109)
- Thika Road (A2)

Strategy 2; Optimum Implementation of Planned Road Projects

The following road improvement projects are currently planned by the Government, and are intended to be implemented at the optimum timing:

- Construction of bypasses (3 bypasses and 2 Link road)
- Construction of missing links (12 roads)
- Improvement of intersections (11 grade- separation, 8 at – grade intersections)

Strategy 3; Establishment of Radial-Circumferential Type Road Network (R/C Road Network) in Urbanized Area

Urbanization in the Study area has been growing rapidly. The urban transport network shall ensure that road passenger transport addresses the accessibility and mobility needs and standards to limit travel time and distance in the influenced area. Efficient and hierarchical road network shall be established by improving the existing trunk roads as indicated below.

- Construction of Missing Links (7 - roads)
- Radial Roads (R1～R8)
- Circumferential Road (C1～C3)
- Improvement of existing arterials, collector and local streets

Strategy 4; Execution of Bus Oriented Policy

Public passenger transport operations such as buses are optimal when regulation and infrastructure are provided to facilitate its operations. The regulation and its enforcement, and development of road infrastructure for road based public transport is one of key issues for urban transport. This shall be implemented step by step in accordance with public demand

and development stages of the bus transport industry.

Step 1; Implementation of Bus Incentive Policy

- Restructuring of bus and matatu routes along major public transport corridors.
- Provision of road infrastructure such as bus stops and terminals.
- Incentives in the form of taxes, insurance, credit facilities for financing both new purchases and fleet renewal.

Step 2; Implementation of Bus Priority Policy

- All measures under step 1
- Designation of priority / exclusive bus lanes along major public transfer corridors
- Outlaw of matatus along selected major arterials (Matatus may be able to co-exist with buses as a means of collector and distributor)

Strategy 5; Optimum Development of Railway Transport

The constraints that railways face are stiff competition from road transport, unreliable and ageing structures, particularly the single track, bridges, telecommunication, signaling and other facilities. The extent of urban commuter services is limited by the ageing infrastructure and inefficient network despite the great demand for the services. The participation of the private sector shall be encouraged by the Government to cater for more commuters as a Public Service Obligation (PSO).

Step 1; Improvement of existing railway as urban commuter services.
Step 2; Introduction of light rail system on limited routes with high demand.

Strategy 6; Introduction of Urban Expressway System

The transport demand in the urbanized area is expected to grow at a fast rate. Consequently, the preparation works such as acquisition of road right of way for the introduction of urban expressway system shall be considered. The at-grade road spaces shall be reserved utilizing the existing roads.

Step 1; Upgrading of Uhuru Highway
Step 2; Construction of circumferential route (C–2 line).
Construction of radial routes within C-3.
Step 3; Construction of circumferential route (C-3 line).
Extension of radial routes.

16.5 TRANSPORT DEVELOPMENT TARGET

(1) Basic Concepts

The highway and street network plays a major role in providing the travel mobility and access to property. Access is a fixed need for every area served by the highway system. Mobility is provided at the service level. Mobility can incorporate several qualitative elements, such as riding comfort and absence of speed changes, but the most basic factor is operating speed or trip travel time which may be expressed in terms of congestion.

The appropriate degree of congestion that should be used in planning highway improvements is determined by merging the desire of the motorists against availability of means for satisfying these desires. The degree of congestion that should not be exceeded during the design year on a proposed highway can be realistically assessed by determining the operating conditions that the majority of motorists will accept as satisfactory or acceptable degree of congestion.

Based on the concepts mentioned above, the targets of transport development plan are proposed in accordance with the guidelines of the Highway Capacity Manual (HCM).

(2) Level of Services by Highway Class

HCM defines four (4) urban classes based on street function and design as shown in Table 16.5-1.

TABLE 16.5-1 URBAN STREET CLASS BASED ON FUNCTIONAL AND DESIGN CATEGORIES

Design Category	Functional Category	
	Principal Arterial	Minor Arterial
High Speed	I	N/A
Suburban	II	II
Intermediate	III	III or IV
Urban	IV	IV

Source: HCM

Table 16.5-2 lists the criteria on Level of Services (LOS) of urban streets based on average travel speed and urban street class. It should be noted that if demand volume exceeds capacity at any point on its street (volume capacity ratio, V/C>1), the average speed might not be at a good measure. The general definition of LOS is shown in Table 16.5-3.

TABLE 16.5-2 LEVEL OF SERVICE BY CLASS

Urban Street Class	I	II	III	IV
Signal Density(signal/km)	0.5	2	4	6
Range of free flow speeds(FFS)	90 to 70km/h	70 to 55km/h	55 to 50km/h	55 to 40km/h
Typical FFS	80km/h	65km/h	55km/h	45km/h
LOS	Average Travel Speed (km/h)			
A	>72	>59	> 50	>41
B	> 56-72	>46-59	>39-50	>32-41
C	> 40-56	>33-46	>28-39	>23-32
D	> 32-40	>26-33	>22-28	>18-23
E	>26-32	>21-26	>17-22	>14-18
F	≦26	≦21	≦17	≦14

Source: HCM

TABLE 16.5-3 DEFINITIONS OF LEVELS OF SERVICE

General Level of Service	General Operating Conditions	Characteristics	Speed
A	Free Flow	Completely unimpeded operation Control delay at signal intersection is minimal	100%
B	Reasonably Free Flow	Only slightly restricted Control delay is not significant	70%
C	Stable Free Flow	More restricted Longer and adverse signal co ordination	50%

Source: HCM
Remarks: -Service Volume (veh/h) of class II, standard condition
-Service Volume (veh/h) of class IV, standard condition

(3) Proposed Targets

LOS and average travel speed as the indicators of targets by each road class as shown in Table 16.5-4.

TABLE 16.5-4 PROPOSED TARGETS BY STREET CLASS

Design Category	Road Class	Class	LOS	Average Travel Speed (km/h)
High Speed	International Highway	I	B(1)	60
Urban	Principal Arterials (Ring and Circumferential Road)	II	C	40
Urban	Minor Arterials (Arterial other than above)	III	C	30
Urban	Collectors and others	IV	D	20

Note: (1) LOS for the International Highway in rural and sub-urban area is proposed B and average travel speed more than 60km/h.

Aside from the proposed target, the following should be maintained as the minimum target of the Master Plan.

(1) Level of Service;

The level –of-service in the year 2025 should be not less than the present average levels, with an average travel speed not less than the present average speed.

(2) Accessibility Coverage;

The coverage rate is defined by road density within the area surrounded by arterials or by the travel time of zonal population to the city center. The target rate in the year 2025 should be more dense than the present value.

(3) Traffic Parameters;

The parameters of vehicle-kilometer, vehicle-hour and volume capacity ratio will be used as indicators for Master Plan efficiency and evaluation purposes. The parameters in the year 2025 should show more efficiency than the present value.

CHAPTER 17

TRANSPORT MASTER PLAN ALTERNATIVES

CHAPTER 17 TRANSPORT MASTER PLAN ALTERNATIVES

17.1 GENERATION OF MASTER PLAN ALTERNATIVES

17.1.1 Major Components of Master Plan

In compliance with the policies and strategies proposed in the previous chapter, the major components for urban transport development plan in Nairobi Area were examined covering each sector.

- Road Development
  - Planned projects
  - Radial and circumferential Road Network (Radial and Circumferential; R/C Road Network(1) and (2))

- Public Transport (Bus and Matatu)
  - Bus Incentive Policy
  - Bus Priority Policy

- Public Transport (Railway)
  - Upgrading of existing railway
  - Introduction of new railway (LRT)

- Expressway System
  - Stage 1
  - Stage 2
  - Stage 3

The conceptual figure for each sector is illustrated in Figure 17.1-1 to Figure 17.1-6.

(1) Planned Projects

The planned projects which were prepared by the Government are listed in Table 17.1-1 and shown graphically in Figure 17.1-1.

(2) R/C Road Network Projects

R/C Road Network (1)

The list of R/C road network projects is shown in Table 17.1-2. The road projects aimed at structuring an efficient radial and circumferential urban road network by utilizing the existing roads and planned projects. Refer to Figure 17.1-2.

R/C Road Network (2)

In addition to R/C Road Network (1), Road Network (2) is proposed to complete the functional linkage of road network, covering the followings:

- Extension of Eastern Bypass Link Road (Extension of Outer Ring Road between Thika Road and Northern Bypass);
- Extensions of Western Bypass Link Road (Extension of James Gichuru Road between Ngong Road and Langata Road); and
- Nairobi River Road between C3 (Extension of Quarry Road) and Eastern Bypass Link Road (Outer Ring Road).

TABLE 17.1-1 PLANNED PROJECTS

1. Bypasses & Bypass Link Roads	
1.1 Bypass	
(1) B-1	Southern Bypass
(2) B-2	Northern Bypass
(3) B-3	Eastern Bypass
1.2 Link Roads	
(1) L-1	Western Bypass Link Road
(2) L-2	Eastern Bypass Link Road /Outer Ring Road
2. Planned Radial Road	
2.1 R-3	Ngong Road/ Haile Selassie Road
2.2 R-4	Uhuru Highway
2.3 R-5	Limuru Road
2.4 R-6	Muranga Road
3. Missing Roads	
3.1 M-1 Missing Link No.1	(River Road to Ngara Road)
3.2 M-2 Missing Link No.2	(Ole Odume Road-Part) / (Muringa Road to Argwings Kodhek Road)
3.3 M-3 Missing Link No.3	(River Side Drive to Ring Road Westlands)
3.4 M-4 Missing Link No.4	(Mpaka Road) / (Mpaka to First Parkland Avenue)
3.5 M-5 Missing Link No.5	(General Waruingi Street to Juja Road)
3.6 M-6 Missing Link No.6	(Oloitoktok Road to Ring Road Kileleshwa)
3.7 M-7 Missing Link No.7	(Argwings Kodhek Road to James Gichuru Road)
3.8 M-8 Missing Link No.8	(Processional Way) / (State House Road to Kenyatta Avenue)
3.9 M-9 Missing Link No.9	(Milimani Road) / (Ralph Bunche Road to Denis Pritt Road)
3.10 M-10 Missing Link No.10	(Likoni Road Extension) / (Enterprise Road to Mombasa Road)
3.11 M-11 Missing Link No.11	(Paw Paw Road Extension) / (Muhoho Avenue to Langata Road)
3.12 M-12 Missing Link No.12	(Kung'u Karumba Road to Ngong Road)
3.13 M-13 Missing Link No.13	(Muthiora Road to Hinga Road)
3.14 M-14 Missing Link No.14	(Convent Drive Extension) / (Convent Dr to Kabarsiran Av)
3.15 (1) M-15a Missing Link No.15a	(Ring Road Parkland) / (Ring Road Parkland to Limuru Road)
3.15 (2) M-15b Missing Link No.15b	(Ring Road Parkland Extension) / (Limuru Road to Thika Road)
3.15 (3) M-15b Missing Link No.15b	(Ring Road Parkland Extension) / (Limuru Road to Thika Road)
3.15 (4) M-15c Missing Link No.15c	(Ring Road Parkland Extension) / (Ring Road Parkland to Limuru Road thru Karura Forest)
3.15 (5) M-15d Missing Link No.15d	(Ring Road Parkland Extension) / (Ring Road Parkland to Peponi Road)
3.16 M-16 Missing Link No.16	(Quarry Road Extension) / (Landhies Road to Quarry Road)
4. Intersection Improvement	Upgrading and improvement of major intersections
5. Non Motorised Transport	Pedestrian way and bicycle path
6. Traffic Management	Minor intersection improvement and network improvement

TABLE 17.1-2 R/C ROADS NETWORK PROJECTS

Radial Arterials	
R-1 Mombasa Road	R-2 Langata Road
R-3 Ngong Road	R-4 Waiyaki Way
R-5 Limuru Road	R-6 Thika Road
R-7 Juja Road	R-8 Jogoo Road
Circumferential Arterials	
C-1	Haile Selassie Avenue / Uhuru Highway / University Way / Moi Avenue
C-2	Langata Road / Mbagathi Road / Woodlands Avenue / Arboretum Road / Museum Hill Road / Ngara Road Quarry Road / Lusaka Road
C-3	Southern Bypass / Ring Road Kilimani Extension / Ring Road Kilimani / Ring Road Kileleshwa / Ring Road Westlands / Ring Road Parklands / Ring Road Parklands Extension / First Avenue Eastleigh / Likoni Road / Likoni Road Extension
Secondary Arterials	
S-1 Enterprise Road	
S-2 Magadi Road	
S-3 Naivasha Road	
S-4 Lower Kabete Road	
S-5 Kiambu Road	
S-6 Kamiti Road	
S-7 Dandora Road Extension	

(3) Bus Oriented Policy

As discussed in the transport development policy, the bus oriented policy is emphasized as one of key issues for urban transport to be implemented step by step.

Step 1; Bus Incentive Policy and Measures

This measure includes the restructuring of bus and matatu routes along major public transport corridors and provision of road infrastructures such as bus stops and terminals with incentives in the form of taxes etc.

Step 2; Bus Priority Policy and Measures

In this step, all measures under Step 1 will be implemented, and exclusive bus lanes along the following major public transport corridors will be designated, while matatu will be operated along feeder routes.

- Thika Road
- Juja Road
- Mombasa Road
- Outer Ring Road
- Waiyaki Way
- Ngong Road
- Langata Road

(4) Rail System

The development of railway transport is also proposed by two steps as mentioned in the transport development policy.

Step 1; Improvement of Existing Railway

The existing railway shall be upgraded. This includes the following routes:

- Nairobi to Thika route
- Nairobi to Athi River route
- Nairobi to Embakasi route
- Nairobi to Limuru route

Step 2; Improvement of Light Rail System (LRT)

The LRT will be introduced as step 2 in the limited routes with high demand.

- Thika Road – Moi Avenue – Mombasa Road
  (from Thika / Outer Ring Road intersection to Mombasa / Railway line intersection)

(5) Introduction of Urban Expressway System

The transport demand in the urbanized area is expected to grow at a fast rate, therefore preparation works such as acquisition of road right of way for urban expressway shall be commenced.

Step 1; Upgrading of Uhuru Highway

Step 2; Construction of circumferential route (C-2 line)
Construction of radial routes with C-3

Step 3; Construction of circumferential routes (C-3 line)
Extension of radial routes

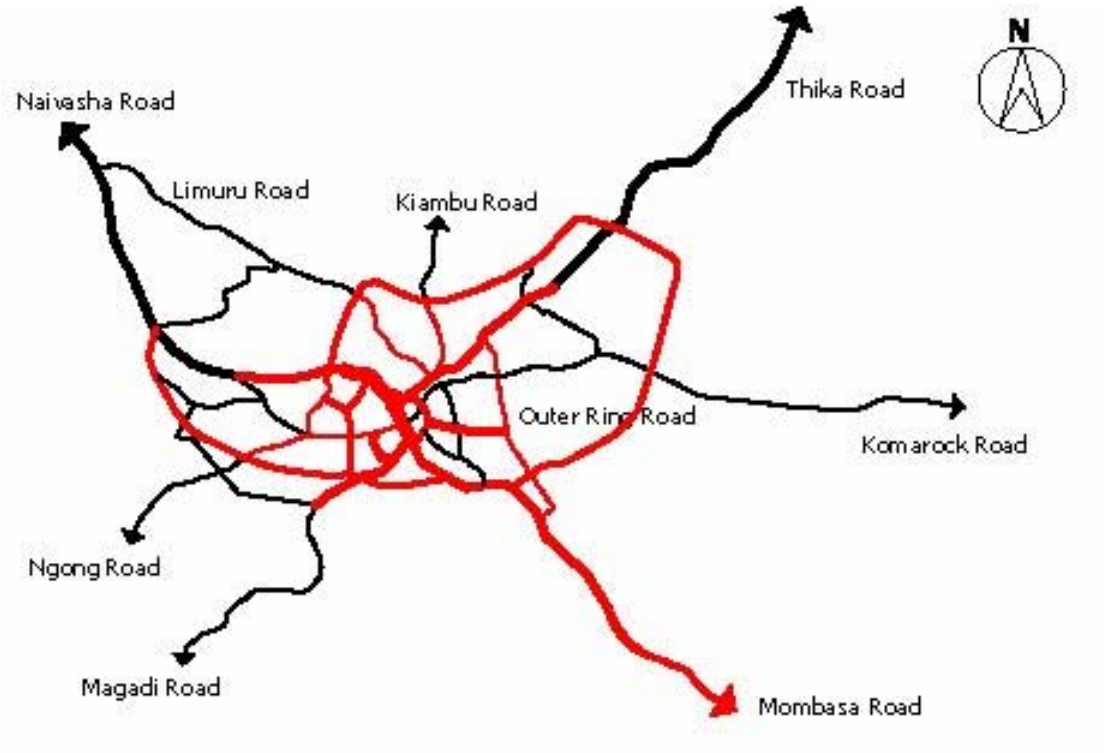


FIGURE 17.1-1 PLANNED ROAD NETWORK

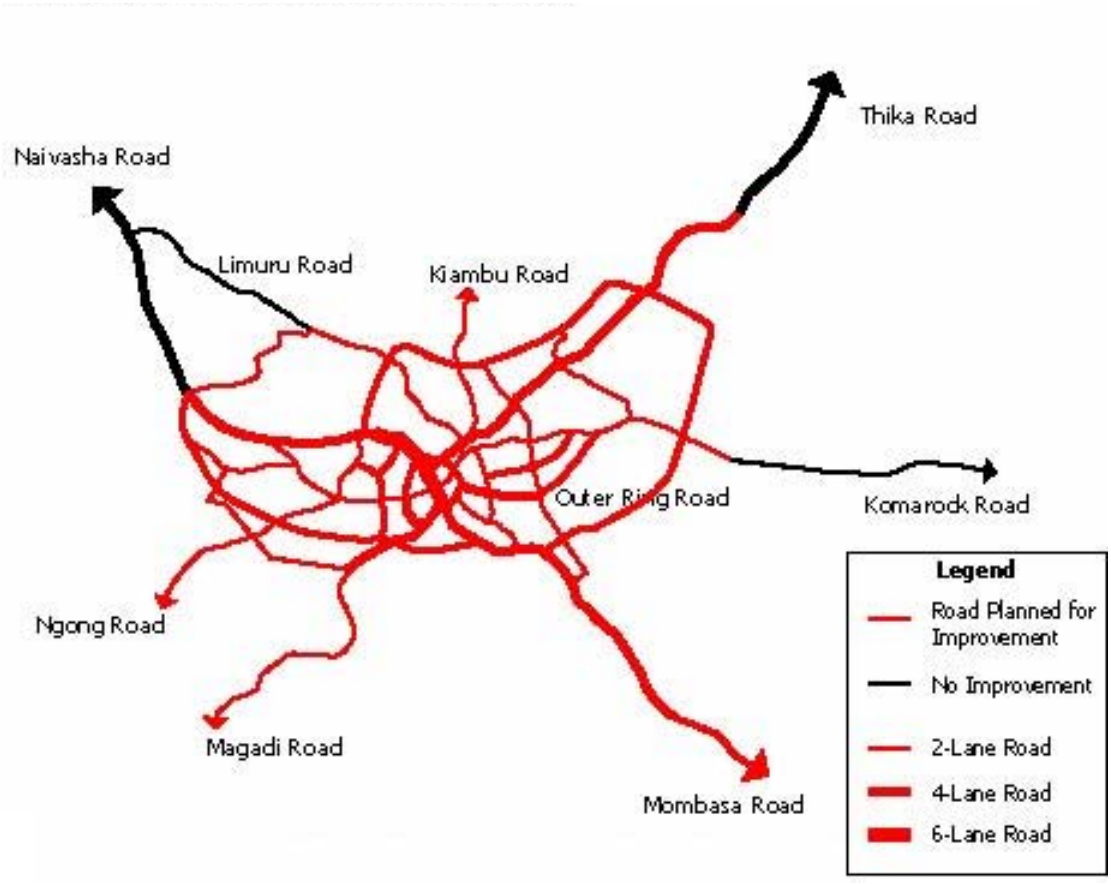


FIGURE 17.1-2 RADIAL AND CIRCUMFERENTIAL ROAD NETWORK

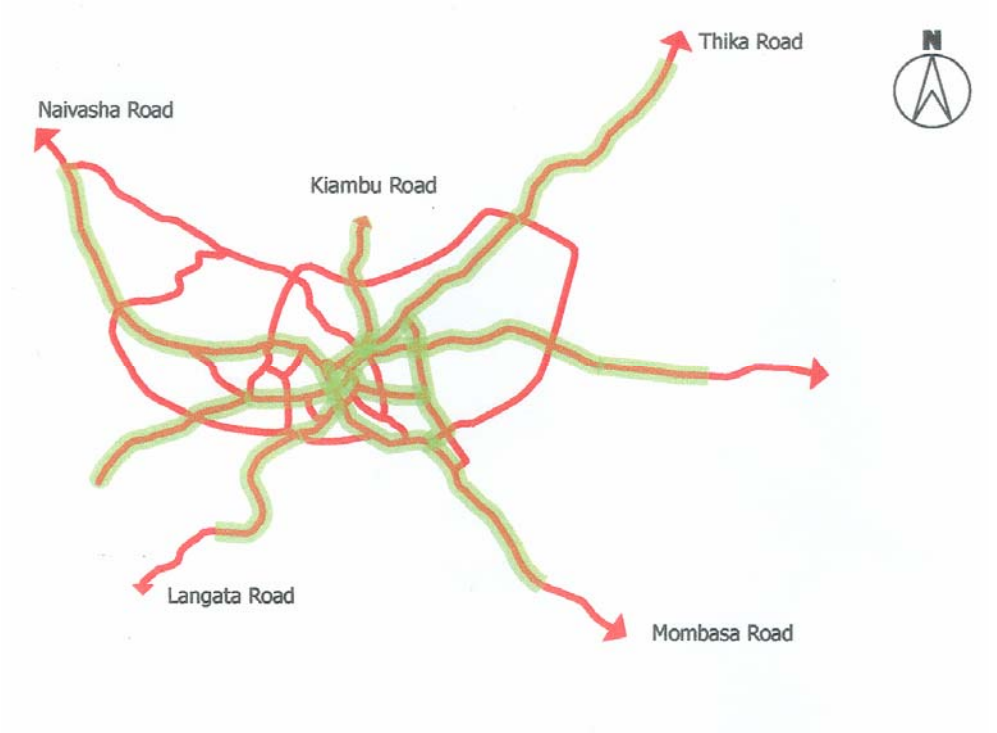


FIGURE 17.1-3 BUS INCENTIVE MEASURES

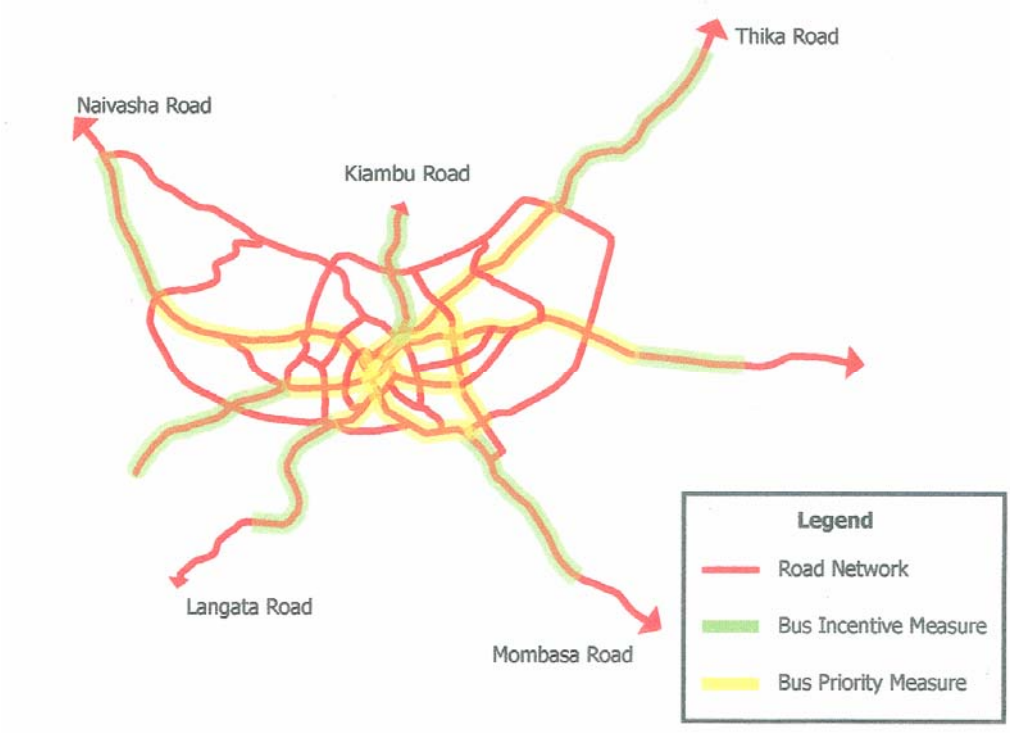


FIGURE 17.1-4 BUS PRIORITY MEASURE

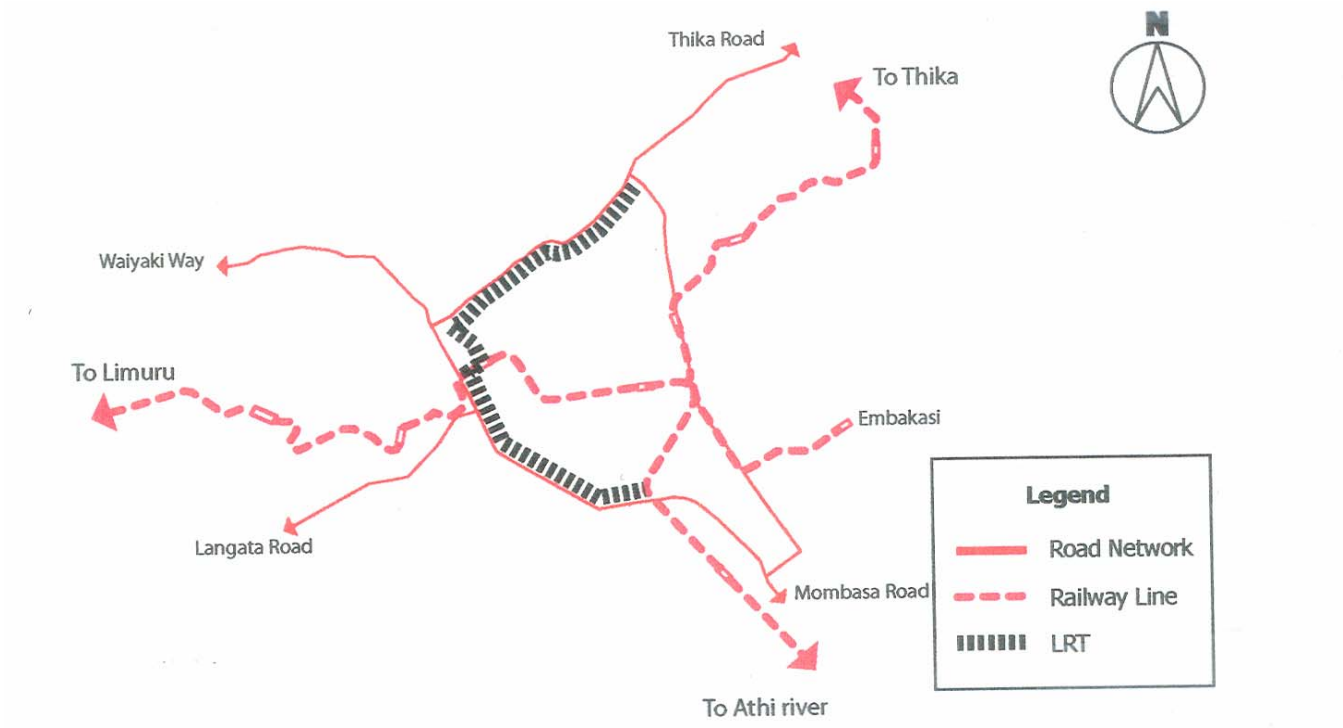


FIGURE 17.1-5 RAIL SYSTEM

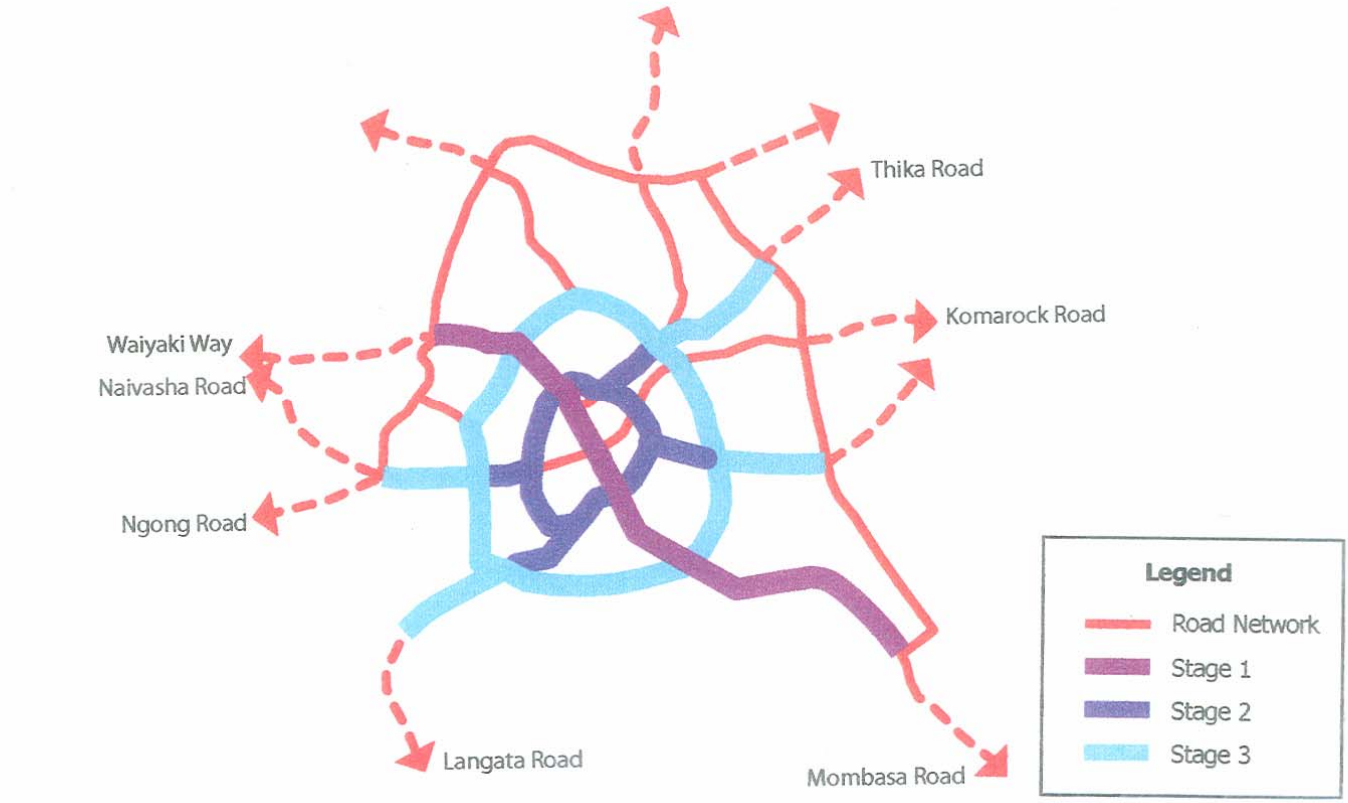


FIGURE 17.1-6 EXPRESSWAY SYSTEM

17.1.2 Generation of Master Plan Alternatives

Six (6) master plan alternatives are generated with the combination of major components examined in line with the policy and strategy proposed for the Study.

The combination of main policies and alternatives is shown in Table 17.1-3 and graphically demonstrated in Figure 17.1-7. The conceptual transport network of master plan alternatives are presented in Figure 17.1-8.

Do Nothing; Present Road Network and Present Traffic Pattern

This case is assumed to be used as the base for evaluating the alternatives. Under this case, the road network is assumed to be the same as the present one. The modal share in the future is assumed to remain almost the same as the present one except the influence of the increase in traffic demand and change due to the growth of economy.

Alternative 1; Basic Policy

This Alternative assumes the implementation of basic policy comprising of 1) the road network with completion of planned projects, 2) bus incentive policy and 3) upgrading of existing rail.

Alternative 2; Expanded Basic Policy (1)

The expanded basic policy (1) is the expansion / enhancement of basic policy to provide higher mobility and accessibility of road network (R/C road network (1)) and to enact the policy encouraging more utilization of bus (Bus Priority Policy).

Alternative 3; Expanded Basic Policy (2)

The expanded basic policy (1) is further expanded resulting to expanded basic policy (2) which includes the upgrading of existing rail and improvement of Uhuru Highway in addition to R/C road network (2) and bus priority policy.

Alternative 4; Rail Oriented System

This Alternative is the improved version of Alternative 3. A new railway along the high demand corridors is introduced.

Alternative 5; Expressway Oriented System

This Alternative is also the extension of Alternative 3, which aims at establishing the expressway oriented urban transport system composed of expressway stage 1, 2 and 3.

Alternative 6; Ideal Urban Transport System

This Alternative assumes the introduction of the ideal urban transport system encompassing almost all modern transport infrastructures and services such as 1) R/C road network (2), 2) Bus priority policy, 3) upgrading of existing rail, 4) new railway (LRT) and expressway stage 1, 2 and 3.

The linkage of policy, strategy and each plan alternative is shown in Table 17.1-4.

TABLE 17.1-3 MASTER PLAN ALTERNATIVES

Alternatives	Main Policies	Road Development			Public Transport				LRT	Expressway System			Modal Share in 2025
		Present	Planned Projects	R/C Network	Present	Bus Incentive	Bus Priority	Existing Rail		Stage 1	Stage 2	Stage 3	
Do notihng	・Present Road Network ・Present Traffic Pattern	○			○								・Walk 44% ・Car 26% ・Public 30%
Alternative 1 Basic Policy	・Planned Projects ・Bus Incentive Policy		○			○							・Walk 42% ・Car 26% ・Public 32%
Alternative 2 Expanded Basic Policy (1)	・R/C Road Network (1) ・Bus Priority Policy			○			○						・Walk 40% ・Car 25% ・Public 35%
Alternative 3 Expanded Basic Policy (2)	・R/C Road Network (2) ・Bus Priority Policy ・Existing Rail ・Improvement of Uhuru Highway			○			○	○					・Walk 40% ・Car 25% ・Public 35%
Alternative 4 Rail Oriented System	・R/C Road Network (2) ・Bus Priority Policy ・Existing Rail ・LRT			○			○	○	○				・Walk 39% ・Car 24% ・Public 37%
Alternative 5 Expressway Oriented System	・R/C Road Network (2) ・Bus Priority Policy ・Existing Rail ・Expressway (Stage 1,2 & 3)			○			○	○		○	○	○	・Walk 39% ・Car 28% ・Public 33%
Alternative 6 Ideal Urban Transport	・R/C Road Network (2) ・Bus Priority Policy ・Existing Rail ・LRT ・Expressway (Stage 1,2 & 3)			○			○	○	○	○	○	○	・Walk 39% ・Car 26% ・Public 35%

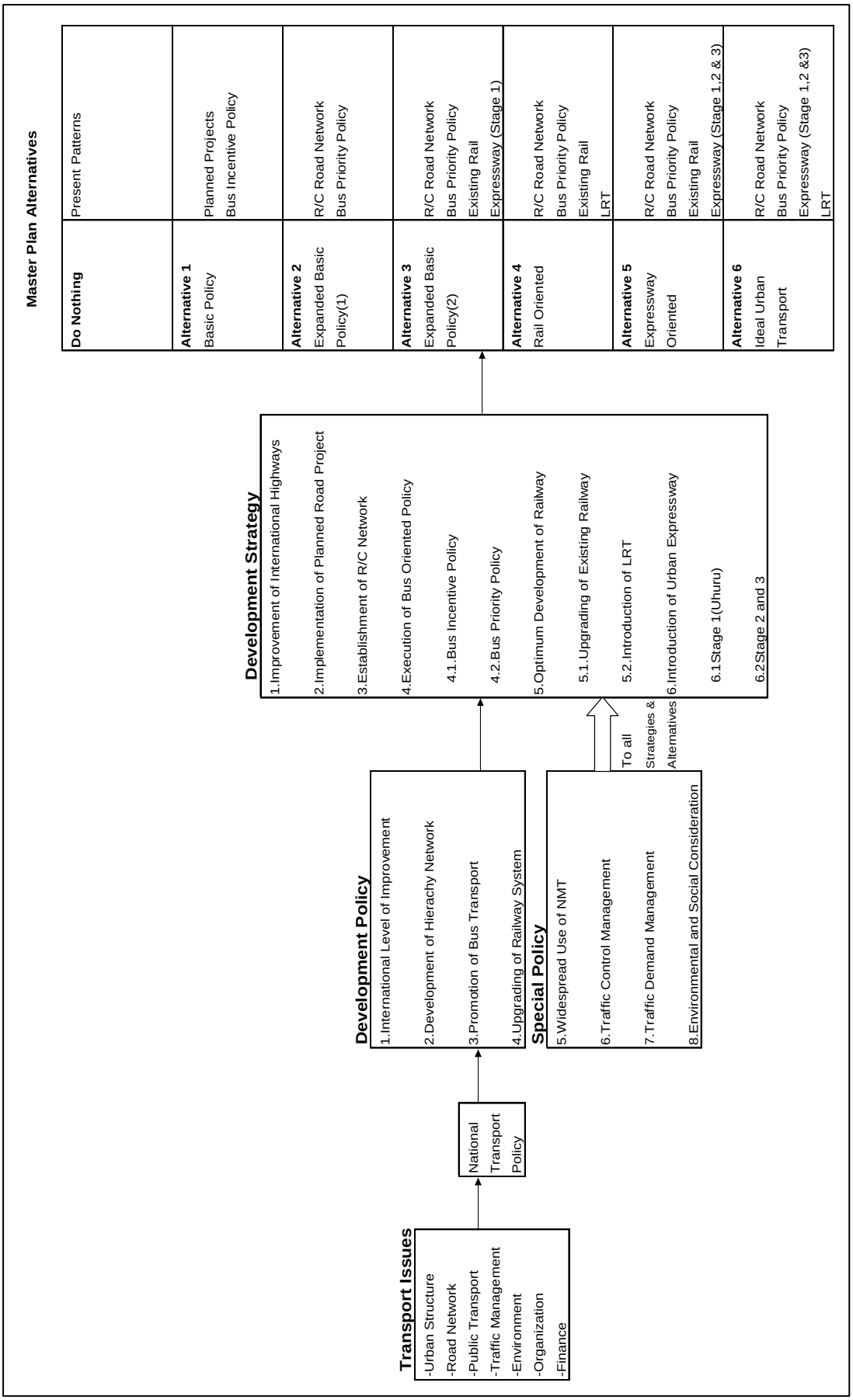


FIGURE 17.1-7 LINKAGE OF POLICY, STRATEGY AND PLAN ALTERNATIVE

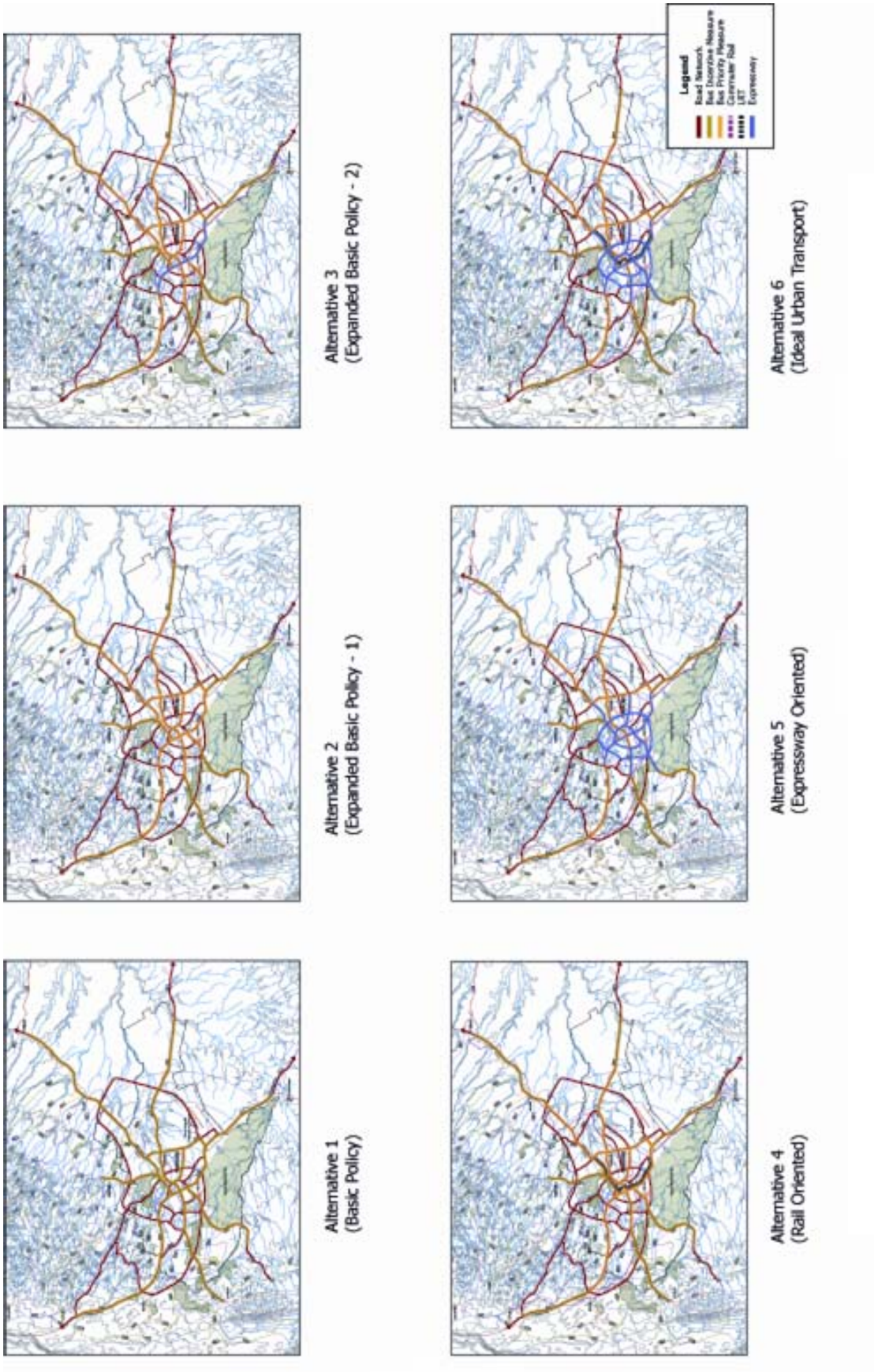


FIGURE 17.1-8 CONCEPTUAL TRANSPORT NETWORK OF MASTER PLAN ALTERNATIVES

17.1.3 Assumption of Modal Share Simulation

(1) Modal Split model formulation

Logit model is chosen to estimate modal split. This model can be expressed by the following:.

Pij car = Ucar / (U car + U public)

U_car = a1 * Car_rate_i + b1 * Car_rate_j + c1 * Park_car + d1 * Tij_car + e1 * Cij_car

U_public = + d2 * Tij_public + e2 * Cij_public

Where; Pij: modal share

U: Utility function

Car_rate: Car ownership rate in origin or destination zone

Tij_car : travel time by car mode

Tij_public: travel time by bus or rail mode (= min (Tij_bus, Tij_Rail))

Park: parking cost only in CBD area (=70Ksh)

Cij_car : travel cost by car mode (VOC: Vehicle operation cost = 20Ksh/km)

Cij_public: travel cost by bus or rail mode (= min (Tij_bus, Tij_Rail))

a, b,c,d,e : parameters

The explanatory variables by zone pair and zonal attribute are introduced in the model, the former of which are the travel time and travel cost by private and public modes. The latter are car ownership rate and parking cost in origin or destination zone.

(2) Modeling the modal shift from NMT to MT

Considering the modal shift from walking to private or public mode by the implementation of transportation policies, total walking shift rates are developed using the logit model below.

Pij walk = U_walk / (U_walk + U_car + U_public)

U_walk = f1 * Lij + f2 * Car_rate_i + f3 * Car_rate_j

Where; Lij : Trip length from I zone to j zone

Car_rate: Car ownership rate in origin or destination zone

f1, f2, f3: model parameter

TABLE 17.1-4 NMT MODAL SHIFT MODEL PARAMETERS

	To Home	To Work	To School	Others
Lij	-2.0765	-2.2246	-2.1584	-2.0958
Car_Rate at Origin Zone	-	-13.1474	-11.3551	-12.2861
Car_Rate at Destination Zone	-11.5039	-	-	-

(3) Assumption of travel time and cost estimate for Network Improvement Policies

Travel time and cost among all zone pairs were estimated using TRANSCAD assignment module with the assumption of following mode condition.

Travel time Tij = Tij_simulation * F+ Tij_access + Tij_egress + Tw

Travel cost Cij = a Lij =< c

Cij = a + b*(Lij - c) Lij > c

Where; Ti_simulation: Travel Time from i to j by TRANSCAD assignment module

Tij_access: Travel time from origin zone to transport network / station

Tij_egress: Travel time from transport network / station to destination zone

Tw: Waiting time at station/bus stop

Lij: Travel length from i to j (km)

F: Adjustment factor derived from the travel speed survey

a, b, c: parameters

TABLE 17.1-5 ASSUMPTION OF TRAVEL TIME SIMULATION

Mode	Policy Type	Vo Speed(km/h)	F Adjustment factor	Tij_access/egress Zone Access	Tw Waiting Time
Car	Existing Road	20 - 60 km/h	0.75	5 min	0 min
	Planned road	40 - 60 km/h	0.75	5 min	0 min
	R/C Network	60 km/h	0.80	5 min	0 min
	Expressway	80 km/h	0.80	5 min	0 min
Bus	Existing	20 - 60 km/h	0.65	5 min	10 min
	Bus incentive	20 - 60 km/h	0.65	5 min	10 min
	Bus Priority	20 - 60 km/h	0.70	5 min	10 min
Rail	Existing	25 km/h	1.00	(by simulation)	20 min
	Rehabilitation	35 km/h	1.00	(by simulation)	10 min
	LRT	40 km/h	1.00	(by simulation)	10 min

TABLE 17.1-6 ASSUMPTION OF TRAVEL COST SIMULATION

		A(constant)	B(slope)	c (km)
Car	Parking	70	0	0
	VOC	0	20	0
Bus		20	2	5
Rail		20	2	5
LRT		20	2	5

(4) Assumption of Occupancy Rate and PCU for Bus Policies

Number of passenger per vehicle (Occupancy Rate) and passenger car unit (PCU) for each bus policy, are assumed as shown in Table 17.1-7.

TABLE 17.1-7 ASSUMPTION OF AVERAGE NO. OF PASSENGER AND PCU

		Occupancy Rate	PCU (Passenger Car Unit)
Car		1.7	1.10
Bus	Existing	19.0	1.60
	Bus Incentive	24.5	1.75
	Bus Priority	28.0	1.85

(5) Preparation of Input Data of Modal Split Simulation

Input data in terms of each parameter required by the modal split models were prepared for each traffic zone and zone pair for each of the alternative strategies. Combinations of transport improvement policies for each alternative are listed in Table 17.1-8 while the planning data, estimates of population, work force, student and car ownership in each zone are shown in Table17.1-9.

TABLE 17.1-8 COMBINATION OF POLICIES IN EACH ALTERNATIVE STRATEGY

	Road Network	Bus Service	Railway Service
(Do-Nothing)	Existing	Existing	Existing
Alternative 1	Existing + Planned Projects	Bus Incentive	Existing
Alternative 2	Existing + Planned Projects R/C Network (1)	Bus Priority	Existing
Alternative 3	Existing + Planned Projects R/C Network (2) + Improvement of Uhuru Highway	Bus Priority	Rehabilitation
Alternative 4	Existing + Planned Projects R/C Network (2) + LRT	Bus Priority	Rehabilitation LRT
Alternative 5	Existing + Planned Projects R/C Network (2) + Expressway Stage 1 2 & 3	Bus Priority	Rehabilitation
Alternative 6	Existing + Planned Projects R/C Network (2) + LRT + Expressway Stage 1 2 & 3	Bus Priority	Rehabilitation LRT

TABLE 17.1-9 FUTURE FRAMEWORK

	2004	2010	2015	2025
GRDP per capita(Nairobi) (at 1982 constant prices :Ksh)	19,040	22,080	25,590	34,390
GRDP per household(Nairobi) (at 2004 constant prices :Ksh)	32,600	37,805	43,815	58,882
Number of Household	889,317	1,028,675	1,131,492	1,391,838
Car ownership rate per household	23.3%	31.1%	41.3%	49.2%
Number of private car(Nairobi)	207,339	319,428	467,740	684,833
Population 5 & above	2,143,254	2,540,716	2,834,559	3,507,666
Student at enrolment place base	1,258,802	1,603,787	1,804,838	2,273,343
Worker at office base	517,825	620,510	707,122	877,545
Unemployment	366,627	356,777	322,599	316,419

(6) Simulation Results of Alternatives (Modal Share)

The simulation results of modal share of alternatives 1, 2, 3, 4, 5, 6 and Do-nothing case in 2004 and 2025 are available in Table 17.1-10 and illustrated in Figure 17.1-9 and Figure 17.1-10.

TABLE 17.1-10 MODAL SHARE IN ALTERNATIVES

	WALK	CAR	BUS	RAIL	LRT	TOTAL
2004	2,326,021	723,614	1,682,859	21,533	0	4,754,027
	48.9%	15.2%	35.4%	0.5%	0.0%	100.0%
Alternative 0	3,613,754	2,156,583	2,481,613	24,020	0	8,275,969
Do-Nothing 2025	43.7%	26.1%	30.0%	0.3%	0.0%	100.0%
Alternative 1	3,460,442	2,130,421	2,659,986	25,120	0	8,275,969
	41.8%	25.7%	32.1%	0.3%	0.0%	100.0%
Alternative 2	3,302,676	2,066,701	2,879,628	26,963	0	8,275,969
	39.9%	25.0%	34.8%	0.3%	0.0%	100.0%
Alternative 3	3,302,807	2,069,541	2,849,791	53,830	0	8,275,969
	39.9%	25.0%	34.4%	0.7%	0.0%	100.0%
Alternative4	3,243,235	1,990,196	2,782,962	55,182	204,393	8,275,969
	39.2%	24.0%	33.6%	0.7%	2.5%	100.0%
Alternative 5	3,255,812	2,312,524	2,659,447	48,186	0	8,275,969
	39.3%	27.9%	32.1%	0.6%	0.0%	100.0%
Alternative 6	3,235,898	2,109,899	2,679,460	51,917	198,795	8,275,969
	39.1%	25.5%	32.4%	0.6%	2.4%	100.0%

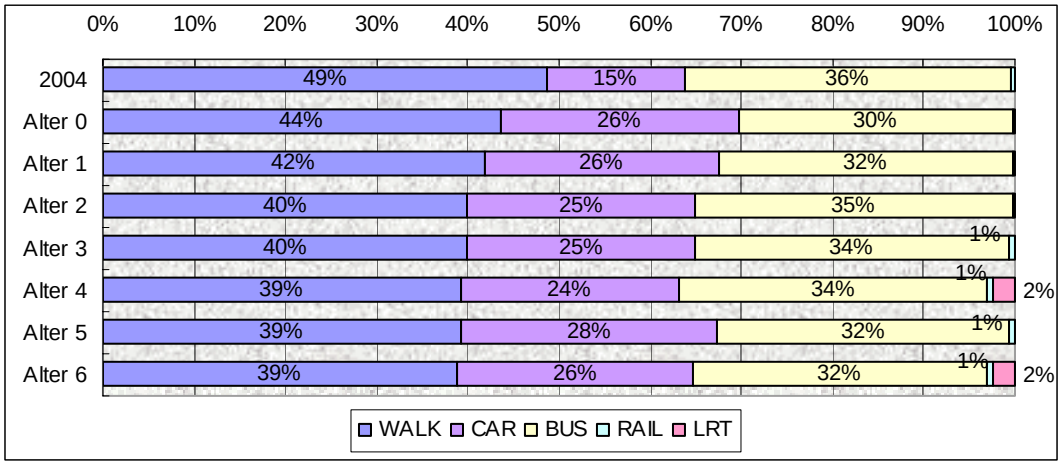


FIGURE 17.1-9 MODAL SHARE IN ALTERNATIVES

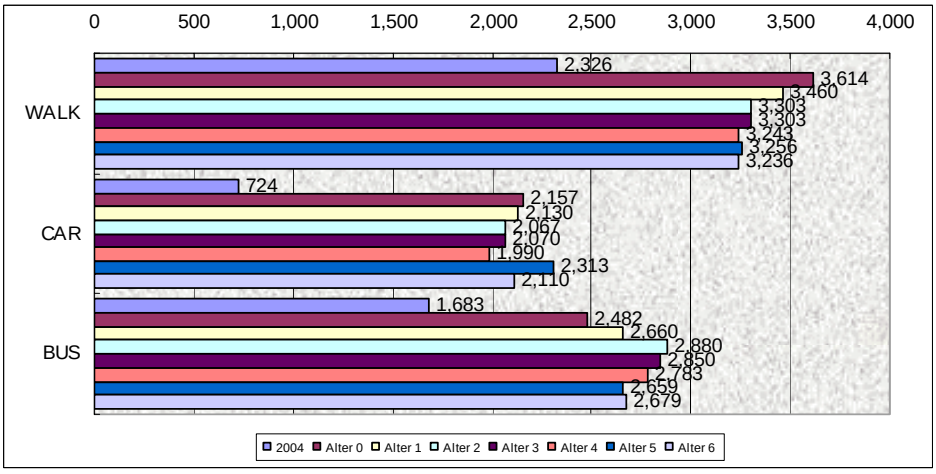


FIGURE 17.1-10 NUMBER OF TRIP BY MODE IN ALTERNATIVES

17.2 COMPARATIVE EVALUATION OF MASTER PLAN ALTERNATIVES

17.2.1 Evaluation Method

The master plan alternatives are comparatively evaluated based on the five (5) factors.

(1) Economic Viability

- Benefit Cost Ratio (B/C Ratio)
  Economic Internal Rate of Return (EIRR)

(2) Traffic Condition

- Average Travel Speed
  This indicator should be higher than the figure shown in Table 17.2-1 as proposed in Chapter 16.
- Average V/C Ratio
  This should be smaller than the volume capacity ratio, (V/C ratio =1) for LOS=C, and (V/C ration a little bigger) for LOS=0.

TABLE 17.2-1 TARGETS OF TRAVEL SPEED AND V/C

	LOS	Average Travel Speed (km/hour)	Average V/C Rates
Principal Arterials	C	40	1.0
Minor Alternatives	C	30	1.0
Collectors and others	D	20	A little bigger than 10.

(3) System Efficiency

- Travel Length
  The travel length of alternatives is compatible with each other. The shortest is best.
- Travel Time
  The travel times are also compared with each other. The shortest is best.
- Travel Cost

(4) Environmental impact

- Traffic nuisance; estimated degree of nuisance for the alternatives are compared with each other.
- Traffic accidents; degrees of impact on increase/decrease of traffic accidents are compared with each other.

(5) Social Impact

- Right of way acquisition
  The area of reserved right of way and area to be newly acquired are compared with each other.
- Relocation of project affected people (PAP)
  The probable number of PAP is roughly estimated and difficulty of relocation is compared with each other.
- Public acceptance of transport policy and modes is evaluated.

17.2.2 Comparative Evaluation of Transport System

(1) Traffic Assignment Analysis

The traffic assignment analysis of six (6) alternatives was made on the proposed transport networks in Year 2025. The results are graphically shown in Figure 17.2-1 which indicates number of vehicles and VCR on each link.

(2) Comparative Analysis of Traffic Indicators

Table 17.2-2 summarizes the comparison of traffic indicators of each alternative.

TABLE 17.2-2 TRAFFIC INDICATORS OF ALTERNATIVES

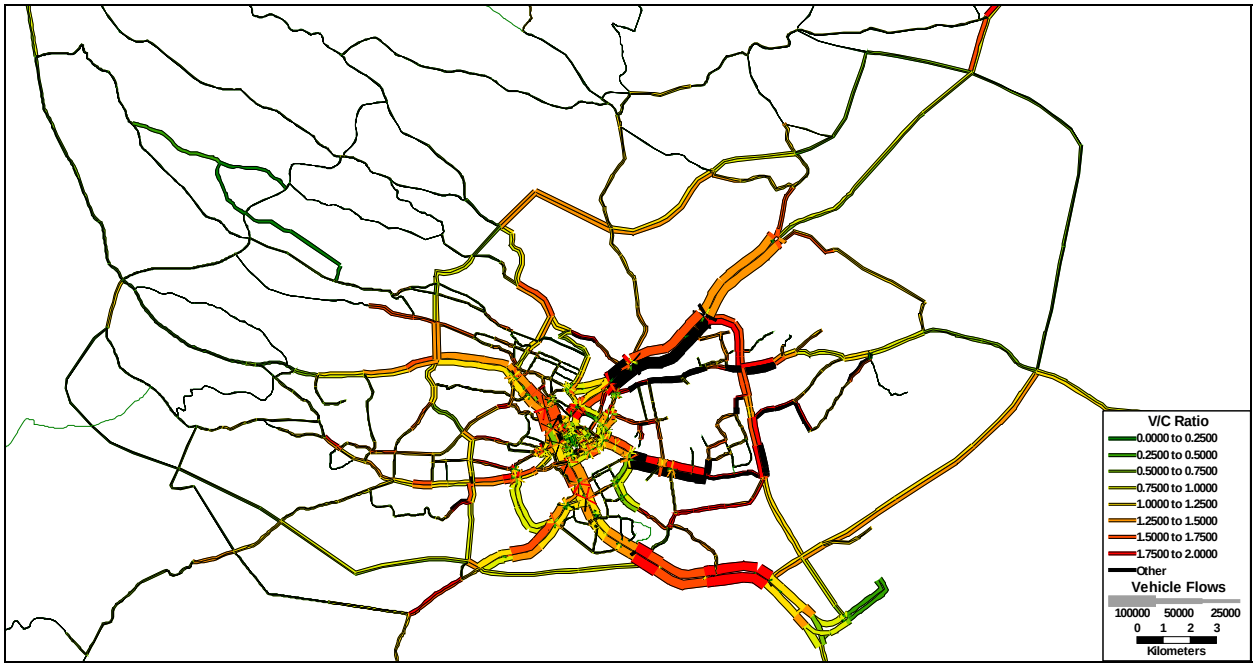
	Total trips (trips/day)	Vehicle-hours total (1,000veh.hours)	Vehicle-km Total (1,000veh.km)	Ave. travel speed (km/h)	Ave. V/C Urbanised area (radial)	Ave. V/C Urbanised area (circumferential)	Ave. V/C Central area
2004	779,774	286	9,935	34.7	0.59	0.68	0.97
Alternative 0	1,933,581	2,484	27,934	11.2	1.67	1.69	2.19
Alternative 1	1,914,054	1,100	24,987	22.7	1.11	1.11	1.43
Alternative 2	1,864,083	717	22,382	31.2	0.94	0.92	1.13
Alternative 3	1,863,804	655	21,751	33.2	0.90	0.87	1.09
Alternative 4	1,806,045	606	20,978	34.6	0.88	0.86	0.99
Alternative 5	2,013,039	680	23,868	35.1	0.98	0.81	0.83
Alternative 6	1,878,875	597	22,195	37.2	0.92	0.75	0.75

The traffic indicators of each alternative were evaluated from the view point of reduction of vehicle trip hours, length and fluidity. As for the reduction of vehicle trip, Alternative four (4) shows the highest efficiency of network, followed by Alternative 3 and 6 which are evaluated as preferable in comparison with Alternative 0 and 1.

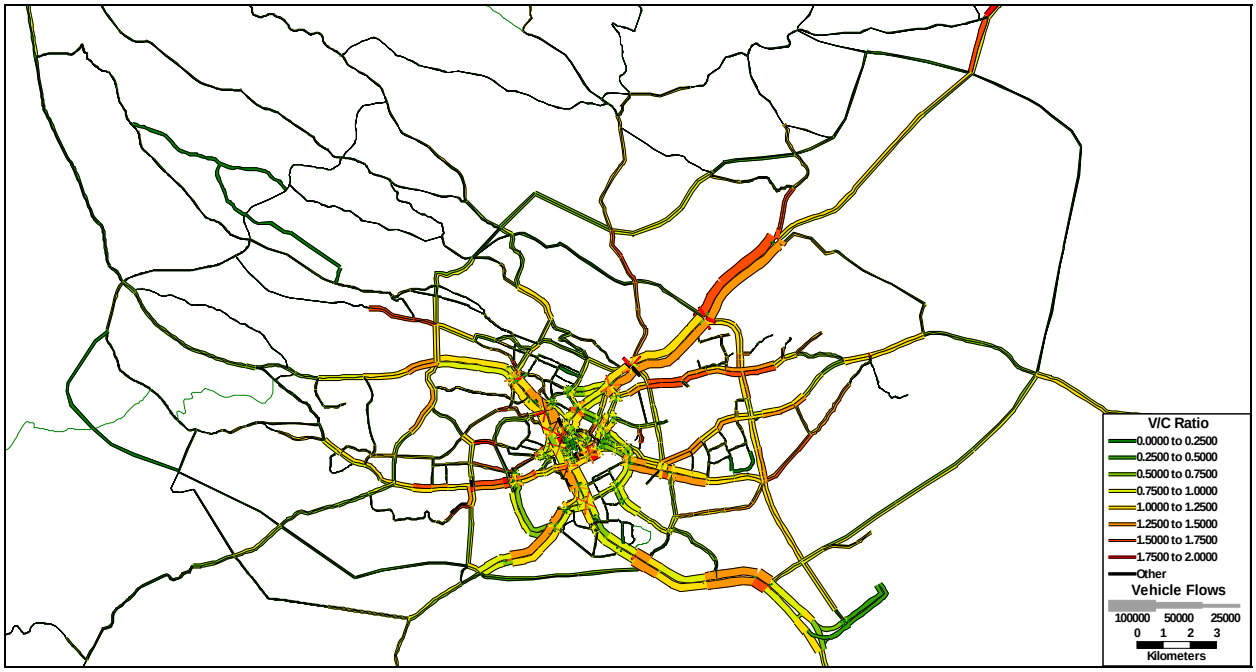
As for the fluidity of movement, Alternative 6 also shows the highest average travel speed and lowest VCR reflecting well formulated expressway network. Alternative 3, 4 and 5 indicates the formable results, amongst which Alternative 3 is likely to be preferable because of reasonable average travel speed and VCR less than 1.0 without infrastructure facilities of LRT and expressway.

(3) Comparative Analysis of VCR

The VCR on major arterials was further analyzed in both the urbanized area and central area, as shown in Table 17.2-3 and Table 17.2-4 respectively. Compared to the Do Nothing Case, each alternative shows preferable results regarding the road congestion (V/C Ratio).

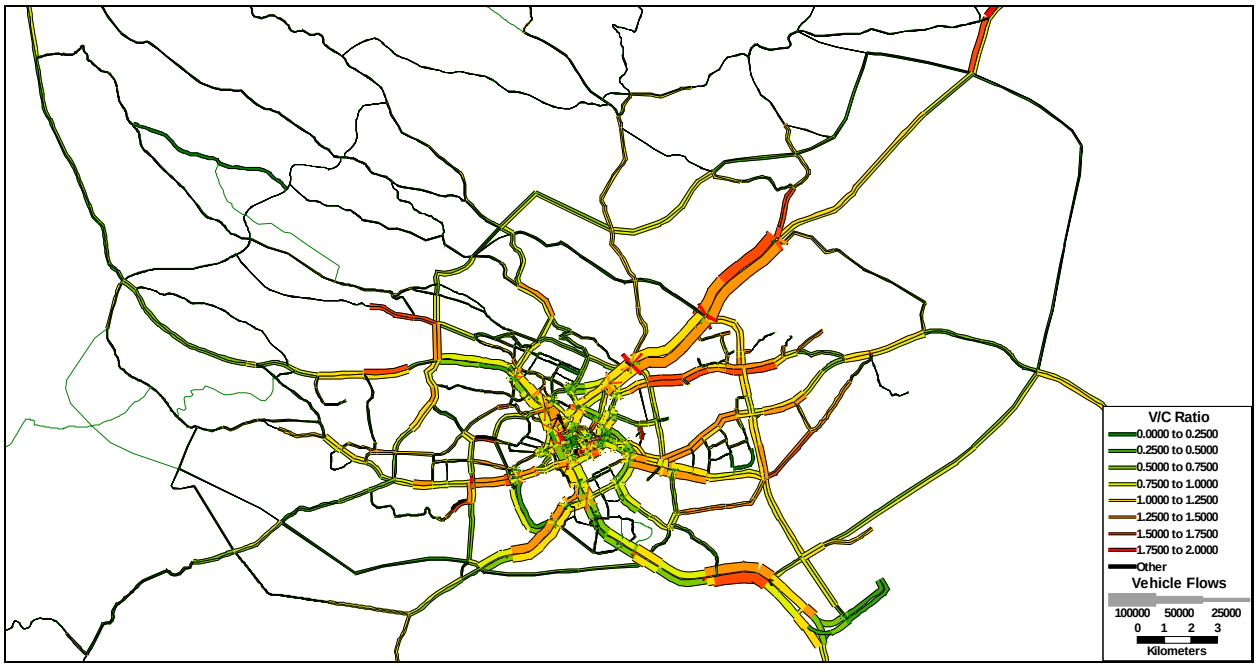


Alternative 1

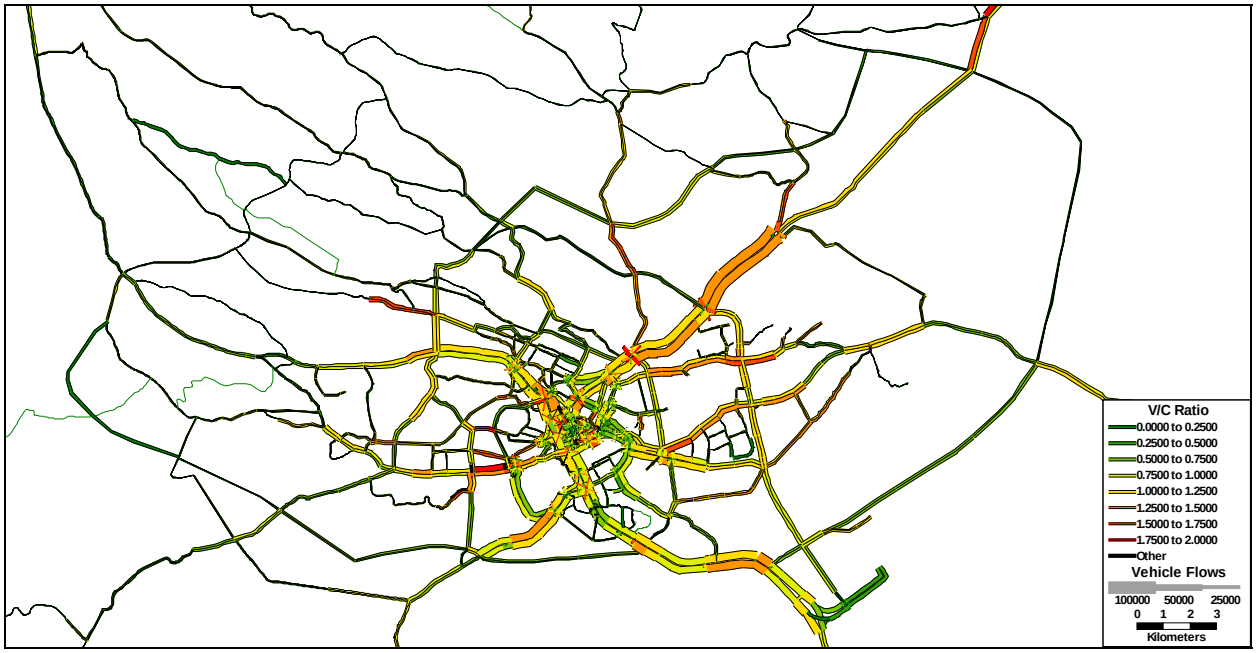


Alternative 2

FIGURE 17.2-1 (1) TRAFFIC ASSIGNMENT OF ALTERNATIVES

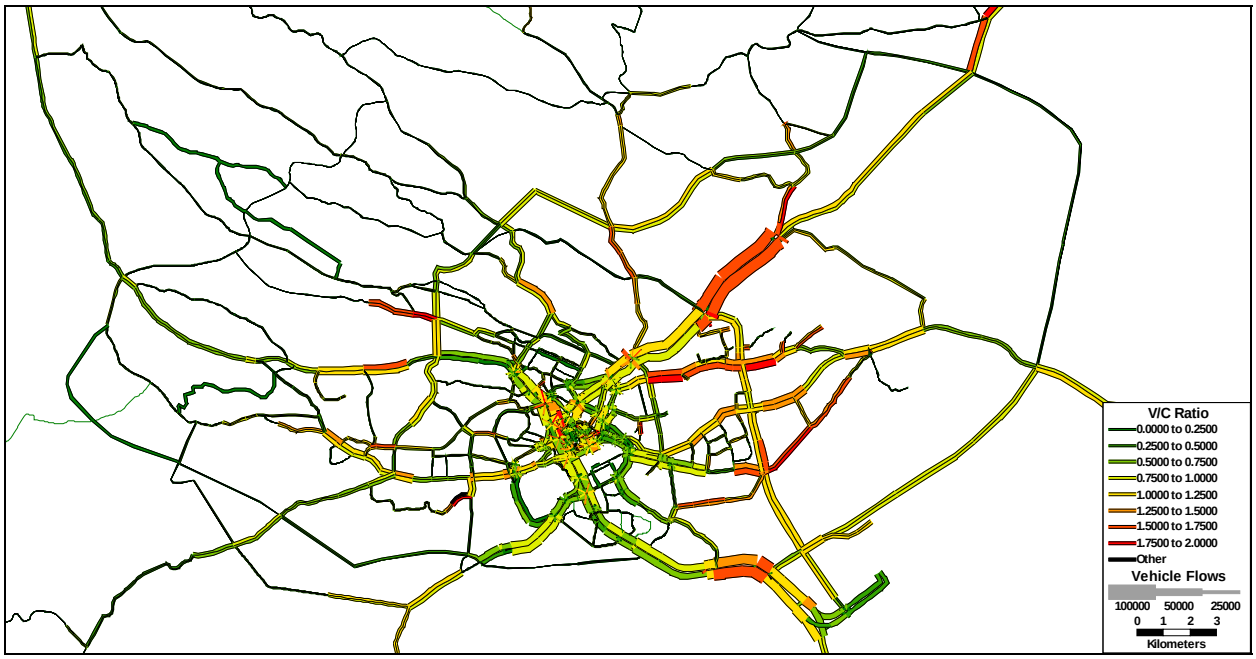


Alternative 3

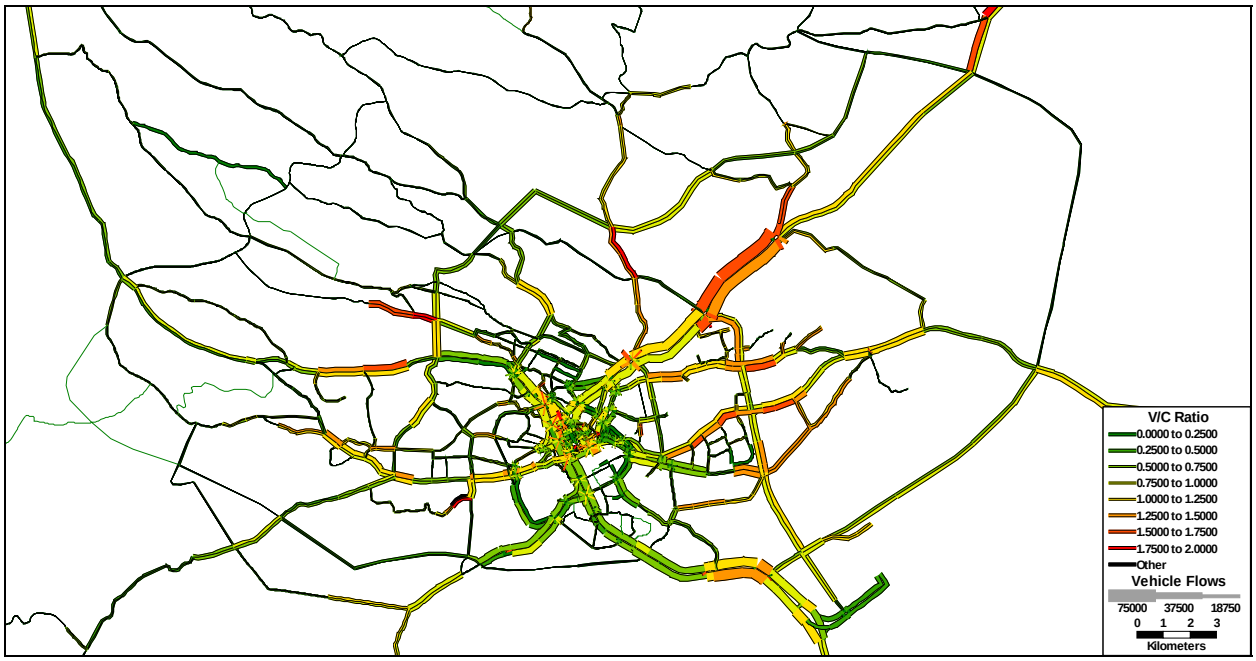


Alternative 4

FIGURE 17.2-1 (2) TRAFFIC ASSIGNMENT OF ALTERNATIVES



Alternative 5



Alternative 6

FIGURE 17.2-1 (3) TRAFFIC ASSIGNMENT OF ALTERNATIVES

As for the road congestion in urbanized area, Alternative 4 showed the most desirable results with average V/C ratio of 0.88 in radial direction followed by Alternative 2 and 3. V/C ratio by direction also shows moderate values except for north direction. Capacity of arterial roads in north direction is relatively critical in all alternatives. Even in case of Alternative 3, average V/C ratio shows some 1.4 by scrutinizing the V/C ratios. In the circular direction, the capacity of arterial roads sufficiently meets the traffic demand except for Alternative 1.

As for the road congestion in the central area, the forecast results show different evaluation compared to those for urbanized area. Most preferable result was obtained from Alternative 6 followed by Alternative 5, 4 and 3. In Alternative 6 case, V/C ratios are generally below 1.0 with an average value of 0.78. Capacity analysis by direction revealed that the direction towards the west relatively showed strained results. Alternative 3 shows preferable results for urbanized area except for Alternative 5 and 6 which require an expressway system.

TABLE 17.2-3 COMPARATIVE ANALYSIS OF ROAD VCR

Unit: Kilometre

VCR	Do Nothing	Alt1	Alt2	Alt3	Alt4	Alt5	Alt6
Below 0.50	670.5	936.1	1,022.3	1,056.5	1,032.1	1,095.5	1,131.3
0.50 - 0.75	206.0	173.0	170.7	187.2	234.6	207.4	219.2
0.75- 1.00	92.2	112.8	167.3	128.1	119.1	147.6	125.7
1.0 - 1.25	86.7	96.2	83.2	103.2	97.9	100.0	93.8
1.25 - 1.50	90.7	101.1	53.6	49.0	45.5	41.6	36.1
1.5 - 1.75	81.8	34.6	21.4	17.3	12.1	22.9	13.0
1.75 - 2.00	48.2	31.0	9.0	2.6	3.0	7.5	3.3
2.00 and above	139.2	29.9	3.4	2.5	2.1	2.0	1.9

TABLE 17.2-4 COMPARATIVE ANALYSIS OF AVERAGE VCR BY AREA

Area	Alt0	Alt1	Alt2	Alt3	Alt4	Alt5	Alt6
Central	1.49	1.15	0.93	0.86	0.83	0.77	0.69
Dagoretti	1.08	0.74	0.63	0.58	0.57	0.57	0.55
Embakasi	1.47	1.25	0.89	0.84	0.80	0.89	0.80
Kasarani	1.81	1.07	0.89	0.79	0.76	0.83	0.77
Kibera	1.44	0.89	0.64	0.60	0.59	0.56	0.51
Makadara	1.60	1.17	0.88	0.79	0.70	0.67	0.57
Pumwani	2.14	1.49	0.98	0.97	0.92	0.81	0.74
Westland	1.61	1.07	0.83	0.77	0.75	0.64	0.60

TABLE 17.2-5 VCR IN URBANIZED AREA

	Year		2025 Alt0	2025 Alt1	2025 Alt2	2025 Alt3	2025 Alt4	2025 Alt 5	2025 Alt6
	Area	Name of Road							
Radial Road	North	R-6 Thika Road	2.38	1.44	1.43	1.10	1.07	1.19	1.12
		S-5 Kiambu Road	1.94	1.25	1.18	0.93	0.91	1.15	1.05
	East	R-7 Koma Rock	1.71	1.02	0.87	0.73	0.69	0.81	0.64
		R-8 (New Road)	-	-	1.28	1.36	1.25	1.53	1.35
		S-7 Kangundo Road	1.81	1.11	0.78	0.88	0.87	1.01	0.89
	South East	R-1 Mombasa Road	1.58	1.18	1.01	1.00	0.93	1.03	0.95
	South West	R-2 Langata Road	2.15	1.69	0.82	0.88	0.86	0.96	0.91
	West	R-3 Ngong Road	0.96	0.78	0.68	0.65	0.64	0.72	0.66
		S-3 Naivasha Road	1.29	1.09	0.75	0.88	0.91	1.03	0.99
	North West	R-4 Waiyaki Way	1.73	1.37	1.08	1.06	1.03	1.15	1.14
		R-5 Limuru Road	1.05	0.31	0.43	0.39	0.46	0.38	0.38
		Red Hill Road	1.08	0.35	0.32	0.34	0.25	0.30	0.30
		S-4 Lower Kabete Road	1.47	1.53	1.54	1.55	1.56	1.67	1.62
	Total		**1.67**	**1.11**	**0.94**	**0.90**	**0.88**	**0.98**	**0.92**
Circumferential	East	C-2 (New Road)	-	-	0.65	0.60	0.58	0.28	0.24
		C-3 First Avenue	1.90	1.01	0.85	0.83	0.73	0.62	0.52
		C-4 Outer Ring Road	2.87	1.57	1.29	1.29	1.25	1.26	1.15
		EC1 Expressway C-1	-	-	-	-	-	0.61	0.53
		EC2 Expressway C-2	-	-	-	-	-	0.78	0.72
	West	C-2 Mbagathi Road	1.46	0.78	0.72	0.56	0.56	0.37	0.33
		C-3 (New Road)	-	1.21	1.04	0.91	1.02	0.59	0.58
		C-4 James Gichuru Road	2.02	0.93	0.64	0.68	0.69	0.59	0.58
		EC1 Expressway C-1	-	-	-	-	-	0.68	0.61
		EC2 Expressway C-2	-	-	-	-	-	0.27	0.21
	Total		**1.69**	**1.11**	**0.92**	**0.87**	**0.86**	**0.81**	**0.75**
URBANIZED AREA TOTAL			**1.68**	**1.11**	**0.92**	**0.88**	**0.86**	**0.86**	**0.80**

TABLE 17.2-6 VCR IN CENTRAL AREA

	Year		2025 Alt0	2025 Alt1	2025 Alt2	2025 Alt3	2025 Alt4	2025 Alt 5	2025 Alt6
	Area	Name of Road							
Radial Road	North	R-6 Muranga Road	3.58	1.99	1.65	1.62	1.52	1.33	1.12
		ER6 Expreesway Thika	-	-	-	-	-	0.59	0.52
	East	R-7 Jogoo Road	2.66	1.99	1.44	1.29	1.08	0.95	0.81
		R-8 Juja Road	2.65	1.97	1.22	1.07	0.85	0.90	0.77
		S-7 (New Road)	-	-	-	0.98	1.05	0.73	0.68
		ER7 Expreesway Juja	-	-	-	-	-	1.06	0.96
	South East	R-1 Mombasa Road	1.64	1.31	0.98	0.95	0.79	0.72	0.67
		S-1 Enterprise Road	1.10	0.63	0.78	0.72	0.67	0.55	0.46
		ER1 Expressway Mombasa	-	-	-	-	-	0.64	0.50
	South West	R-2 Langata Road	2.06	1.38	1.20	1.22	1.14	0.78	0.70
		ER2 Expressway Langata	-	-	-	-	-	0.71	0.63
	West	R-3 Ngong Road	2.95	1.47	1.35	1.51	1.25	1.02	0.98
		ER3 Expressway Ngong	-	-	-	-	-	1.08	1.03
	North West	R-4 Chiromo Road	1.91	1.25	1.06	1.07	1.02	0.75	0.77
		R-5 Limuru Road	2.41	1.30	0.69	0.53	0.51	0.49	0.45
		S-4 Parklands Road	1.42	1.20	0.61	0.69	0.64	0.52	0.47
		ER5 Expressway Waiyaki	-	-	-	-	-	0.97	0.85
CENTRAL AREA TOTAL			**2.19**	**1.43**	**1.13**	**1.09**	**0.99**	**0.83**	**0.75**

(4) Economic Evaluation

Unit Traffic Cost

Countable benefits from the Master Plan development consist of the following items:

a) Vehicles Traffic cost saving benefit
b) Pubic Transport Passenger travel time cost saving

Traffic cost consists of vehicle operating cost (VOC) and travel time cost (TTC). VOC can be subdivided into two (2) groups: a) running cost and b) fixed cost. Vehicle running cost is varied in proportion to vehicle running distance while fixed cost is varied to travel time.

The unit VOC is principally used by modifying and updating of unit VOC estimated in "The Study on Rural Roads Improvement in Western Kenya" using inflation rate between 1999 and 2004. Table 17.2-7 is the summary of VOC by vehicle types.

TABLE 17.2-7 UNIT RUNNING COST BY VEHICLE TYPES

Unit: Ksh

Item		Passenger Car	Matatu	Large Bus	Medium Truck	Heavy Truck
Running Cost / 1000 Veh-Km	Fuel Cost	5,796	4,460	11,894	12,886	13,877
	Oil Cost	211	352	387	528	598
	Tyre Cost	644	896	1,638	1,575	6,038
	Maintenance Spares Cost	365	216	625	334	658
	Maintenance Labour Cost	290	2,711	3,098	1,220	1,937
	Depreciation Cost	0	2,070	4,779	2,632	5,178
	Total	7,307	10,706	22,422	19,175	28,285
Fixed Cost/Veh Hour	Crew Cost	19.37	57.76	57.76	57.76	57.76
	Overhead Cost	11.30	9.04	8.22	8.37	7.53
	Opportunity Cost of Capital	7.83	7.58	19.99	8.36	16.44
	Depreciation Cost	52.19	8.52	22.49	18.80	36.99
	S-Total	90.69	82.90	108.46	93.28	118.71
	Factor	0.30	0.80	0.80	0.70	0.70
	Total	27.21	66.32	86.76	65.30	83.10

Passenger travel time cost is estimated on the basis of a function of wage rate and trip purpose. Table 17.2-8 shows the estimated unit time.

TABLE 17.2-8 TIME VALUE OF PASSENGER BY VEHICLE TYPE

Unit: Ksh / hr

	P Car	Bus	Truck
Time Value	152.99	218.38	0

Benefit Estimation

The saving in vehicle operating cost and travel time cost are estimated on the basis of estimated vehicle kilometres and hours using traffic assignment to alternative transport networks and unit traffic cost. Yearly benefits derived from the alternative plans are shown in Table 17.2-9.

TABLE 17.2-9 YEARLY BENEFITS DERIVED FROM ALTERNATIVE PLAN IN 2025

Unit: Ksh

		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Road and Public Transport System	Running Cost	487	2,687	4,022	9,971	3,666	7,659
	Fixed Cost	393	1,361	1,940	4,254	3,781	4,406
	Time Cost	2,009	6,906	9,886	21,141	19,169	21,948
Total		2,889	10,954	15,849	35,366	26,615	34,013

Economic Cost

The economic cost for road sector projects consists of total construction cost of road improvement works, engineering and maintenance cost. Bus transport system cost consists of purchasing of buses, construction of bus / taxi terminals and other necessary facilities. Rail transport system cost consists of construction cost of LRT system, improvement of existing Kenyan Railway and purchasing rolling stock. Traffic management cost consists of traffic signal system, traffic safety facilities, equipment of on-street parking and intersection improvement cost. The estimated economic cost is shown in Table 17.2-10.

TABLE 17.2-10 ECONOMIC COST BY ALTERNATIVE PLANS

Unit: Thousand Ksh

		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Road Network Development	1. Bypass and Link Roads	5,548	5,548	6,696	6,696	6,696	6,696
	2. Missing Links	5,090	5,090	5,090	5,090	5,090	5,090
	3. Radial Roads	5,250	5,250	7,974	7,974	7,974	7,974
	4. Circumferential Road	0	1,220	1,220	1,220	1,220	1,220
	5. Secondary Arterial Roads	0	2,500	2,500	2,500	2,500	2,500
	6. Signalization	1,393	1,393	1,393	1,393	1,393	1,393
	7. NMT	1,118	1,118	1,118	1,118	1,118	1,118
	8. Uhuru Highway	647	3,081	3,081	3,081	3,081	3,081
	S-Total	19,045	25,199	29,071	29,071	29,071	29,071
Public Transport System	1. Bus Incentive Policy	0	336	336	336	336	336
	2. Bus Priority Policy	0	1,596	1,596	1,596	1,596	1,596
	3. Upgrading Existing Rail	0	0	4,872	4,872	4,872	4,872
	4. LRT System	0	0	0	120,960	0	120,960
	S-Total	0	1,932	6,804	127,764	6,804	127,764
Traffic Management	1. Traffic Circulation in City Center	210	210	210	210	210	210
	2. On Street Parking	84	84	84	84	84	84
	3. Enforcement	84	84	84	84	84	84
	4. Public Education	126	126	126	126	126	126
	S-Total	504	504	504	504	504	504
Traffic Institution	1. Human Resource Capacity Building	84	84	84	84	84	84
	2. Institutional Development	84	84	84	84	84	84
	S-Total	168	168	168	168	168	168
Expressway Development	Stage 1	0	0	0	0	21,773	21,773
	Stage 2	0	0	0	0	52,443	52,443
	Stage 3	0	0	0	0	110,695	110,695
	S-Total	0	0	0	0	184,911	184,911
Total		20,109	19,717	27,803	36,547	157,507	221,458

Economic Evaluation

The economic indicators of benefit/cost ratio (B/C) and economic internal rate of return (EIRR) are estimated by applying the estimated economic cost and economic benefits mentioned above. Table 17.2-11 shows the economic indicators of the six alternative plans.

TABLE 17.2-11 ECONOMIC INDICATORS OF ALTERNATIVE PLANS

Unit: Thousand Ksh

	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Present Value of Benefit ('000 Ksh)	8,530	32,342	45,856	62,850	58,727	66,855
Present Value of Cost ('000 Ksh)	8,312	11,721	15,408	29,677	37,056	59,928
Rough Net Present Value ('000 Ksh)	218	20,621	30,449	33,173	21,671	6,927
Rough B/C Ratio	1.026	2.759	2.976	2.118	1.585	1.12
Rough EIRR (%)	12.1%	39.4%	42.7%	42.2%	41.3%	17.1%

Notes: 1) Discount rate is assumed to be 12 %.
2) Project life of master plan is assumed to be 30 years from the year 2025.

(5) Air Pollution of Alternative Plans

Air pollution components such as HC, CO and NOx produced by each alternative plan are estimated and presented in Table 17.2-12. For comparison purposes, the differences between each alternative plan with 'Do Nothing' case is observed. The results of computation show that Alternative 4 has the highest differences followed by Alternative 3.

TABLE 17.2-12 AIR POLLUTION OF ALTERNATIVE PLANS

Unit: Kilogram

		Do Nothing	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
HC	Amount	7,095	6,347	5,685	5,525	5,328	6,062	5,638
	Reduction from Do-Nothing Case	0	748	1,410	1,570	1,767	1,033	1,457
CO	Amount	58,661	52,473	47,002	45,677	44,054	50,123	46,610
	Reduction from Do-Nothing Case	0	6,188	11,659	12,984	14,607	8,538	12,051
NOx	Amount	6,928	6,197	5,551	5,394	5,203	5,919	5,504
	Reduction from Do-Nothing Case	0	731	1,377	1,534	1,725	1,009	1,424

Notes: Discharge rates are assumed as follows: HC 0.254 g/km, CO 2.10 g/km, NOx 0.248 g/km

(6) Overall Evaluation

Table 17.2-13 presents the overall evaluation of six (6) alternative plans. The overall evaluation is assessed from the viewpoint of economic viability, traffic function, system efficiency, environmental impact, and social impact.

Do-nothing is considered beyond acceptable level except social impact because of no road right of way required.

Alternative 1 shows a scarcely acceptable level in economic viability, traffic condition, system efficiency and environmental impact because of possible traffic conditions on both the urbanized area and city centre.

Alternative 2 scores an almost acceptable level because of promotion of bus operation, but traffic nuisance will still remain due to traffic congestion in the city centre.

Alternative 3 is evaluated as highly acceptable in terms of economic viability and traffic condition and fair in system efficiency. The environmental impact is also considered as highly preferable because of improvement of Uhuru Highway.

Alternative 4 shows almost the same evaluation as Alternative 3 in traffic condition and system efficiency and fair in economic viability except social impact due to additional right of way refined for LRT implementation.

Alternative 5 is also considered the same as Alternative 3, except traffic congestion in the urban area and additional right of way required for the construction of an expressway.

Alternative 6 demonstrates the highest score from the viewpoints of traffic condition, system efficiency and environmental impact but scores low in economic viability and social impact because of huge additional right of way required for construction of LRT and expressway. This means that implementation of this plan is pre-mature at this moment.

TABLE 17.2-13 COMPARATIVE EVALUATION OF TRANSPORT SYSTEM ALTERNATIVE

Alternatives	Economic Viability (B/C Ratio, EIRR)	Traffic Efficiency (Ave. Speed, Ave. VCR)	System Efficiency (Trip Length, Travel Time)	Environmental Impact	Social Impact
Do Nothing ・ No Special Policies ・ Present Pattern		・ Average Travel Speed = 11.2 km/h ・ Average VCR = 1.67 (2.14) ・ Proposed network in 2025 is not acceptable [XX]	・ Trip length = 27.9 pcu-km ・ Travel Time = 2.48 pcu-hr ・ System efficiency is very bad [XX]	・ Due to increasing congestions and no-control of car traffic volumes, traffic pollution, nuisance will be more than tolerable. [XX]	1) Small 2) Small 3) No Change [◎]
Alternative 1 Basic Policy ・ Planned Projects ・ Bus Incentive Policy	Inferior investment ・ B/C Ratio = 1.03 ・ EIRR = 12.1 % [X]	・ Average Travel Speed = 22.7 km/h ・ Average VCR = 1.11 (1.43) ・ Proposed network in 2025 is not acceptable [X]	・ Trip length = 25.0 pcu-km ・ Travel Time = 1.10 pcu-hr ・ Benefit = 2.89 million Ksh ・ System efficiency is bad [X]	・ Reducing matatu numbers will relatively improve pollution, but traffic congestion will aggravate traffic nuisance [X]	1) Relatively small 2) Relatively small 3) Relocation of matatu routes may be acceptable [O]
Alternative 2 Expanded Basic Policy (1) ・ R / C Road Network (1) ・ Bus Priority Policy	Fair investment ・ B/C Ratio = 2.76 ・ EIRR = 39.4 % [O]	・ Average Travel Speed = 31.2 km/h ・ Average VCR = 0.92 (1.13) ・ Proposed network in 2025 is fairly acceptable [△]	・ Trip length = 22.4 pcu-km ・ Travel Time = 0.72 pcu-hr ・ Benefit = 10.95 million Ksh ・ System efficiency is fairly good [△]	・ By reducing car numbers in the city centre, traffic nuisance (air, noise, etc) will be improved. ・ City landscape and tourism image will be improved [△]	1) Relatively small 2) relatively small 3) Large relocations of matatu routes may not be acceptable [△]
Alternative 3 Expanded Basic Policy (2) ・ R/C Road Network (2) ・ Bus Priority Policy ・ Upgrading of Existing Rail ・ Uhuru Highway Improvement	Fair investment ・ B/C Ratio = 2.98 ・ EIRR = 42.7 % [O]	・ Average Travel Speed = 33.2 km/h ・ Average VCR = 0.88 (1.09) ・ Proposed network in 2025 is acceptable [O]	・ Trip length = 21.8 pcu-km ・ Travel Time = 0.66 pcu-hr ・ Benefit = 15.85 million Ksh ・ System efficiency is good [O]	・ By reducing car numbers in the city centre, traffic nuisance (air, noise, etc) must be improved but still remain. [◎]	1) Relatively small 2) Relatively small 3) Large relocation of matatu routes / preferable change of landscape [O]
Alternative 4 Railway Oriented ・ R/C Road network (2) ・ Bus Priority Policy ・ Upgrading of Existing Rail ・ LRT	Inferior investment ・ B/C Ratio = 2.12 ・ EIRR = 28,2 % [X]	・ Average Travel Speed = 34.6 km/h ・ Average VCR = 0.86 (0.99) ・ Proposed network in 2025 is highly acceptable [◎]	・ Trip length = 21.0 pcu-km ・ Travel Time = 0.61 pcu-hr ・ Benefit = 35.37 million Ksh ・ System efficiency is good [O]	・ By reducing car traffic and increasing LRT passengers, traffic nuisance such as air pollution will be decreased. [◎]	1) Large 2) Large 3) Large relocations of matatu routes / Acceptance of LRT [O]
Alternative 5 Expressway Oriented ・ R/C Road network (2) ・ Bus Priority Policy ・ Upgrading of Existing Rail ・ Expressway (Stage 1,2 & 3)	Inferior investment ・ B/C Ratio = 1.58 ・ EIRR = 21.3 % [X]	・ Average Travel Speed = 35.1 km/h ・ Average VCR = 0.86 (0.83) ・ Proposed network in 2025 is highly acceptable [◎]	・ Trip length = 23.9 pcu-km ・ Travel Time = 0.68 pcu-hr ・ Benefit = 26.61 million Ksh ・ System efficiency is good [O]	・ By reducing congestion in City Centre, traffic nuisance will be decrease. ・ City landscape and tourism image will be improved. [◎]	1) Large 2) Largel 3) Large relocations of matatu routes / Expressway not familiar [X]
Alternative 6 Ideal Urban Transport ・ R/C Road network (2) ・ Bus Priority Policy ・ Upgrading of Existing Rail ・ Expressway (Stage 1, 2 & 3) ・ LRT	Inferior investment ・ B/C Ratio = 1.12 ・ EIRR = 17.1 % [XX]	・ Average Travel Speed = 37.2 km/h ・ Average VCR = 0.80 (0.75) ・ Proposed network in 2025 is highly acceptable [◎]	・ Trip length = 22.2 pcu-km ・ Travel Time = 0.60 pcu-hr ・ Benefit = 34.0 million Ksh ・ System efficiency is very good [◎]	・ Traffic congestion is drastically improved. ・ Modern transport facilities will inspire socio-economic activities. [◎]	1) Large 2) Large 3) Large relocations of matatu routes / Largely acceptable of LRT / Expressway not familiar [△]

Note: Average VCR = Urbanised (Centre): Social Impacts: 1) ROW acquisition, 2) Relocation of PAP, 3) public Acceptance

17.3 MASTER PLAN COMPONENTS

17.3.1 Selected Transport Master Plan

Alternative 3 of Transport Master Plan is recommended based on the evaluation on traffic condition, system efficiency, environmental impact and social impact and economic analysis.

Alternative 3 is composed of:

- R/C Road Network (2);
- Bus Incentive and Priority Measures;
- Upgrading of existing rail as Commuter Rail; and
- Improvement of Uhuru Highway, Stage 1.

The conceptual transport system of Alternative 3 is graphically demonstrated in Figure 17.3-1.

17.3.2 Major Components of Master Plan

Major projects of the Master Plan are listed in Table 17.3-1. It embraces the areas of road network and public transport improvement, traffic management and traffic institution enhancement. The proposed road networks in the urban and urbanized area are presented in Chapter 18.

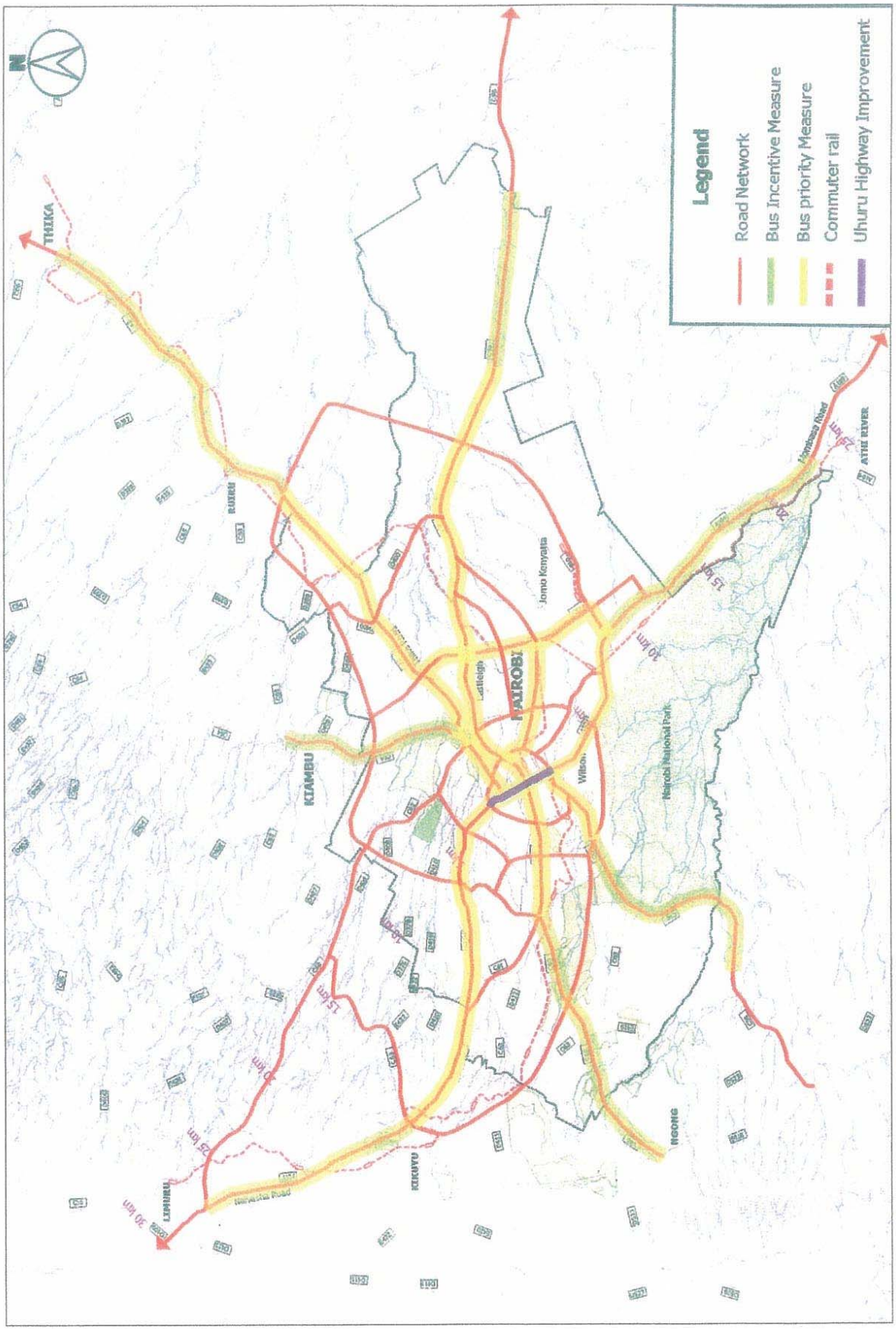


FIGURE 17.3-1 SELECTED TRANSPORT MASTER PLAN

TABLE 17.3-1 MAJOR PROJECTS OF TRANSPORT MASTER PLAN

Sector	Projects	Unit	Short Term (2006-2010)	Medium Term (2011-2015)	Long Term (2015-2020)	Total
Road Network	1. Bypass and Link					
	1) Bypass Roads	Km			85.0	85.0
	2) Link Roads	Km			24.4	24.4
	3) Link Road Extension	Km			9.4	9.4
	2. Missing Links					
	1) Arterial Roads	Km	19.8			19.8
	2) Collector	Km	6.5	1.6		8.1
	3) Local Road	Km		5.1		5.1
	3. Radial Roads					
	1) Inside C-3	Km	21.9			21.9
	2) C-3 South & West	Km		51.1		51.1
	3) C-4 North & East	Km		54.2		54.2
	4) New Radial Road	Km		9.7	1.2	10.9
	4. Circumferential Roads					
	1) C-1 & C-2	Km		11.4		11.4
	2) C-3	Km			6.0	6.0
	5. Secondary Arterial	Km			65.3	65.3
	6. Intersection Improvement	No.	18	30		48
	6. Non Motorized Transport	Km	23.8	18.2	17.8	59.8
	7. Uhuru highway Improvement					
	1) Widening	Km	1.2	2.5		3.7
	2) Grade Separation	No.	1		6	7
	Sub-total	Km	92.1	223.7	79.8	395.6
Public Transport	1. Bus Incentive Policy	Set	1			1
	2. Bus Priority Policy	Set		1	1	2
	3. Existing Rail	Set	1	1	1	3
	Sub-total		2	2	2	6
Traffic Manage-ment	1. Traffic Circulation in City Centre	Set	1			1
	2. On Street Parking	Set	1	1		2
	3. Traffic Enforcement	Set	1			1
	4. Public Education	Set	1			1
	Sub-total		4	1	0	5
Traffic Institution	1. Human Resource Capacity Building	Set	1			1
	2. Institutional Development	Set	1			1
	Sub-total		2			2

CHAPTER 18

ROAD DEVELOPMENT PLAN

CHAPTER 18 ROAD DEVELOPMENT PLAN

18.1 STUDY METHODOLOGY

18.1.1 Study Procedure

The process of the study to formulate the road development plan is shown in Figure 18.1-1. The figure shows that there are three major classifications of the proposed road network namely; 1) radial and circumferential, 2) intersection improvement and 3) facilities for non-motorized transport.

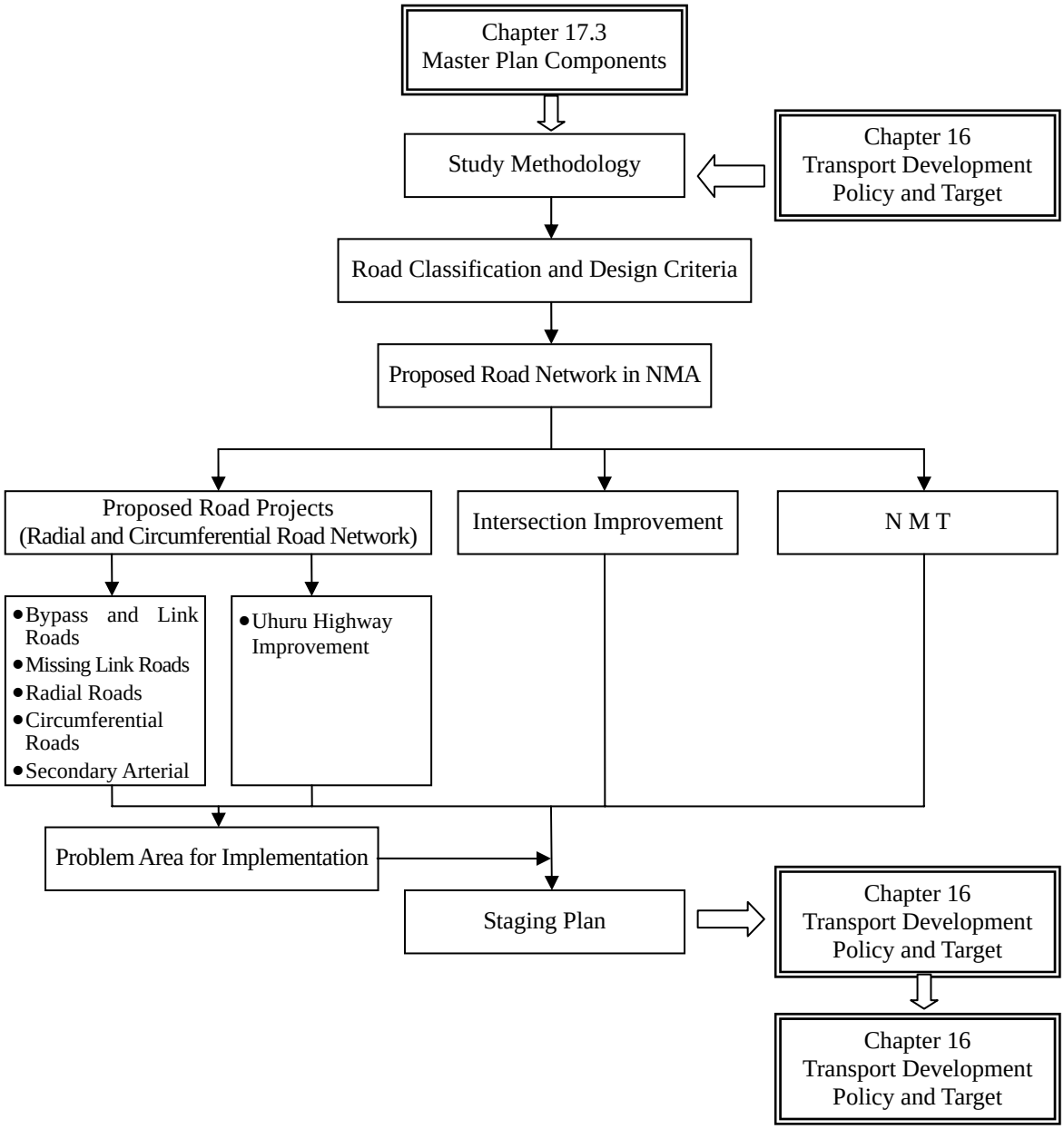


FIGURE 18.1-1 STUDY PROCEDURE

18.1.2 Planning Concept

(1) Present Road Network Problems and Road Development Plan

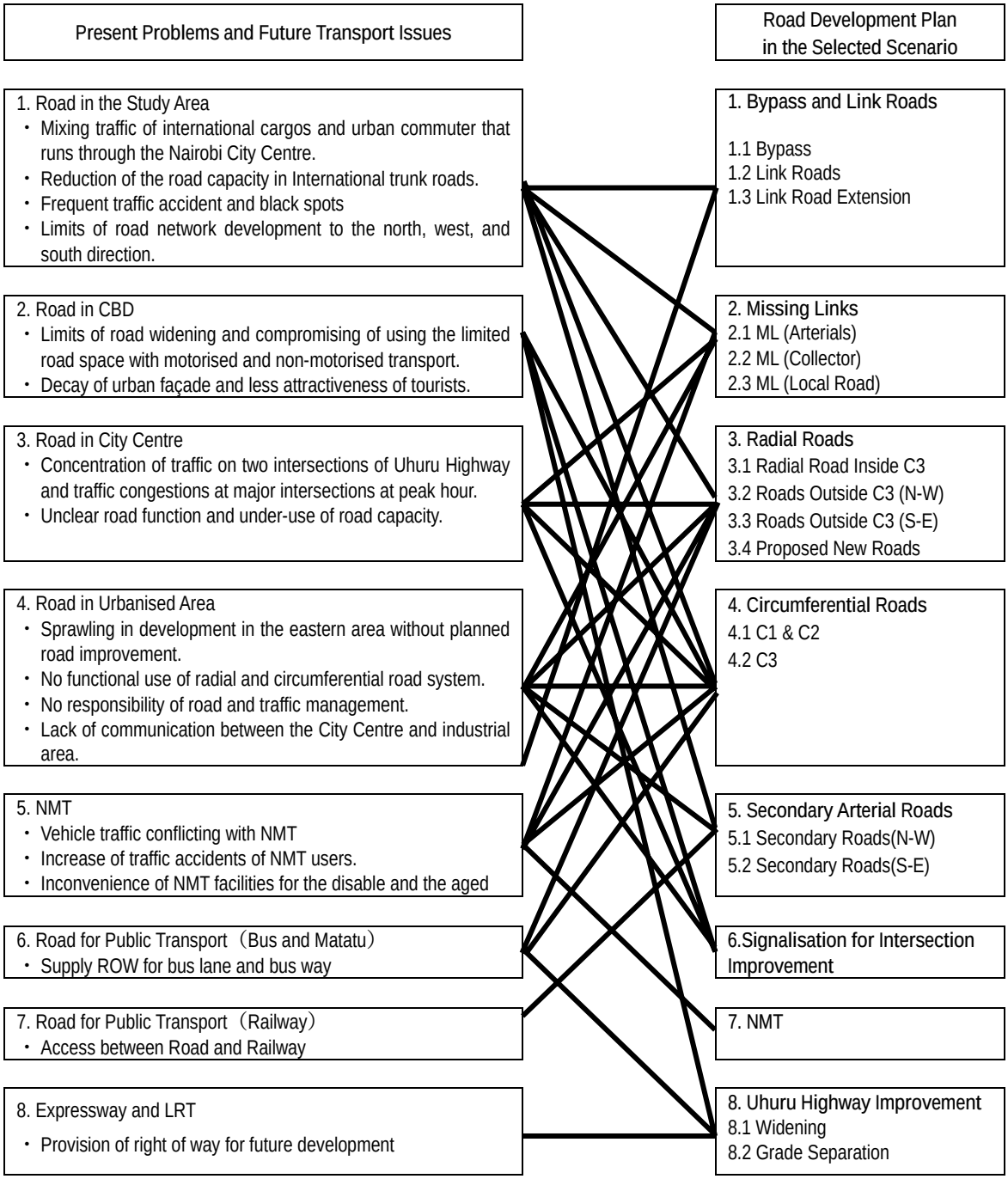


FIGURE 18.1-2 PRESENT TRANSPORT PROBLEMS AND ROAD DEVELOPMENT PLAN

The road network problems came into perspective after thorough review of the present situation of the road network. The review gave importance both to the infrastructure and operational problems. In essence, the problems related to transportation can be mitigated by formulation/ enhancement of the following measures:

1. Bypass and Link Roads
2. Missing Links
3. Radial Roads
4. Circumferential Roads
5. Secondary Arterial Roads
6. Signalisation for Intersection Improvement
7. Non-Motorised Transport
8. Uhuru Highway Improvement

Appreciation to the merits of the proposed road development plan can be realized by considering the magnitude of the problems shown in Figure 18.1-2. Further, the same figure illustrates the expected problems that can be addressed by each proposed measure.

(2) Basic Direction of Road Network Planning

The basic directions of road development plan are as follows:

i) Maximum utilisation of existing road network
ii) Introduction of radial and circumferential road network system
iii) Hierarchical and functional road network
iv) Harmonised development with public transport
v) Enhancement of Non-Motorised Transport (NMT)
vi) Provision of space for future expressway and Light Rail Transit (LRT)

18.2 ROAD CLASSIFICATION AND DESIGN CRITERIA

Road classifications, functions and characteristics of road class in the future road network together with the design criteria is shown in Table 18.2-1. It is recommended that the list of manuals/ guidelines below is consulted for the details of design.

- Road Design Manual, Road Department, Ministry of Transport and Communication, Kenya, August 1987
- Standard Specification for Road and Bridge Construction, Road Department, Ministry of Transport and Communication, Kenya, August 1986
- Road Design Guidelines for Urban Roads (2nd Draft), MOLG, August 2001 (RDGU)
- A Policy on Geometric Design of Highway and Streets, the American Association of State Highway and Transportation Officials (AASHTO), Washington D.C.
- Highway Capacity Manual, Forth Edition, Transportation Research Board, National Research Council, Washington D.C.
- Guide for Design of Pavement Structures, AASHTO
- Road Structure Guidelines, Japan Association of Road, February 2004

TABLE 18.2-1 ROAD FUNCTION OF FUTURE ROAD NETWORK

Item	International Highway	Principal Arterials	Minor Arterials	Collector	Local Road
Function	International Highway for connecting neighbouring Countries	• National inter city trunk road • Primary distributor • District distributor	Local distributor carries traffic form access road to district distributors	Access road connects to local roads and local distributor.	Local road. Other minor roads of local access.
Flow conditions	Uninterrupted flow except at intersection	Possibly uninterrupted flow except at intersection	Interrupted flow	Interrupted flow	Interrupted flow
Design Traffic by lane (ADT)	17~18,000	10~12,000	10~12,000	9,000 for 2-lane	-
Design Speed (km/h)	100,80,60	60, 50	60, 50,40	50,40,30	50,40,30
Target Speed by LOS (km/h)	60	40	30	20	20
Minimum Road Reserve (m)	80-90	20-60	30	9-15	9 -12
Lane Width (m)	3.5 (3.75)	3.5	3.5	5-7 (for carriageway)	3-5 (for carriageway)
Lane width (m)	3.5	3.5	3.5	5.0~7.0 for 2-lane	3.0~5.0
Median (m) (Central Reserve)	4.5	1.75~2.25	1.0	-	-
Allowance of Median (m)	0.5~ 0.75	0.25	0.25	-	-
Parking lane (m)	2.5	1.5~2.5	1.5	-	-
Shoulder (m)	2.5	1.25	1.25	0.5	0.5
Service Road for frontage area (m)	-	4.0 (Wt 0.5m shoulder each)	4.0 (Wt 0.5m shoulder each)	-	-
Walk Way(m)	2.0	2.0	2.0	If required	If required
Cycle Tracks (m)	3.0	3.0	3.0	If required	If required
Green Belt (m)	1.0	1.0	1.0	If required	If required
Property Access	Preferably excluded	Equal to traffic movement	Primary	Primary	Primary
Applied Road	1.International Highway (A104/109, A2)	1.Bypass 2.Bypass Link Roads 3.Bypass Link Ext. 4.Circumferential Roads 5. Radial Arterials	1.New Radial Roads -Nairobi River Road -Railway Over bridge 2.Secondary Arterials	Other Roads in the road network except local roads	Other Roads in residential road network

Source: Road Design Guidelines for Urban Roads (2nd Draft), MOLG, August 2001 (RDGU), which reviewed with Road Structures Guidelines of Japan (Feb. 2004).

Note: Definition of road by RDGU:

- Primary distributor: Roads linking places of national importance, e.g. urban areas or major towns.
- District distributor: Road within urban areas connecting higher class roads.
- Local distributors: Minor road of local significance

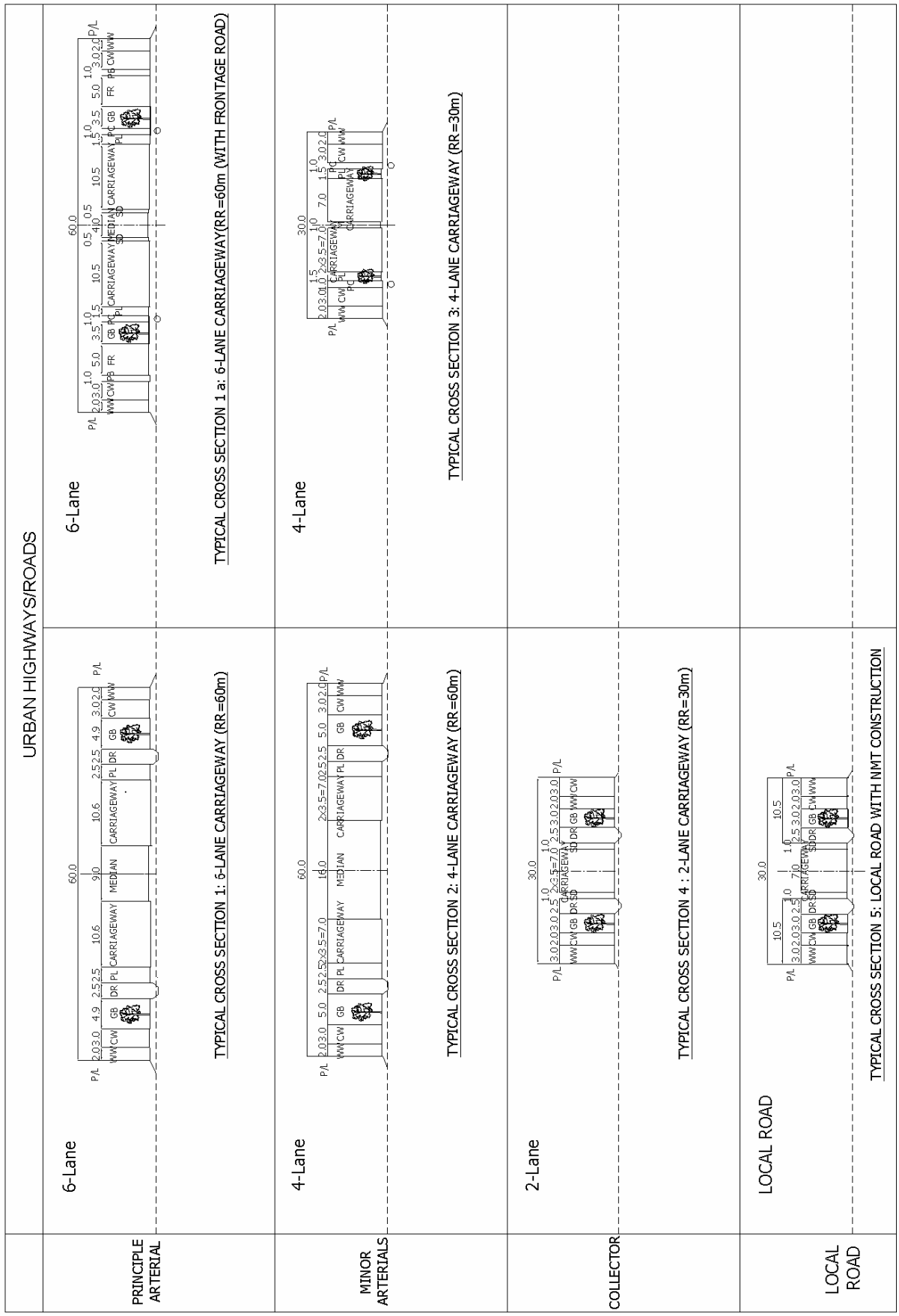


FIGURE 18.2-1 PROPOSED STANDARD CROSS SECTION

18.3 ROAD NETWORK IMPROVEMENT MEASURES

18.3.1 Road Network Plan in the Study Area (Sub-urban Area)

The proposed road network in the Study Area is shown in Figure 18.3-1.

(1) Principles for Road Network Improvement Plan Outside of Nairobi City

- To improve linkages between CBD and regional centres/sub-centres in Nairobi Metropolitan Area
- To improve linkages among regional centres and sub-centres in Nairobi Metropolitan Area
- To improve linkages between sub-centres and regional arteries
- To improve infrastructure serving public transport terminal in sub-centres

Development activities within Nairobi Metropolitan Area (NMA) that are currently performed without planning guidelines shall be organized by providing adequate road network. In addition, the present land use of the sub-urban area is mostly agriculture and ranching but there is on-going residential and housing development along trunk roads and near sub-urban towns. Near at the northern Nairobi City border, there are also rapid housing developments as commuter towns and the Northern bypass is planned to pass through these sub-divisions. Resident associations have already requested to re-route the original design to conserve their community and also the environment. Therefore it is recommended that consultation with the stakeholders and comprehensive EIA be conducted before starting a feasibility study for road reserve acquisition under the context of SEA.

(2) Road Network Improvement Plan Outside of Nairobi City

1) Road Network Improvement of Radial Trunk Roads Connecting Regional Centre/ Sub-centre and CBD in Nairobi

Table 18.3-1 shows the road network improvement of radial trunk roads connecting to the sub-centre. Road class and grade will be revised and LOS will be secured corresponding to expected traffic volume. The proposed road network in the Study Area is shown in Figure 18.3-1.

TABLE 18.3-1 ROAD NETWORK IMPROVEMENT PLAN OF RADIAL TRUNK ROADS CONNECTING SUB-CENTER

Class	Section	Length (km)	No. of lanes (existing)	Pavement type & Condition	Improvement Measures
A2	Nairobi bound. - Ruiru	5.2	4 (6)	Bitumen (Fair & Good)	- This section is included in proposed road improvement project up to Eastern Bypass.
A2	Ruiru – Juja	10.3	4	Bitumen (Fair)	- Road widening
A2	Juja – Thika	14.3	4	Bitumen (Fair & Good)	- Road widening
A3	Thika – NMA border	34.0	2	Bitumen (Fair & Good)	- Maintenance
A104	Nairobi bound. - Athi River Town	10.0	2	Bitumen (Good)	- Road widening from 2 lanes to 4 lanes (on-going NCTIP)
A104	Athi River Town - NMA border	19.9	2	Bitumen & Surface Dressing (SD) (Fair & Good)	- Pavement improvement (on-going NCTIP)
A109	Athi River Town - NMA border	22.1	2	Bitumen (Fair & Good)	- Road widening from 2 lanes to 4 lanes (completion of F/S to Tanzania Border)
A104	Nairobi bound. - Kikuyu	5.9	4	Bitumen (Good)	- Maintenance (on-going NCIP)
A104	Kikuyu – Limuru	13.6	4	Bitumen (Good)	- Maintenance
A104	Limuru - NMA border	2.0	2	Bitumen (Good)	- Maintenance
C62	Nairobi bound. - Limuru	20.2	2	Bitumen (Good)	- Road widening from 2 lanes to 4 lanes between Nairobi boundary and C63 (on-going F/S).
C98	Nairobi bound. - Kangundo	32.2	2	Bitumen (Fair & Good)	- Maintenance
C64	Nairobi bound. - Kiambu	5.4	2	Bitumen & SD (Very Poor & Fair)	- This section is included in proposed road improvement project.
C60	Nairobi bound. - Ngong	4.8	2	Surface Dressing (Fair)	- This section is included in proposed road improvement project

2) Road Network Improvement Plan between Regional Centres and Sub-centres in Nairobi Metropolitan Area

Table 18.3-2 shows the road network improvement between regional centres and sub-centres in NMA. The improvement measures include road widening, road class upgrading, and pavement and alignment improvement.

TABLE 18.3-2 ROAD NETWORK IMPROVEMENT PLAN BETWEEN REGIONAL CENTERS AND SUB-CENTERS IN NAIROBI METROPOLITAN AREA

Class	Section	Length (km)	No. of lanes (existing)	Pavement type & Condition	Improvement Measures
D521	Tala - A3 Road	32.7	2	Gravel (Poor & Fair, partly Very Poor)	- Pavement improvement to bituminous surface
E434	Athi River Town (A109) – C98	22.3	2	Gravel & Earth (Very Poor & Good)	- Upgrading from class E to D - Pavement improvement to bituminous surface
C63	Ruiru – Kiambu	15.7	2	Bitumen & Surface Dressing Very Poor, Poor & Good	- Road rehabilitation
C63, D407	Kiambu – Limuru	28.2	2	Bitumen & Surface Dressing (Good)	
E702	Ngong(C60) – Ongata Rongai	12.9	1	Gravel Poor & Fair	- Upgrading from class E to D - Road widening
E1499, E1508 & new road	Ngong(C60) – Southern Bypass (to Kikuyu)	8.0	2	Earth & Surface Dressing (Very poor)	- Upgrading from class E to D - Partly new road construction

3) Road Network Improvement Plan between Sub-centers and Regional Arteries

The improvement measures include road widening, road upgrading and pavement and alignment improvement (See Table 18.3-3).

TABLE 18.3-3 ROAD NETWORK IMPROVEMENT PLAN BETWEEN SUB-CENTERS AND REGIONAL ARTERIES

Class	Section	Length (km)	No. of lanes (existing)	Pavement type & condition	Improvement Measures
C99, D519	Kangundo －A109	29.6	2	Earth & Gravel (Poor & Fair)	- Pavement improvement to bituminous surface
E1599 & new road	A2 (Ruiru)	18.0	2	Earth (Very Poor)	- Pavement improvement to bituminous surface
E1535 & new road	Gatunyaga – C98 (Ruai)	25.0	2	Gravel (Poor & Fair)	- Pavement improvement to bituminous surface - New road construction - Class upgrading（Supplementary route for A2
E1535	A2 (Ruiru)	15.5	2	Gravel (Poor to Fair)	- Pavement improvement

4) Road Improvement Plan Serving Public Transport Terminal in Regional Centres and Sub-centres

The roads connecting public bus terminal and radial trunk road shall be improved. Road improvement measures in Thika, Tala, Limuru, Athi River Town and Ngong shall be carried out to facilitate smooth movement of bus/matatu between terminals and radial trunk roads.

18.3.2 Proposed Road Network in Nairobi City (Urban Area)

(1) Road Network Density in Nairobi City

The road density of Nairobi City has an average of 1.7km/km^2 and 0.5km/1000 pop., while the road densities of the NMA and the whole country are 0.5km/km^2 and 0.7km/1000 pop. and 0.3km/km^2 and 5.2km/1000 pop, respectively. This indicates that the road density increases from the rural to urban, corresponding to the agglomeration of economic activities, while road density per capita decreases corresponding to the population density.

In Nairobi City, the road density varies from 0.5km/km^2 to 21km/km^2 from the outer area to the city centre. In particular, the east areas (Embakasi and Kassarani) show very low road density, i.e, 0.5km/km^2 and 0.2km/1000 pop. These areas have developed sub-divisions, industrial estates, and a sports complex yet the overall land use plan is not in place. Private road network is constructed only within each sub-division and is not fully connected to other road networks and higher class roads. These private roads are rarely registered in the CCN road inventory. The collector and local road network in and among the sub-division should be prepared following the completion of a land use plan. It is recommended that the overall land use plan in these areas should be prepared and the road reserve for the road network be designated promptly based on the proposed plan. On the other hand, the Central area has a road density of 21km/km^2 and space is not available for road widening

and construction of new roads. Effective traffic management shall be introduced in this area to mitigate traffic congestion.

(2) Principles for Road Network Improvement of Nairobi City as Urban Area

In addition to the mentioned principles for road network improvement for sub-urban area, the specific principles in Nairobi City (Urban Area) are;

- To improve hierarchical and functional road network
- To improve international highways
- To construct bypass and its link roads
- To guide and coordinate future urban land use plan to avoid sprawling sub-division development in the eastern area.

(3) Proposed Road Network Improvement Plan and Road Projects

The proposed road network in Nairobi City is shown in Figure 18.3-2. The proposed road network improvement plan and road projects are discussed in Section 18.4.

18.3.3 Proposed Road Network in Urbanised Area

The proposed road network in the urbanised area is shown in Figure 18.3-3.

(1) Principles for Road Network Improvement of Urbanised Area

In addition to the above principles, the specific principles of road network improvement of urbanised area (City Centre, CBD) are;

- To improve radial and circumferential road system by using the existing road network.
- To establish three circumferential corridors (C1, C2, and C3) by improvement of the existing road network and construction of missing sections.
- To construct missing link roads.
- To improve NMT routes both along all radial and circumferential roads and specific NMT route.
- To improve traffic circulation in the City Centre and CBD

Most of radial and circumferential roads pass through the residential areas in the urbanised area and its vicinity. It is important to protect the community and conserve the environment in case of widening or new construction. Consequently, it is recommended that consultation with the stakeholders and comprehensive EIA's be conducted in the context of SEA.

(2) Proposed Road Network Improvement Plan and Road Projects

The proposed road network improvement and road projects are discussed in Section 18.4.

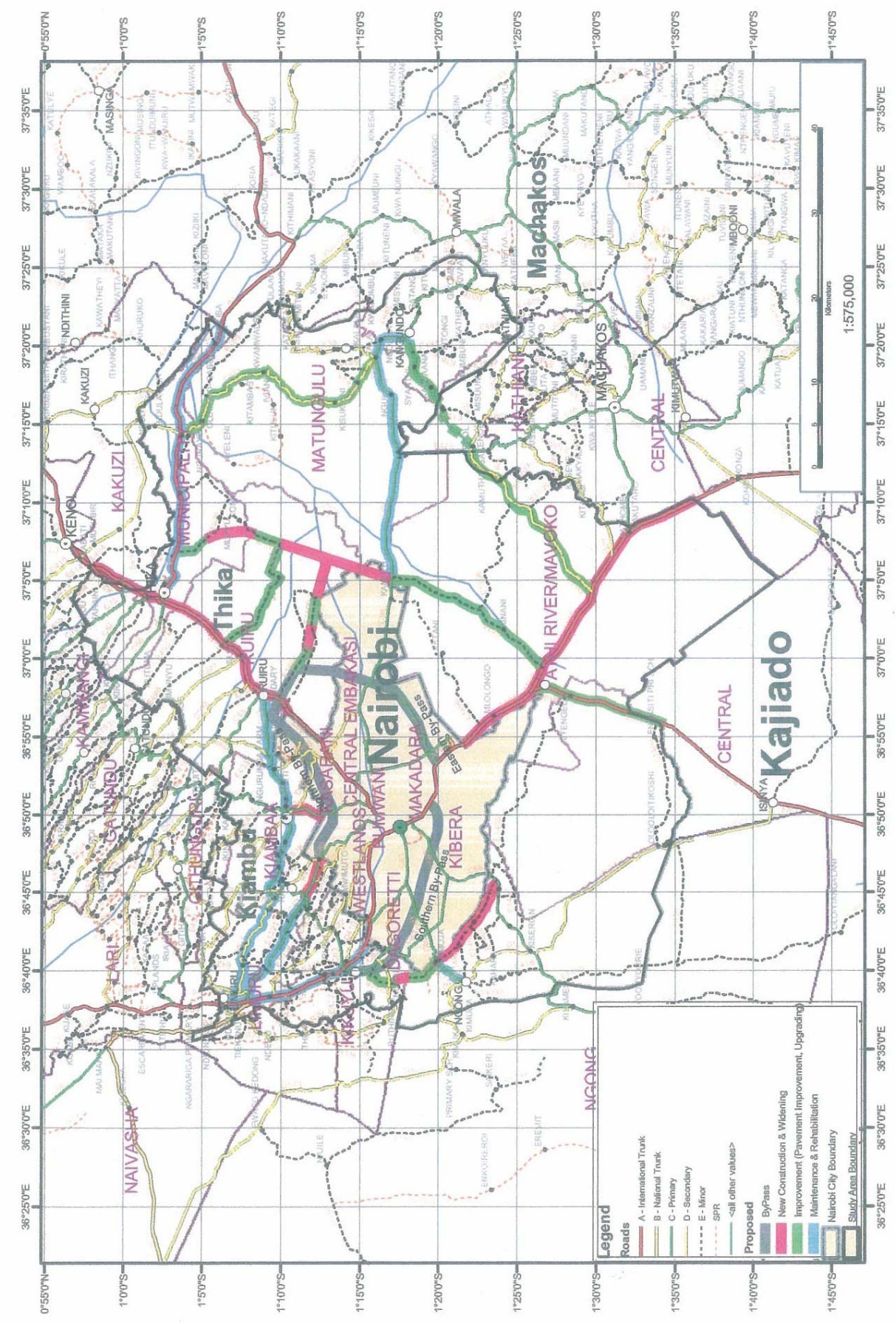


FIGURE 18.3-1 PROPOSED ROAD NETWORK IN THE STUDY AREA (SUB-URBAN AREA)

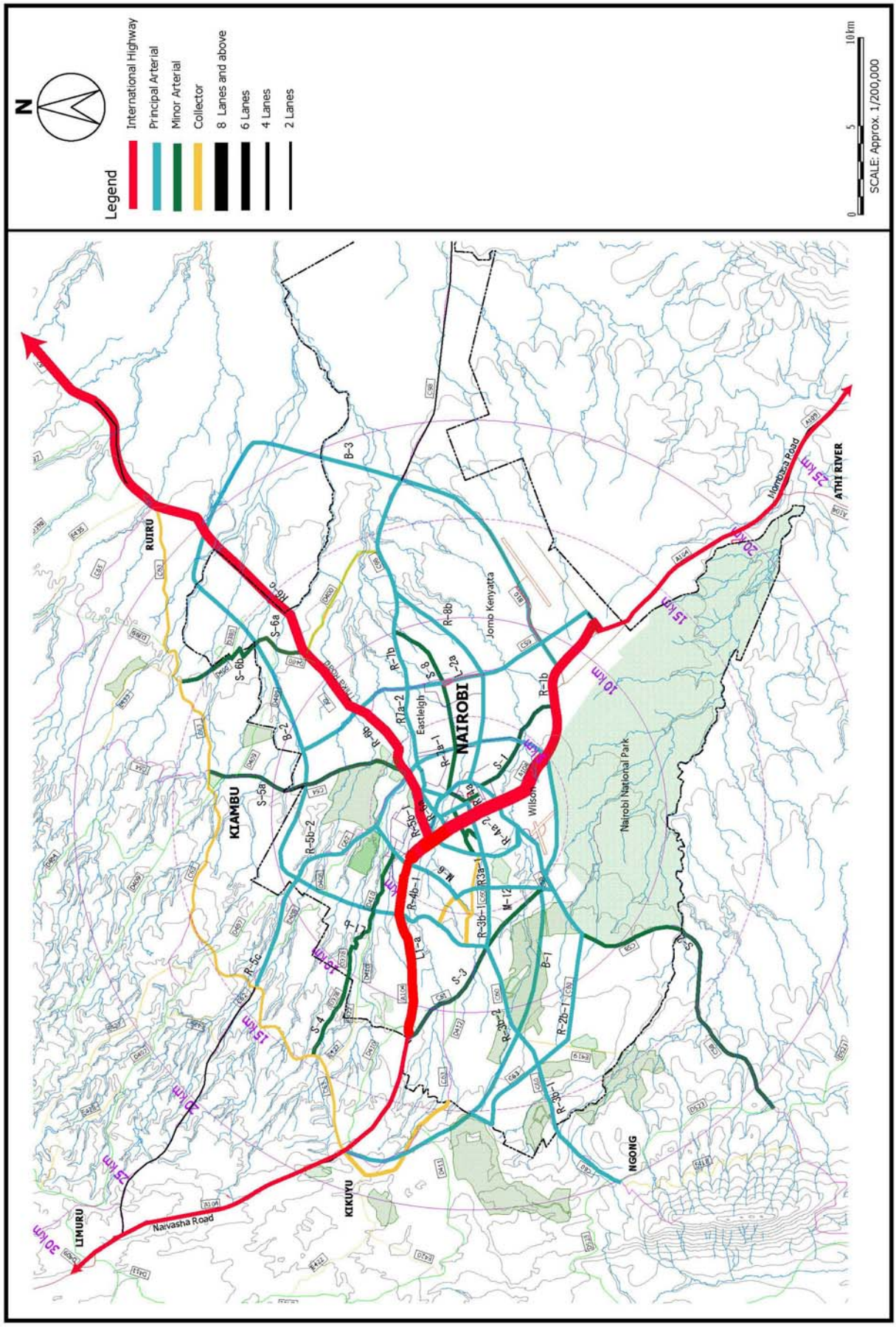


FIGURE 18.3-2 PROPOSED ROAD NETWORK IN NAIROBI CITY (URBAN AREA)

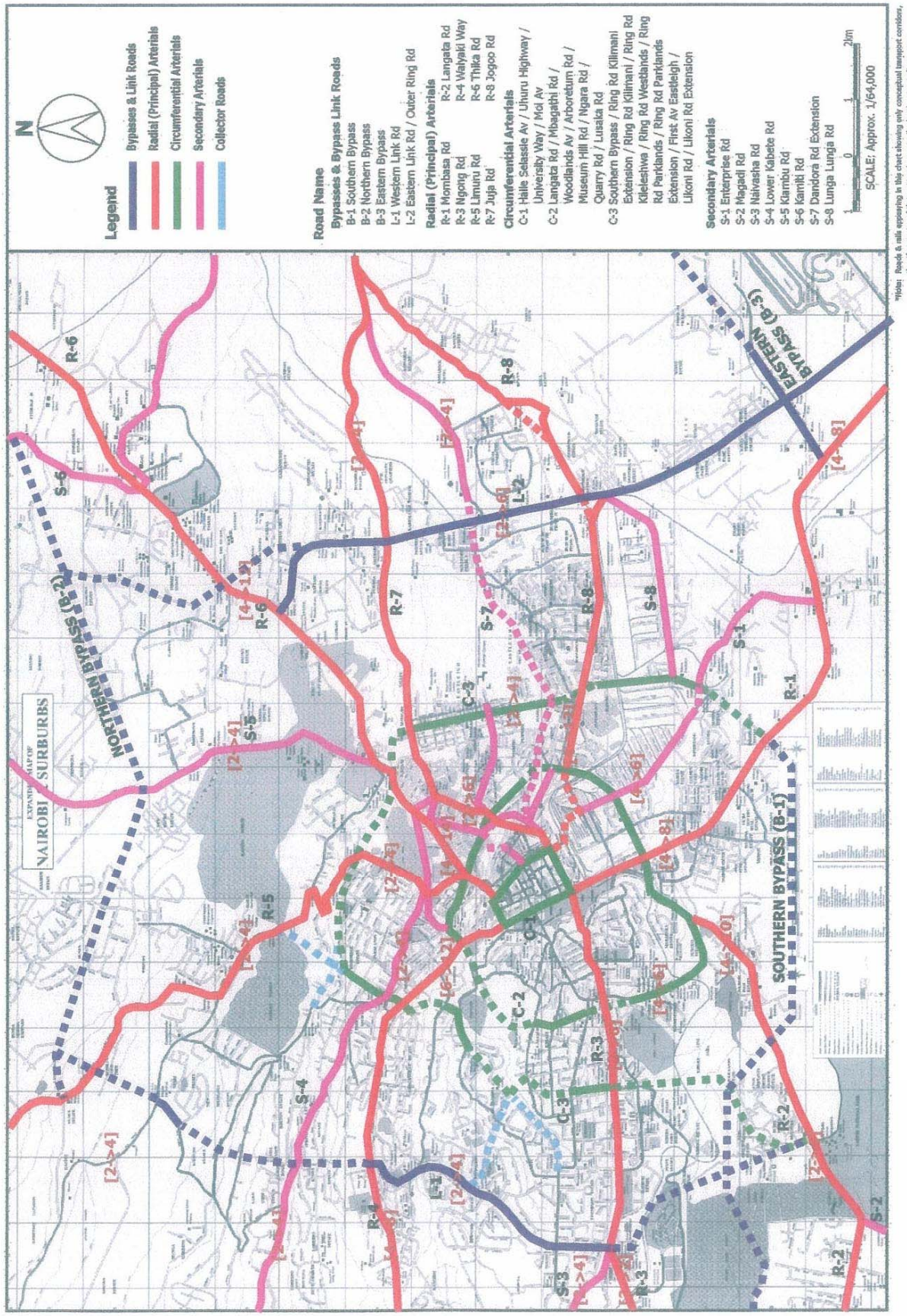


FIGURE 18.3-3 PROPOSED ROAD NETWORK IN URBANISED AREA