UGANDA NATIONAL ROADS AUTHORITY (UNRA)

PREPARATORY SURVEY ON
THE GREATER KAMPALA
ROADS IMPROVEMENT PROJECT
IN
THE REPUBLIC OF UGANDA

FINAL REPORT

VOLUME I EXECUTIVE SUMMARY

SEPTEMBER 2014

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIPPON KOEI CO., LTD.

EIGHT-JAPAN ENGINEERING CONSULTANTS INC.

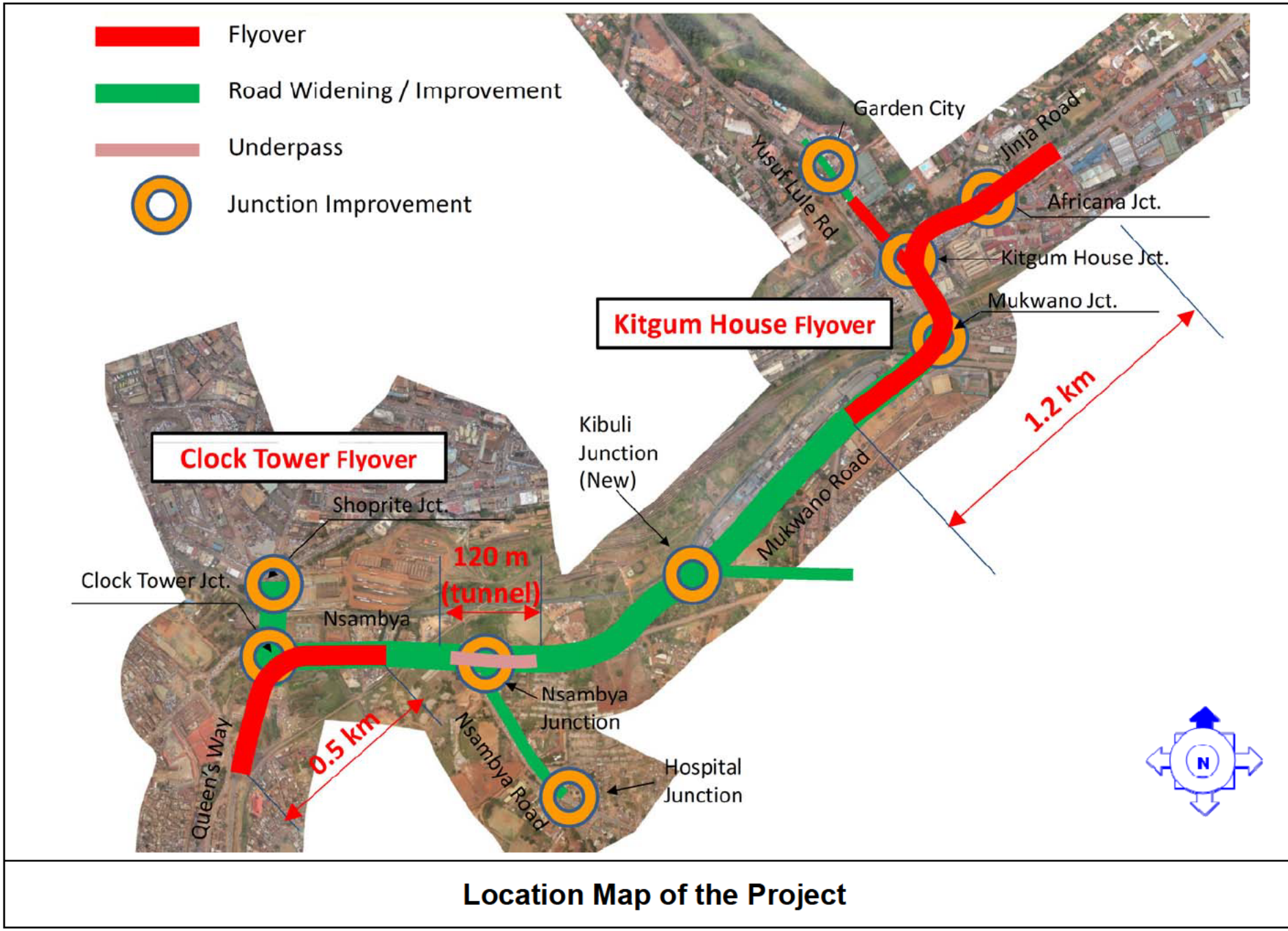
The exchange rates applied in this Survey are:

USD 1.00= UGX 2,579.54= JPY 98.80 (November 2013)

*UGX: Ugandan Shillings

LOCATION MAP OF THE SURVEY

Preparatory Survey on the Greater Kampala Roads Improvement Project



Location Map of the Project

Perspective Image of the Project (1) – Clock Tower Flyover (View from Nsambya Road)

Perspective Image of the Project (2) – Kitgum House Flyover (Kitgum House Junction)

Perspective Image of the Project (3) – Kitgum House Flyover (View along Access Road)

SYNOPSIS

1. Country	The Republic of Uganda
2. Name of Study	Preparatory Survey on the Greater Kampala Roads Improvement Project
3. Counterpart Agency	Uganda National Roads Authority (UNRA)
4. Objectives of Study	1. To review the pre-feasibility study of the Project 2. To conduct a comprehensive feasibility study to propose a project that would mitigate congestion and facilitate urban transportation in Kampala City
5. Study Area	The Greater Kampala Metropolitan Area (GKMA)

6. Scope of the Survey

(1) Review of Existing Transportation Plan
(2) Review and Update of Pre-F/S
(3) Supplemental Traffic Survey
(4) Preparation and Evaluation of Alternatives
(5) Assistance to UNRA for Facilitating Stakeholder Meetings
(6) Selection of Priority Projects
(7) Environmental and Social Considerations
(8) Confirmation of Project's Scope and Preparation of Design Criteria
(9) Natural Condition and Public Utility Survey
(10) Preliminary Design, Construction Plan, Land Acquisition Plan, and Construction Cost Estimate for the Selected Alternatives
(11) Studies on Implementation Structure and Schedule
(12) Project Cost Estimate
(13) Study of Procurement Condition
(14) Preparation of Operation and Maintenance Plan
(15) Project Evaluation

7. Scope of the Project Determined by the Survey

Location

The flyovers at Clock Tower Junction and Kitgum House Junction as well as widening of Mukwano Road between each flyover in Kampala city.

Package-1

Components	Description
i) Flyover	• Clock Tower Flyover, Total L=584m (Bridge L=366m), 2-lane
ii) Road Widening/Improvement (including footways and drainage)	• Queen's Way Widening L=500 m, 4-lane (existing: 2-lane) • Entebbe Rd. Improvement L=200 m, 6-lane • Nsambya Rd. Widening L=420 m, 6-lane (existing: 4-lane)
iii) Pedestrian Bridge	• Clock Tower Pedestrian Bridge, L=220 m • Shoprite Pedestrian Bridge, L=72 m
iv) Junction Improvement (with NMT provisions*)	• Shoprite Junction • Clock Tower Junction

Package-2

Components	Description
i) Underpass	• Nsambya Underpass, Total L=430m (Tunnel L=130m), 4-lane
ii) Road Widening/Improvement (including footways and drainage)	• Mukwano Rd. Widening L=1,330m, 4-lane (existing: 2-lane) • Gaba Rd. Widening L=500m, 4-lane (existing: 2-lane)
iii) Junction Improvement (with NMT provisions*)	• Nsambya Junction • Hospital Junction • New Kibuli Junction

Package-3

Components	Description
i) Flyover	• Kitgum House Flyover, Total L=1,293m (Bridge L=1,003m), - Mukwano Rd. – Kitugum House Jct. 3-Lane, - Kitgum House Jct – Jinja Rd. 2-Lane, - Kitugum House Jct. – Yusuf Lule Rd. (Branch Way) 1-Lane
ii) Road Widening/Improvement (including footways and drainage)	• Mukwano Rd. Widening L=410 m, 4-lane (existing: 2-lane) • Access Rd. Improvement L=210 m, 5-lane • Jinja Rd. Improvement L=590 m, 4-lane • Yusuf Lule Rd. Improvement L=470 m, 4-lane • Nile Ave. Improvement L=120, 4-lane
iii) Junction Improvement (with NMT provisions*)	• Mukwano Junction • Kitgum House Junction • Africana Junction • Garden City Junction

* NMT (Non-Motorized Transport) provisions include footways, cycle ways, pedestrian crossings, street lightings and traffic signals.
* The scope is subject to minor changes based on the results from the Detail Design.

Main Technologies to be applied to the Project

Following bridge technologies are proposed in the Survey and will be further examined in the detailed design study.

Narrow box girders with steel-concrete composite deck slab: To be applied for Kitgum House Flyover for the purpose of minimising construction period, securing rigidity of a small-radius curved bridge, reduction of cost and ensuring safety during the construction work.

Weathering steel: Proposed for all the steel superstructures and piers in order to minimize maintenance works. The surface will be painted for protection and suitable appearance in the urban area.

Steels for Bridge High Performance Structure (SBHS): Proposed to apply at connections between girders and piers where the stress is concentrated. It is advantageous to reduce the thickness of steel plates and to improve workability of welding joint.

Screwed steel pile: To be applied for all the piling foundation of the flyovers and pedestrian bridges for the purpose of minimising construction period, construction spaces and environmental impacts such as noise, vibration, and disposal of waste soil.

8. Implementation Schedule

Activities	Schedule
i) Detailed design	September 2014 – August 2015 (12 month)
ii) Tender period	September 2015 – December 2015 (4 month)
iii) Evaluation of technical proposal	January 2016 – March 2016 (3 month)
iv) Evaluation of financial proposal	April 2015 – May 2016 (2 month)
v) Contract signing	September 2016
vi) Commencement of civil works	October 2016
vii) Completion of civil works	December 2018 (27 month)
viii) Defect liability period	One year

It is noted that following measures were considered to plan the above schedule in order to expedite the implementation process:

- UNRA fund the consultancy service of the detailed design and tender assistance for the immediate commencement.
- Integrate pre-qualification and the bidding stages into one stage for procurement of contractors.

9. Construction Cost

Following table shows estimated construction costs for the Project for each contract package. The time of the cost estimate is November 2013

[redacted]

10. Relocation of Utilities

The Survey identified manifold underground and overhead utilities which will be affected by the Project. Providers/administrators of these utilities are summarized as follows:

i) Uganda Electricity Transmission Company Limited (UETCL; transmission lines)
ii) Umeme (electricity distribution)
iii) National Water and Sewerage Corporation (NWSC); and
iv) Telecommunications companies (at least ten different entities).

Relocation works of utilities will be undertaken by UNRA and KCCA, prior to the commencement of the construction works.

UNRA and KCCA will also endeavour to relocate Clock Tower monument. A methodology of the relocation will be examined by the Ugandan side.

11. Organization for Implementation and O&M

- UNRA is the executing agency and will be responsible for implementation of the Project by undertaking procurement and contract management, project management of works and supervision contracts under the Project.
- UNRA have experienced several major projects including the construction of New Nile Bridge at Jinja that can be made used of in the implementation of the Project.
- After the completion of the Project, KCCA would be responsible for the O&M of the asset provided through the Project and may from time to time seek the support of UNRA, if required.
- KCCA committed to form a Bridge Management Unit consists of five structural/bridge engineers and labour teams prior to the commencement of the construction works. Training for the members of the management unit will be provided through the Project.
- MoWT is responsible for policy formulation, regulation and monitoring.
- Uganda Road Fund (URF) will be the main source of the O&M budget for the Project assets.

12. Environmental and Social Considerations

EIA Study

EIA study was carried out in the Survey. The EIA report for the Project was submitted to National Environmental Management Agency (NEMA) in May 2014. It is expected to be approved by the end of August 2014.

Land Acquisition and Resettlement

Expected are of land to be acquired and households to be resettled and affected by the Project are as follows:

Item	Volume
i) Land to be acquired	6.2 ha
ii) Nos. of affected private landowner	53 owners
iii) Households to be resettled	21 households
iv) Evaluation of financial proposal	88 persons

13. Economic Evaluation

EIRR ;	25.2%
B/C :	2.34
NPV :	USD 192.0 million

Conditions of the economic analysis:

- Cost: Project cost (excluding tax), operation and maintenance cost
- Benefit: Saving of travel time cost (TTC) and saving of vehicle operating cost (VOC)
- Project Life: 25 years (including construction period)

14. Recommendations

- This project, by itself, cannot solve the future traffic congestion problem. Road capacity of Kampala will need to keep improving in order to accommodate the ever-increasing traffic demand.
- Flyover constructions at Jinja-Lugogo Junction, Fairway Roundabout, Murago Junction, Wandegeya Junction, and Buwaize Junction can be the next targets as recommended in the Pre-F/S.
- Widening of Queen's Way and improvement of Kibuye Roundabout are necessary for the effective use of Clock Tower Flyover.
- Implementation of the BRT maximizes the project's effectiveness.
- Since it is predicted that Kampala will be a city as large as Johannesburg in the next 20 years, large transport infrastructure such as mass transit system and/or intra-urban expressway will be necessary.
- The owner of the Project will need to have an adequate maintenance capacity. Since the flyover structures will be the first major steel bridges in the country, appropriate capacity building should be made and adequate budget should be allocated.
- Further discussion and examination on the method of the relocation of Clock Tower monument shall be continued in a detailed design stage.

PREPARATORY SURVEY ON THE GREATER KAMPALA ROADS IMPROVEMENT PROJECT IN THE REPUBLIC OF UGANDA

FINAL REPORT (VOLUME I : EXECUTIVE SUMMARY)

VOLUME I Executive Summary

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LIST OF ABBREVIATIONS

AADT	Average Annual Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
AfDB	African Development Bank
AFR	Annual Fund Requirement
AL	Axle Loading Survey
A-RAP	Abbreviated Resettlement Action Plan
B/C	Benefit/Cost Ratio
BRT	Bus Rapid Transit
BS	British Standard
BSTW	Bugolobi Sewage Treatment Works
CAESAR	Center for Advanced Engineering Structural Assessment and Research
CBD	Central Business District
CBR	California Bearing Ratio
CIP	Capital Investment Plan
COI	Corridor of Impact
CPI	Consumer Price Index
CSTW	Conventional Sewage Treatment Works
CZ	Center Zone
DAF	Dynamic Amplification Factor
D/D	Detailed Design
DRSC	District Road Safety Committees
DT	Design Traffic
DTM	Digital Terrain Model
DUCARIP	District, Urban and Community Access Roads Investment Plan
EAC	East African Community
EGI	e-Government Infrastructure
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EIS	Environmental Impact Study
ERB	Engineers Registration Board
ERP	Economic Recovery Program
ESA	Equivalent Single Axle
EU	European Union
FDI	Foreign Direct Investment
FO	Flyover
F/S (FS)	Feasibility Study

FY	Fiscal Year
GCPs	Ground Control Points
GDP	Gross Domestic Product
GKMA	Greater Kampala Metropolitan Area
GL	Guideline
GOJ	Government of Japan
GOU	Government of Uganda
GPS	Global Positioning System
GRDP	Gross Regional Domestic Product
HCM	Highway Capacity Manual
HDM	Highway Development and Management Model
ICB	Internationally Competitive Bidding
IUCN	International Union for Conservation of Nature
JCT	Junction
JTC	Junction Turning Counts Survey
KCC	Kampala City Council
KCCA	Kampala Capital City Authority
KfW	German Government
KIIDP	Kampala Institutional Infrastructure Development Programme
KPDP	Kampala Physical Development Plan
KPL / KLA	Kampala
KRC	Kenya Railways Corporation
KSPA	Kampala Special Planning Area
KUTIP	Kampala Urban Transport Improvement Program
LC	Local Council
LCB	Locally Competitive Bidding
LCC	Life Cycle Cost
LCCA	Life Cycle Cost Analysis
LGDPs	Local Government Development Plans
LGMSDP	Local Government Management and Service Delivery Programme
LM	Load Model
MATA	Metropolitan Area Transport Authority
MCC	Manual Classified Count Survey
MDGs	Millennium Development Goals
MICT	Ministry of Information and Communications Technology
MLIT	Ministry of Land, Infrastructure, Transport and Tourism of Japan
MoFA	Ministry of Foreign Affairs
MoFPED	Ministry of Finance, Planning and Economic Development

MoLG	Ministry of Local Government
MoLHUD	Ministry of Lands, Housing and Urban Development
MoWHC	Ministry of Works, Housing and Communications
MoWT	Ministry of Works and Transport
NBI	National Data Transmission Infrastructure
NCRP	Nakivubo Channel Rehabilitation Project
NDP	National Development Plan
NEMA	National Environmental Management Authority
NITA-U	National Information Technology Authority - Uganda
NMT	Non-Motorized Transportation
NPV	Net Present Value
NRSC	National Road Safety Council
NTMP	National Transport Master Plan
NWSC	National Water and Sewerage Corporation
OD	Origin Destination
O&M	Operation and Maintenance
PAPs	Project Affected People
PC	Pre-stressed Concrete
PCE	Passenger Car Space Equivalence
PCU	Passenger Car Unit
PEAP	Poverty Eradication Action Plan
PGA	Peak Ground Acceleration
PPDA	Public Procurement Disposal of Public Assets Authority
PSV	Public Service Vehicles
PZ	Planning Zone
Q-V	Quantity-Velocity
RA (Rbt)	Roundabout
RAFU	Road Agency Formation Unit
RAP	Resettlement Action Plan
RC	Reinforced Concrete
RD (Rd)	Road
RSDP	Road Sector Development Plan
RVR	Rift Valley Railways
SAP	Structural Adjustment Program
SBD	Standard Bidding Documents
SFR	Strategic Framework for Reform
SHS	Ugandan Shilling
SIPs	Sector Investment Plans

SO	Special Order
SPT	Standard Penetration Test
STGO	Special Types General Order
TLB	Transport Licensing Board
TOD	Transit Oriented Development
TS	Tandem System
TTC	Travel Time Cost
TWG	Technical Working Group
UACE	Uganda Association of Consulting Engineers
UAV	Unmanned Aerial Vehicle
UBDM	Uganda Bridge Design Manual
UBOS	Uganda Bureau of Statistics
UCC	Uganda Communications Commission
UDL	Uniformly Distributed Loads
UEB	Uganda Electricity Board
UEDCL	Uganda Electricity Distribution Company Limited
UEGCL	Uganda Electricity Generation Company Limited
UETCL	Uganda Electricity Transmission Company Limited
UGX	Ugandan Shilling
UIPE	Uganda Institution of Professional Engineers
UJAS	Uganda Joint Assistance Strategy
UNABCEC	Uganda National Association of Building and Civil Engineering Contractors
UNBS	Uganda National Bureau of Standards
UNRA	Uganda National Roads Authority
UPF	Uganda Police Force
URC	Uganda Railways Corporation
URF	Uganda Road Fund
US	Uganda Standard / United States
USGS	United States Geological Survey
USD	United States Dollar
USHS	Ugandan Shilling
UTL	Uganda Telecom Ltd.
UTM	Universal Transverse Mercator
UTODA	Uganda Taxi Operators and Drivers Association
VOC	Vehicle Operating Cost
WB	World Bank
WDC	Wakiso District Council

EXECUTIVE SUMMARY

1 Background

The National Transport Master Plan including a Transport Master Plan for the Greater Kampala Metropolitan Area (NTMP/GKMA) has established a long-term framework for the transport sector (goal by 2023) and proposed the urban transport master plan focused on GKMA including widening of arterial roads and improvement of junctions and railroad crossings. The proposed development pattern was transit oriented development (TOD). The Bus Rapid Transit (BRT) project is currently under preparation and would cover major urban corridors of GKMA and is expected to improve the traffic condition in Kampala's central urban area.

Under these circumstances, Japan International Cooperation Agency (JICA) conducted the Study on Greater Kampala Road Network and Transport Improvement (Pre-F/S) in 2010 in response to a request from the government of Uganda (GOU). The Pre-F/S reviewed the NTMP/GKMA and selected priority projects for the road network improvement and carried out the pre-feasibility study on these selected projects. The JICA, Ministry of Works and Transport (MoWT), Uganda National Roads Authority (UNRA), and Ministry of Finance Planning and Economic Development (MoFPED) reached a consensus that these projects are necessary for the improvement of the transportation in GKMA and came to an agreement to conduct the Preparatory Survey on the Greater Kampala Roads Improvement Project (hereinafter referred to as the Survey and the Project) on 18 October 2012.

The objectives of the Survey are to review and update the Pre-F/S and to conduct a comprehensive feasibility study to propose a suitable project that would mitigate congestion and facilitate urban transportation in Kampala City, thereby contributing to the economic and social development of Uganda. The Survey was commenced in March 2013.

2 Development Plans and Present Condition of the Survey Area

2.1 Development Plans

On April 18, 2013, GOU published Vision 2040, which is the country's current long-term national plan. Vision 2040 builds on previous efforts and lessons learnt, and analysis of Uganda's past development strategies including Vision 2025 and Vision 2035, which are both aimed to transform the country from a peasant society into a modern and prosperous society. Vision 2040 articulates clear strategies and policy directions to transform the country into a competitive upper middle-income country with a per capita income of USD 9,500, and Uganda's population is projected to reach 61.3 million from 32.9 million in 2010. In 2007, after the implementation of the third revision of Poverty Eradication Action Plan (PEAP 3), GOU determined that the country should move from PEAPs to the six five-year National Development Plans (NDPs). The first NDP

was launched in April 2010.

As for Kampala Capital City Authority (KCCA), a draft final report for the Kampala Physical Development Plan (KPDP) was prepared in September 2012. KPDP proposed a number of projects and a Capital Investment Plan.

2.2 Natural Conditions

2.2.1 Meteorology

The GKMA is located in a tropical area and at 1,150 m elevation characterized by predominantly torrential rains and high humidity. The temperature in Kampala City is within a narrow range between 16.0°C and 29.9°C across the year. Kampala City has two tropical rainy seasons throughout the year, i.e., light rain season from March to May, and heavy rain season from September to December.

2.2.2 Topography

The topography of Kampala City is characterized by a series of low-lying hills with flat hilltops. These hills are surrounded by a network of wet valleys, which are covered by swamps. Many of the swamps have been reclaimed and developed. When rain falls, water flows into swamps via drainage channels particularly around Nakivubo Channel which is laid across the city center and is the biggest among eight main drainage systems in Kampala District.

2.2.3 Geology

According to previous studies, a basement rock layer is found at a relatively shallow depth of 5-10 m below recent swamp deposits, alluvium and lacustrine deposits. At the project site, swamp deposits are mainly found along Nakivubo Channel.

2.2.4 Earthquakes

Uganda is located in Tanzania Craton bordered by two tectonic plate boundaries; viz. the Somali Plate in the east where volcanoes are active, and the Nubian Plate in the west where earthquakes likely occur. Most of the location of earthquakes in Uganda concentrates at the surrounding area of the tectonic plate boundary. In general, the magnitude of earthquake around the convergent plate boundary is larger than that of the spreading plate boundaries.

According to the Material Report of the tender dossier for the construction of the Kampala Northern Bypass, Kampala City has experienced a maximum intensity of Grade V (very light damage).

2.3 Socio-Economic Conditions

2.3.1 Population of GKMA and Projections

The population of GKMA was estimated at around 2.50 million in 2008, and projected in NTMP to reach 4.50 million in 2023, with an average growth rate of about 4%. On the other hand, KPDP estimated that the population was at 3.15 million in 2011, and forecasted to reach 5.00 million in 2022, and 8.00 million in the long term (2035 or 2040). Considering the wider planning area and long-term planning period, the projections by KPDP were applied in the traffic demand forecast.

2.3.2 National and Regional Economy

Uganda's economy has maintained good performance until FY2010/11—having an annual gross domestic product (GDP) growth rate of 6-10% per annum—even though the GDP per capita has grown at only 3.5% of the average rate over the past decade due to the rapid population growth.

According to KPDP, the gross regional domestic product (GRDP) of GKMA in 2011 was about USD 6.6 billion at current prices, which is 36.5% of GDP of the whole of Uganda. The per capita GRDP of GKMA in 2011 was estimated at USD 2,100. This value is equivalent to 3.8 times of the national average (USD 2,100/USD 548.8). The future target growth rates of GRDP were projected at 9.3% per annum up to 2022, and 7.3% up to 2035. The per capita GRDP was forecasted to grow with rates of 3.5% up to 2022, and 4.6% up to 2035.

2.3.3 Inflation (Consumer Price Index: CPI)

The past trend of CPI in Uganda has been varying within a comparatively stable range of 6%-8% from FY1999/00 to FY2007/08. However, FY2008/09 recorded an inflation rate of 14.1% while FY2011/12 registered a higher inflation rate of 23.5, which was the highest rate in the past ten years. all types of commodities, particularly food, clothing and footwear, and fuel, indicated two-digit inflation rates in FY2011/12. It was reported that this high inflation rate was attributed mainly to the high currency exchange rate (UGX to USD) and increase in fuel prices. According to the Bank of Uganda, the inflationary pressures were abated from the second quarter of FY2012/13.

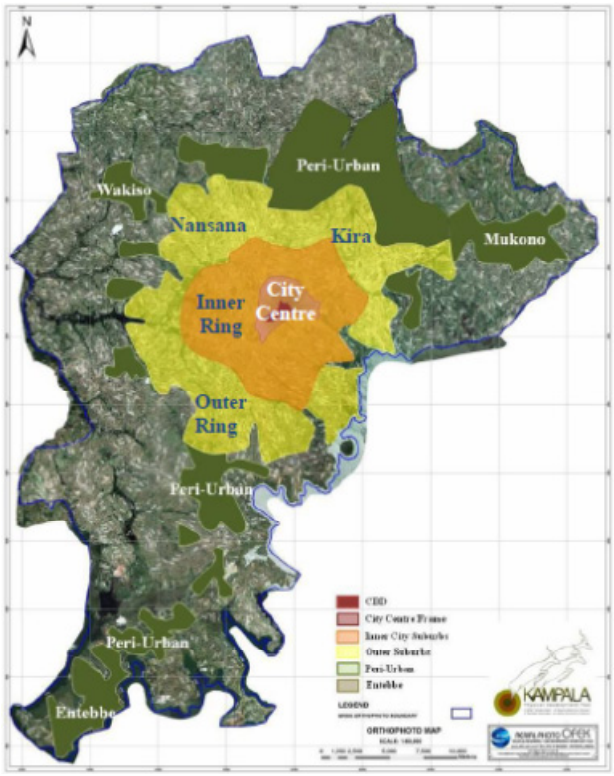
2.3.4 Vehicle Registration in Uganda

Motorization in Uganda proceeded rapidly in recent years. The number of registered cars has increased at 10.2% based on the annual rates between 2005 and 2009. Motorcycles have increased with the highest rate (28.2% per annum) and followed by minibuses (22.6% per annum) during the same period. Trucks also indicated an increase in growth rate (15.7% per annum). However, vehicle ownership of cars per 1,000 population in 2009 was at 3.1 vehicles, which is not so high at present.

2.4 Structure Plan and Land Use

2.4.1 Present Urban Structure and Key Issues

Kampala's present urban structure is affected by 1) its traditional and colonial history, 2) natural constraints (morphology, Lake Victoria, wetlands, etc), and 3) the access routes going to/coming from the city. Kampala City has a clear radial structure concentrated on its center with concentric ring belts around it, which consists of the central business district (CBD), city center belt, inner city suburbs, and peri-urban periphery as shown in Figure S2-1. Both GKMA and KCCA lack a clear hierarchy of urban centers and sub-centers as main economic activities are concentrated to the only one city center and the urban sprawl has progressed outside along the eight major radial corridors in a disorderly manner. As a result, severe traffic congestion during peak hours has been observed on major road sections/ intersections directly connected with the CBD and inner city areas.



Source: KPDP

Figure S2-1 Kampala Primary Structure

2.4.2 Kampala Physical Development Plan (KPDP)

(1) Planning Vision and Development Strategy of KPDP

The KPDP proposed Kampala's long-term development vision keeping consistency with the National Policy and Vision as defined by NDP and KCCA's Strategic Vision as follows:

A Modern, Functional, Balanced City and Metropolitan System:

- Driving Uganda's growth, transformation, and modernization; and
- Ensuring Kampala's future as a vibrant, attractive, and sustainable city.

(2) Development Targets of KPDP

The KPDP has set quantitative development targets in the following fields: population, built area and supply of land, densities and intervention approach, economic development, social development, housing, and environment. Among others, the population and economic development targets are shown in below:

Table S2-1 GKMA Population Targets by KPDP

Population and Households	2011	2022 Projection	2022 Target	Long-term Target
Population	3,150,000	5,000,000	5,800,000	8,000,000
Household Size	3.9	3.8	3.8	3.6
Households	800,000	1,300,000	1,500,000	2,200,000

Source: KPDP

Table S2-2 GKMA Economic Activity Targets

Indicator	2011	2022 Target	Long-term Target
Per Capita Domestic Product (USD)	2,100	3,050	5,450
GKMA Domestic Product (USD billion)	6.6	17.5	43.5

Note: 1. Local domestic product calculated including value of owner-occupied homes.
2. Assuming per capita growth of 3.5% per annum in 2011-2022 and 4.5% in2023-2035 (based 2011 USD values)
Source: KPDP

(3) Physical Vision and Conceptual Structure Proposed by KPDP

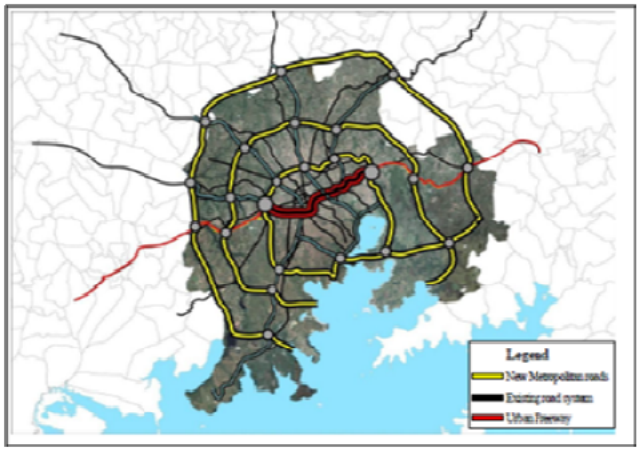
The following scheme shows the physical vision and development policy for GKMA.

- ✓ Strengthening existing cores (Wakiso, Mukono, and Entebbe as existing centres outside of KCCA area),
- ✓ Developing new satellite towns,
- ✓ Development of KCCA, and
- ✓ Construction of a metropolitan road system.

The development policy is aimed at carring out the physical vision of Kampala to create a well-organized and modern urban metropolitan system. The urban conceptual structure clearly indicates the dispersement of urban functions avoiding the present overconcentration to the existing CBD with a combination of radial and circumferential/ring road networks.

(4) KPDP Metropolitan Transportation Plan

The existing road network in GKMA is radial-oriented with eight main radial roads which are partly combined by the Northern Bypass. KPDP proposed a new metropolitan road system, as shown in Figure S2-2, that consists of three ring roads (inner, middle, and outer ring roads) and improve existing radial roads. The most important of the proposed radial roads is the urban freeway that runs along the east-west axis. This main route runs along the existing railway coming from the east just south of Mukwano, passes through the centre of the city and almost parallel to Kampala Road, Queen's Way and Sembule Road, and breaks to the southwest after crossing the Northern Bypass.



Source: KPDP

Figure S2-2 Proposed Metropolitan Road System

2.5 Construction Industry in Uganda

The construction industry in Uganda deals with buildings, civil works and specific-related services, such as plumbing, heat and air-conditioning, plastering and glazing activities, and demolition of buildings. Although the industry is extremely fragmented, the sizes of majority of entities are relatively small compared to those of other industries. The Uganda National Association of Building and Civil Engineering Contractors (UNABCEC) registers contractors that apply and qualify for membership in the association. In addition, MoWT prepares and updates a list of registered contractors for bridge and road construction works.

Table S2-3 Source of Construction Material, Plant and Equipment

Item	Recommendable Source		
	Uganda	Japan	Third Country
[Material]			
Crushed Stone / Aggregate	x		
Sand	x		
Cement	x		x
Reinforcement Steel Bar	x		
Pre-stressing Tendon			x
Steel Beam / Sheet Pile		x	x
Metal Form	x		
Plywood	x		
Bitumen			x
Fuel	x		
Bearing / Expansion Joint		x	x
[Plant and Equipment]			
Earthwork Machineries	x		
Road Work Machineries	x		
Piling Equipment		x	x
Crane	x		x
Pre-stressing Equipment		x	x
Concrete Plant	x		x
Asphalt Pre-mix Plant		x	x

Source: JICA Survey Team

The current availability and the recommended procurement sources of construction materials, plants, and equipment that are in good condition in Uganda are summarized in Table S2-3 with the recommended procurement sources.

3 Outline of the Transportation Administration

3.1 Outline of the Transport System in Uganda

The national transport system of Uganda comprises road, rail, air, and inland water transport modes. In Uganda, over 90% of cargo freight and passengers movement is by road. Road accounts for 96% of the freight cargo whereas rail accounts for only 3.5%. In nominal terms, roads carry an estimated 5,500 million ton-km per year compared to 200 million ton-km by rail, 0.03 million ton-km by air, and negligible freight volume by water. As far as passenger traffic is concerned, road accounts for an average of 95%. Currently, Uganda's road network has an estimated total length of 66,000 km, excluding community access roads. The length of paved national roads increased from 2,200 km in 1996 to 3,490 km in 2013, representing 17% of the total length of the national roads network of 21,000 km.

The total length of roads in Kampala is 1,218 km, of which 467 km (38.4%) are paved (bituminized) and 751 km (61.6%) are unpaved (gravel or earth).

3.2 UNRA

The UNRA, the counterpart agency for this Survey, was established by the UNRA Act 2006, and became fully operational on 1 July 2008. UNRA's mandate is to develop and maintain the national road network totalling to 21,000 km, to manage ferries linking the national road network, and to control axle load. UNRA has been implementing major road and bridge projects including the Construction of a New Bridge Across River Nile at Jinja financed by JICA, which the experiences can be made use of in the implementation of the Flyover Project.

3.3 KCCA

The KCCA was established by an act of the Parliament through the KCCA Act in November 2010 and became effective in March 2011. It replaced the former KCC. As a result, the administration of Kampala City has been directly supervised by the central government. The city clerk, formerly the highest financial officer in KCC, is replaced by the executive director, who is answerable to the minister for KCCA.

With regard to the transport sector, all roads and transport systems within the capital city of Kampala as well as transport planning are under the supervision of KCCA.

The KCCA is administering a total area of 195 km^2 of which 86.7% is land. Its administrative area is divided into five divisions, 99 parishes, and 802 villages.

3.4 Passenger Transport in GKMA

Currently, public transport in GKMA is limited to taxi-motorcycle (known as boda-boda), minibus (locally known as 'taxi' or matatu) and taxi cab (locally called 'special hire'). Most passenger fleet

is dependent on minibus with 11 to 14 seats, which are not well organized, operating without a timetable or fixed stops, soliciting passengers along the route, and stopping (and setting off) everywhere.

3.5 Budget Allocation for Road Sector

The works and transport sector has allocated budgets amounting to UGX 1,651 billion in FY 2012/13, UGX 2,511 billion in 2013/14, UGX 2,576 billion in FY 2014/15, and UGX 2,336 billion in FY 20145/16. These amounts represent 15.9%, 20.7%, 22.7%, and 20.4% of total GOU expenditures, respectively, and indicate one of the highest percentage shares among all sectors.

UNRA is the responsible government agency for the construction and maintenance of national roads. UNRA will be allocated about 70% of the sector's budget and accounts for the highest portion.

In the FY2013/14 budget, the Uganda Road Fund (URF) is expected to contribute 17% of the sector's budget and this will rise to 25% in FY 2017/18. This budget is distributed to road administrators for maintenance works of the roads in the county.

4 Review of Pre-F/S and Related Projects

4.1 Outline of the Pre-F/S

In the Pre-F/S, after evaluating the short-listed projects in terms of consistency with higher plans, engineering factors, socioeconomic factors and environmental impacts, the final short-listed projects, as shown in Table S4-1, were selected and conceptual designs were conducted.

Table S4-1 Source of Construction Material, Plant and Equipment

Phase Proposed in Pre-F/S	Projects
Phase 1	1. Flyover Construction 1.1 Kitgum House Junction Main Flyover 1.2 Kitgum House Junction Ramp Flyover
	2. Mukwano Road Widening
	3. Shoprite & Clock Tower JCTs Traffic Safety Improvement
Phase 2	1.Flyover Construction 1.3 Clock Tower Flyover

Source: Pre-F/S

4.2 Transportation Plans and Projects

Some transportation projects are currently under preparation to solve traffic issues in GKMA. Implementation of those planned projects would largely affect the Project proposed by the Pre-F/S in terms of traffic dynamics and geometric or structural requirement. The following table summarizes existing transportation plans and projects with significant influence to the Project proposed by the Pre-F/S.

Table S4-2 Transportation Plans and Projects Related to the Project

Plan / Project	Fund	Status	Interface
National Transport Master Plan including a Transport Master Plan for the Greater Kampala Metropolitan Area (NTMP/GKMA)	WB and GOU	Final Report approved	Transit-oriented development (TOD) was recommended. Dual carriageway viaduct passing through the railway reserve was planned.
Kampala Physical Development Plan (KPDP)	WB and GOU	Draft Final Report issued	Sustainable transport modes including MRT (immediately, BRT) and NMT were recommended to be developed. Urban freeway passing city centre was proposed to enhance east-west corridor.
Bus Rapid Transit (BRT) Pilot Project	WB and GOU	Draft Final Report of D/D issued	BRT runs along the Kampala-Jinja Road which intersects the flyover route. The flyover is planned to pass over the BRT route.
MoWT Non-motorised Transport (NMT) Policy and NMT Pilot Project in the City Centre	KCCA	Draft document issued	All road projects shall explain how the needs of pedestrians and cyclists have been incorporated into the designs.
Kampala Institutional and Infrastructure Development Project (KIIDP)	WB and GOU	Phase 2 being planned	Carriageway dualling of Mukwano Road and Queen's Way are listed in Lot 2 of the programme.
Southern Bypass		F/S in progress	The project interfaces with the flyover through diversion of motorized traffic from the city centre to the proposed highways.
Northern Bypass Widening	EU and EIB	Under procurement stage	The project interfaces with the flyover through diversion of motorized traffic from the city centre to the proposed highways.
Kampala-Entebbe Expressway	Exim Bank of China and GOU	Under construction	The project interfaces with the flyover through diversion of motorized traffic from the city centre to the proposed highways.
Kampala-Jinja Expressway	AfDB and Infrastructure Fund	Draft Final Report of D/D issued	Project starts in Nakawa and leaves a 3 km gap of poor quality road between the end of the flyover and start of the highway. Need to harmonize the design of this section.
Kibuye-Busega-Mpigi Expressway		D/D in progress	Project starts in Kibuye and leaves a 2 km gap of congested road between the end of the flyover and start of the highway. Need to harmonize the design.

Source: JICA Survey Team

5 Traffic Surveys

5.1 Objective

Traffic surveys were conducted in order to update the traffic data obtained by Pre-F/S, to grasp accurate traffic paths on critical area, and to fill a gap in traffic data obtained by Pre-F/S. The obtained survey data were analyzed and utilized in traffic demand forecast. Details of the supplemental traffic surveys carried out are presented below:

5.2 Supplemental Traffic Surveys

5.2.1 Manual Classified Count Survey (MCC)

The MCC survey was carried out in the city centre of Kampala which had not been collected in JICA's Pre-F/S in 2010. The data is expected to be used not only for this study but also for KCCA and MoWT to consider traffic improvement programs in Kampala City. As for the traffic volumes of roads during the survey hours (14 hours), the largest volume was recorded at T4 Entebbe Road at 83,180 vehicles and the second largest was at T1 Jinja Road at 74,369 vehicles. These volumes

included motorcycles. When the volumes were converted into passenger car unit (PCU), the largest volume was at T1 Jinja Road.

Table S5-1 MCC Survey Results (PCU)

	Passenger Vehicle	Small Size Cargo Vehicle	Minibus (Taxi)	Large size Bus	Medium Goods Vehicle (MGV)	Heavy Goods Vehicle (HGV)	Bodaboda	Total	Heavy Vehicle Ratio(%)	Bodaboda Ratio(%)
T1 Jinja	30,229	1,908	17,180	402	4,381	1,005	13,726	68,831	8.4%	19.9%
T2 Yusuf Lule	19,360	1,518	7,509	218	1,729	573	10,371	41,278	6.1%	25.1%
T3 Kampala	12,001	1,103	7,166	123	917	123	10,789	32,222	3.6%	33.5%
T4 Entebbe	17,978	1,648	22,040	196	2,235	294	23,304	67,695	4.0%	34.4%
T5 Nsambya	12,927	911	10,024	20	1,854	933	16,257	42,926	6.5%	37.9%
T6 Katwe	10,608	405	9,404	68	796	201	14,069	35,551	3.0%	39.6%

Source: JICA Survey Team

An overall growth rate of 10% was obtained for the last three years, corresponding to a growth of 3.3% per annum which is quite lower than the RSDP 3 estimation of 7.5%. The results also show that the traffic volume of Jinja Road has a smaller growth rate than others.

5.2.2 Simple O-D Survey (OD Survey)

(1) Survey Stations

The OD survey was carried out at the same locations as in the MCC. The survey was carried out during peak hours, from 6:00 to 9:00 in the morning and 16:00 to 19:00 in the evening, for a period of one day at each survey point. The type of surveyed traffic included all traffic, excluding boda-bodas, military vehicles, police cars, and ambulances.

The traffic movement goes along the northern- southern and eastern-western axes as shown in the desired line in Figure S5-1 based on consolidated zones. Consolidated zones correspond to the district zone.

5.2.3 Junction Turning Counts Survey (JTC)

The JTC surveys were carried out at the junction between Eighth Street and Mukwano Road and at Clock Tower Junction at peak hours on March 11, 2013 and April 30, 2013, respectively. Traffic flow by direction during AM peak hours (one hour) are illustrated in Figure S5-2.

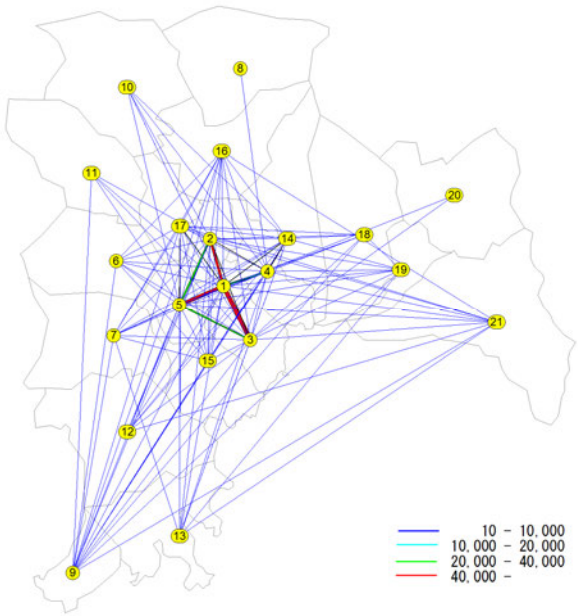


Figure on the left hand side shows O-D desired line connecting consolidated zone based on minimum zones.

Key Consolidated Zone in Kampala District

Zone-1: CENTRAL KAMPALA

Zone-2: KAWENPE

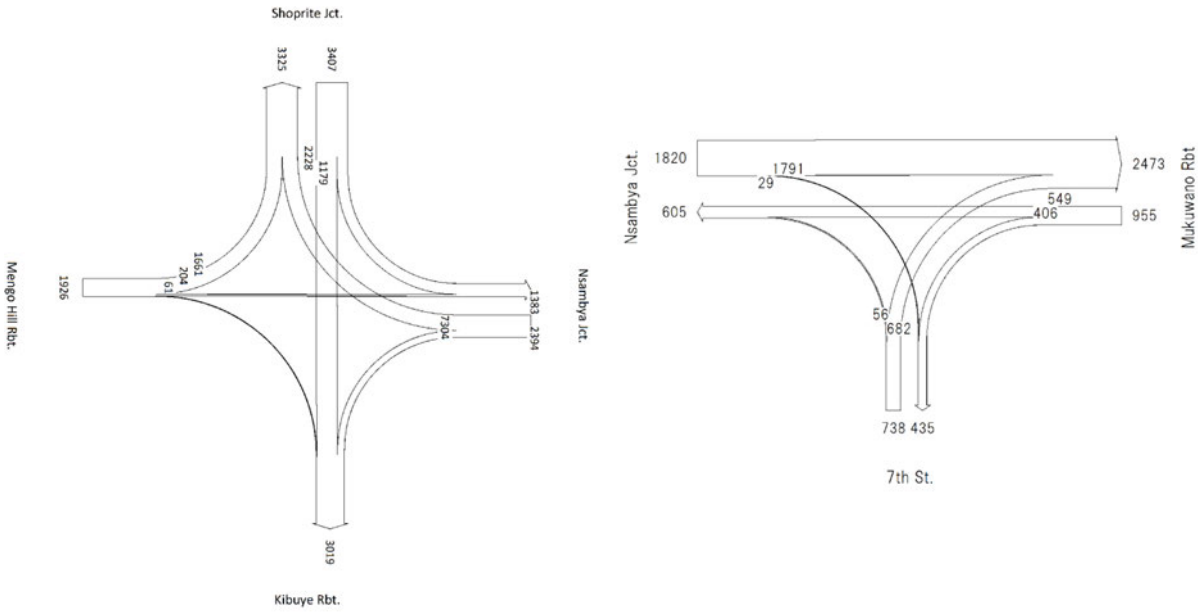
Zone-3: MAKERERE University

Zone-4: NAKAWA and KYAMBOGO

Zone-5: RUBAGA

Source: JICA Survey Team

Figure S5-1 O-D Desired Line (Consolidated Zone)



Clock Tower Junction, AM Peak (PCU) Eighth Street Junction, AM Peak (PCU)

Source: JICA Survey Team

Figure S5-2 Traffic Flow at Clock Tower Junction and Eighth Street Junction

5.2.4 Axle Loading (AL) Survey

The AL survey was carried out for Mukwano Road for a period of two days, i.e., the first day for eastbound traffic, and the second day for westbound traffic. From the survey, the heaviest load observed in the eastbound traffic was 100.4 t for a 7-axle vehicle carrying mining products from Kasese to Lugazi, whereas for the westbound carriageway, the heaviest load observed was 77 t for a

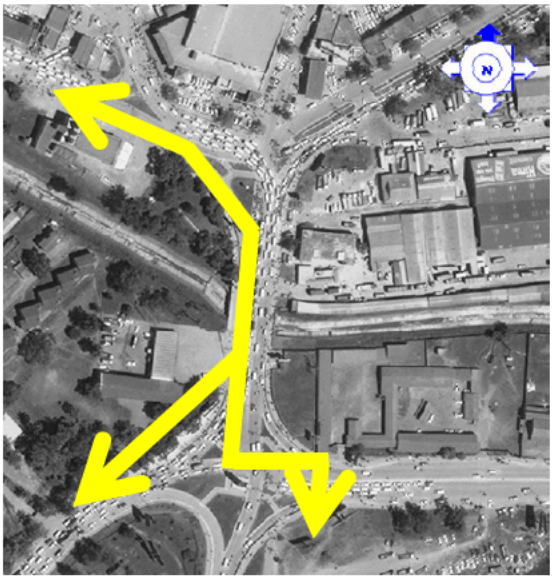
6-axle vehicle carrying agricultural products from the industrial area to Juba (South Sudan). 18% (2 out of 11) of the 7-axle HGVs on the eastbound carriageway had a total weight exceeding the legal limit of 56 t. Moreover, 13% of the HGVs had axle load that exceeds 10 t for a single axle. 25% (one out of four) of the 7-axle HGVs on the westbound carriageway had a total weight exceeding the legal limit of 56 t. Also, 29% of the HGVs had axle load that exceeded 10 t for a single axle.

5.2.5 NMT Survey

(1) Survey Stations

Survey stations for NMT count were located at Clock Tower Junction and Shoprite Junction along Entebbe Road/Queen's Way. The area is the busiest section for pedestrian and cyclist traffic during peak hours in Kampala City.

The number of NMT movements at morning peak hours is larger than that at evening peak hours. Nakivubo Place Road is the highest ranked in terms of number of NMT movements both in the morning and evening.



A main cyclist route was identified as shown in the left figure. The largest traffic per hour was 614, and it was recorded at the section in front of the fire station. Since most of the cyclists attempt to use the walkway, they pose a danger to pedestrians during peak hours.

The pedestrians also follow the main route of cyclists since it is the shortest route to their destination.

Source: JICA Survey Team

Figure S5-3 Main Cyclist Route

6 Traffic Demand Forecast

6.1 Assumptions

6.1.1 Development Scenario

In this Survey, short term - 10 years and Long term (2040) targets of KPDP are applied as growth and/or development scenario in GKMA.

A future road network in GKMA was assumed based on obtained information through discussions

with UNRA and KCCA for future traffic demand forecast in 2023 and 2033 scenarios.

The BRT pilot routes comprise a Y-shaped corridor that runs from Bwaise via Gayaza Road, Bombo Road, and Jinja Road to Kireka, with a branch to the south via Entebbe Road to Zana. In the traafic demand forecast, BRT pilot route are considered in both 2023 and 2033 scenarios.

6.2 Traffic Demand Forecast

6.2.1 Approach

The demand forecast models were developed to estimate traffic demands by adopting the conventional four-step method. The steps include the following components:

I. Trip generation/attraction: estimation of the number of trips generated from and attracted to each zone by trip purpose,
II. Trip distribution: estimation of the number of trips between zones,
III. Modal split: estimation of the number of trips made by each transport mode, and
IV. Traffic assignment: estimation of the number of trips on each link of the road network.

6.2.2 Calibration

Traffic zone for the demand forecast is same as the zone defined for the traffic survey. The basic road network in the Survey area was built based on the map provided by the MoWT. As traffic demand on the network is represented in terms of passenger car unit (PCU), each vehicle type was converted to passenger car taking into consideration the factors of the NTMP and Geometric Design Manual of Uganda.

The present O-D matrices of 2013 were obtained by modifying the previous O-D matrices in 2010. As a result, the total trip in the Survey area was estimated at approximately 714,000 trips per day.

6.2.3 Traffic Demand Forecast

(1) Future O-D Estimation based on Socioeconomic Condition

The total numbers of trips in 2023 and 2033 are estimated at approximately 1.5 and 2.3 million per day, respectively.

(2) Future Public Transport Service by the BRT System

The passengers of minibuses and large buses will shift to the BRT substantially after the introduction of BRT. According to the mode split model, approximately 88,000 trips and 125,000 trips were assumed to shift from minibuses and large buses to the BRT in 2023 and 2033, respectively.

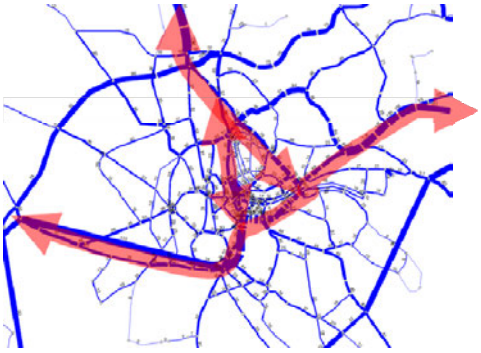
(3) Total Traffic Demand

The number of total trips points to a decrease of present trip numbers due to the revision of inner trip as discussed before and a large increase in the number of future trips due to the high growth rate of both population and economic activities.

(4) Future Traffic Flow

In 2023, a large number of vehicles will likely avoid Kampala Road and Bombo Road due to the capacity decrease and some one-way operation. Traffic moving between the north area and CBD will shift from Bombo Road to Yusuf Lule Road, and traffic on the Kampala Road will shift to both Mukwano Road and Nile Avenue. A demand in 2033 will point toward the increasing importance of the outer ring road due to the traffic demand increase. As a result, main stream on the roads will be difficult to identify. However, Jinja-Mukwano-Mpigi and Jinja-Mukwano-Yusuf Lule will show dominant demand in the city area. Increasing demand between Kitgum House Junction and Entebbe Road Junction will add a burden on Mukwano Road.

With BRT in 2023



With BRT in 2033

Source: JICA Survey Team

Figure S6-1 Results of Future Traffic Assignment in 2023 and 2033

6.2.4 Detailed Traffic Flow

(1) Future Traffic Flow in 2023

A large number of traffic using Kampala Road in the present situation will shift to Nail Avenue and Mukwano Road. In addition, since traffic using Bombo Road will shift to Yusuf Lule Road, a new axis (Nile Avenue – Yusuf Lule Road) will appear. In the Clock Tower Junction area, the change of one-way operation proposed by the BRT design has a large impact on the traffic flow. The north-south axis assumed on Queen's Way-Entebbe Road will be divided into Queen's Way-Entebbe Road and Queen's Way-Nsambya Road.

(2) Future Traffic Flow in 2033

The trip number related to Kitgum House Junction area and Clock Tower Junction area are 1.8

times and 1.6 times compared with 2023, respectively.

6.3 Microsimulation for Evaluation of Junction Plan

6.3.1 General Information

Microsimulation models, which can reproduce individual driver behavior, should therefore be an essential part of any assessment tool.

6.3.2 Microsimulation Modeling

An evaluation of any junction which has complex control and huge traffic volumes might defy measurements in numerical term. Hence, microsimulation is an advantageous tool for this purpose. In the Survey, AIMSUN, which is one of the major microsimulation software, was used.

6.3.3 Presentation

The microsimulation results (movies) were presented in several meetings.

7 Suitable Options for the Flyover Project

7.1 General

7.1.1 Objectives

The objectives of Chapter 7 are to identify some conceivable options of flyovers, examine advantages/disadvantages of the respective options in terms of traffic aspects, implication of existing higher plans, environmental aspects, construction costs and other technical aspects, and finally select a suitable option which is regarded as the most technically feasible, economically viable, environmentally acceptable, and socially optimal for decongestion at the CBD of GKMA.

7.1.2 Selection of Optimum Plan

The approach for the selection of the optimum plan, and the flow of each work and its description are as follows;

- ✓ Traffic Demand Forecast (Refer to Chapter 6)
- ✓ Applicable Design Standards and Constraints for Identification of Flyover Options
- ✓ Identification of Options Accommodating Traffic Flow
- ✓ Selection of Suitable Option

A suitable option is selected in terms of the most technically feasible, economically viable, environmentally acceptable, and socially optimal option for decongestion of critical junctions.

7.2 Conceptual Design Conditions for Flyover Options

7.2.1 Applicable Design Standards

The purpose of the Road Design Manual is intended for use in the design of all rural roads in Uganda. Accordingly, as only limited description is available for urban roads in the manual, it would be necessary to refer to other design standards and manual to set out some specific parameters which are not stipulated in Road Design Manual in Uganda.

7.2.2 Design Conditions

(1) Design Speed

The Road Design Manual recommends the application of a design speed of 50 km/h in urban and peri-urban areas.

(2) Geometric Design Parameter

The geometric parameters for a design speed of 50 km/h and special conditions are basically applied in accordance with the design manual.

(3) Typical Cross Sections Proposed by the JICA Survey Team

In the Survey, typical lane width of 3.5 m, which is the same for Design Class Paved Ib, is recommended. In addition, both Mupigi Highway and Jinja Highway are applied with lane width of more than 3.5 m. The shoulder width is determined depending on traffic and land use situations.

7.3 Prior Conditions and Options

7.3.1 Prior Conditions

(1) Corresponding to the BRT Project

The introduction of BRT on major arterial roads is one of the core projects in the NDP. So far, the detailed design of the BRT pilot routes, which comprise a Y-shaped corridor that runs from Bwaise to Kireka via Gayaza Road, Bombo Road and Jinja Road, and branches to the south via Entebbe Road to Zana, is ongoing.

(2) Queen's Way

According to the road improvement plan of KCCA, Queen's Way will be widened from two lanes to four lanes. At the same time, one-way operation will be changed to two-way operation.

7.3.2 Identification of Flyover Options

(1) Traffic Demand and Traffic Situation in 2023 and 2033 (without Project case)

According to the traffic demand forecast, existing lane number without Queensway and Nsambya

Road between Nsambya Junction and level crossing will provide enough capacity to meet traffic demand in 2023 and 2033. As for the situations of junctions and roundabouts, service level of critical junctions and roundabouts are categorized into service level 'F' from the present to the future. In particular, delay time at Garden City roundabout, Mukwano roundabout, Clock Tower junction and Nsambya junction are notably increased. That means that traffic congestion in Kampala City is caused by not low capacity of roads, but roundabouts and junctions.

The flyover project concept is dictated by the required road functions. The required road functions are defined as follows:

- ✓ To increase traffic capacity at bottlenecks,
- ✓ To accommodate future traffic demand and flow,
- ✓ To consider future plans such as the establishment of BRT,
- ✓ To consider minimizing the negative impacts to the social environment, and
- ✓ Based on the above concepts, to create smooth traffic flow in an urban area.

(2) Conceivable Options

The purpose of building flyovers is basically to decongest the bottlenecks related to the said junctions. According to this situation, many options can be proposed for each area, and a great number of combinations are possible. However, this increase of proposed options would make problems and issues complicated. Hence, flyover options are proposed as one package in the target area in consideration of the dominating traffic flows at critical junctions in 2033 and simplification of the complex traffic flow.

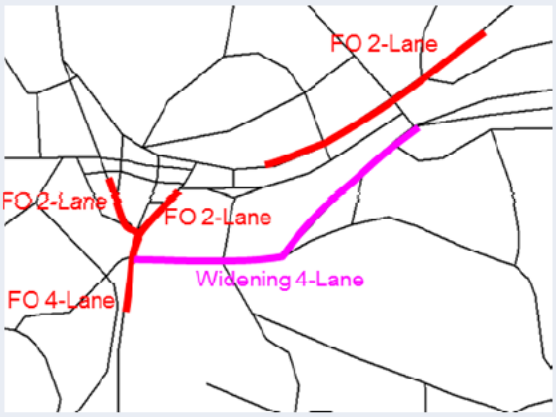
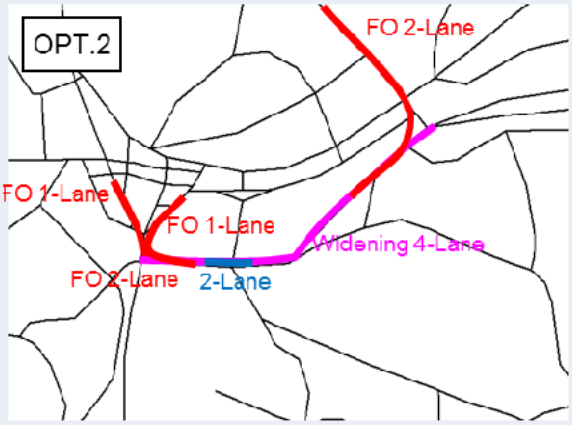
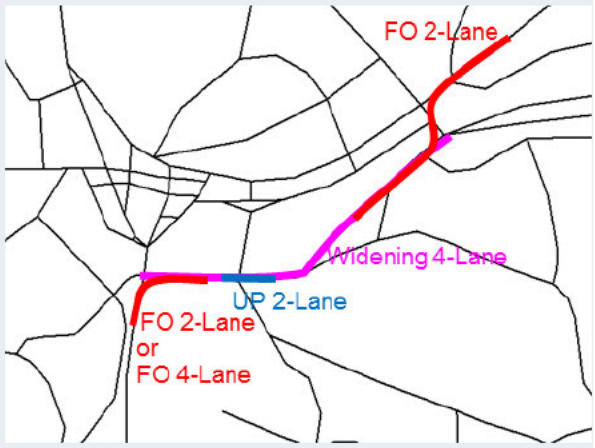
Table S7-1 Considerable Traffic Flows at Critical Junctions

Kitgum House Junction				Clock Tower Junction				Corresponding to
Kampala Road	⇔	Jinja Road	7,245 pcu/day	Queens Way (North)	⇔	Queens Way (South)	56,002 pcu/day	Old Traffic Axis (Option-1)
Mukwano Road	⇔	Yusuf Lule Road	34,684 pcu/day	Queens Way (North)	⇔	Nsambya Road	35,872 pcu/day	Function of Inner Ring Road (Option-2)
Mukwano Road	⇔	Jinja Road	11,461 pcu/day	Queens Way (South)	⇔	Nsambya Road	57,156 pcu/day	New Traffic Axis (Option-3)

Source: JICA Survey Team

The options, as discussed below, are proposed as scenarios corresponding to the concepts of the flyover project as mentioned above.

Table S7-2 Proposed Project Options and Functions

Opt.	Description	
1	**Direct Access to City Centre (Corresponding to Old Traffic Axis)** 	The flyover will carry the currently largest traffic, which is along the east-west axis and north-south axis of GKMA road network and the BRT. Traffic volume along the axis, however, is expected to decrease once the BRT starts operations. Impact on traffic will be subject to BRT operations because the flyover is planned in parallel with the BRT. Lane number of Kitgum House Flyover is given four lanes in total because expected traffic numbers which use the Flyover is more than 50,000pcu/day.
2	**Disperse Traffic (Function of Inner Ring Road)** 	The flyover will carry traffic connecting the south and north areas of GKMA which incorporates current development trends in the Kitgum House Junction area. Improvement of Mukwano Road needs to be implemented before or at the same time as the flyover construction. Also, the part of the flyover at the Clock Tower Junction area would connect between the north (CBD)-east axis, and pass over the BRT route. It means that less conflict with the BRT is expected.
3	**Divert Traffic from City Centre (Corresponding to New Traffic Axis)**  3-1: Two lanes in the Clock Tower Junction area 3-2: Four lanes in the Clock Tower Junction area	The flyover will connect Kampala/Jinja and Kibuye-Busega-Mpigi (KBM), and also apply the traffic management strategy of KCCA, which is to divert traffic from Kampala Road to Mukwano Road. In addition, decrease of conflict (intersecting traffic) with the BRT is expected. Improvement of Mukwano Road needs to be implemented before or at the same time as the flyover construction. Lane number of Kitgum House Flyover is given four lanes in total because expected traffic numbers which use the Flyover is more than 50,000pcu/day. Meanwhile, the Flyover with two lanes is also examined considering the land use (buildup area).

Source: JICA Survey Team

7.4 Evaluation of Options

7.4.1 Evaluation Method and Criteria

(1) Evaluation Methodology

The most preferable project option is examined in this subchapter. The selection of the most preferable project option should not only consider the economic point of view but also take into account the negative impacts to the social environment and the expected effects of the project with regard to decongestion of traffic volume.

(2) Evaluation Criteria and Weighting

The weighting for each evaluation item was determined by important degree to achievement of purpose of the Project. The largest weight of 40% was given to the "traffic and socioeconomic aspect", which evaluates the performance, function and contribution degree to decongestion of the flyover in six sub-criteria from a traffic analysis viewpoint. The second largest weight of 20% followed by the "traffic and socio-economic aspect" was given to the "construction cost" which assess the feasibility of the Project. "Consistency with existing/higher plans and projects", "environmental impacts", and "technical issues" are given 15%, 15%, and 10%, respectively.

7.4.2 Traffic and Socioeconomic Aspects

(1) Evaluation Items and Weighting

The weights and scoring criteria for each item of the traffic aspects are graded in order of importance. The largest weight, i.e., 20 points, is given to traffic demand, BRT crossing, and time saving which are key factors for the project. These three factors demonstrate the advantages most clearly. Meanwhile, the other factors are given 10 points each, having a perfect score of 100 points. In addition, scoring (grading) of the evaluation is the same for both 2023 and 2033. This makes the evaluation for 2023 have a lower demand than for 2033 because sustainable effects in the long term should be considered.

(2) Evaluation

<u>Demand on Flyover</u>

In this factor, the number of uses is simply evaluated in terms of the traffic demand which is equivalent to effect of the Flyover. The highest demand in both 2023 and 2033 resulting from the traffic demand forecast is observed in Option 1, followed by Option 3-2 (four-lane)However, these three without Option-1 do not have much difference in traffic demand. In addition, traffic demand in 2033 is approximately 1.5 times that in 2023. As for the required lane number, in all options, four lane was not required.

Investment Effects

Hypothetical obligation cost is a simple indicator for deciding the prioritization of projects. This simple decision method is characterized by fair evaluation of traffic demand, project cost, and project length. The value of hypothetical obligation cost by itself has no meaning; however, a smaller value indicates higher priority. According to the calculation results, Option-3-1 (two-lane) has the highest investment effect in both 2023 and 2033. It should be noted that the cost applied was not the project cost but the bridge construction cost.

Contribution to Decongestion (Road Network and Junctions)

According to the results of the traffic assignment model, the contribution of any of the options to decongestion of the road network in the urban area is limited. This result was derived from following table. In particular, the congestion degree in GKMA is plainly shows this situation. However, each option has a large impact to decrease the incoming traffic toward the critical junctions. In the short term, Option-1 is the most effective, followed by Option-2. In the medium term, Option-2 is the most effective, followed by Option-1. Option-3 (both two-lane and four-lane) also results to positive impact, but its effectiveness is lower than both Option-1 and Option-2.

Table S7-3 Congestion Degree of GKMA in 2033

Option	0	1	2	3-1 (two-lane)	3-2 (four-lane)
Congestion Degree in GKMA*	1.40	1.40	1.42	1.40	1.42

*Congestion degree in GKMA = (Traffic volume (pcu) on all links)/(capacity of all links)
Source: JICA Survey Team

Crossing BRT Lanes

In 2023, Option-2 and Option-3-2 (four-lane) have almost the same advantage as compared to the other options. In 2033, Option-3-1 (two-lane) has a remarkable advantage. Because the alignment in Option-1 runs parallel with the BRT, the said option, as compared with other options, has the advantage of decreasing the traffic volume crossing the BRT lanes.

Time Saving in the Road Network

For both 2023 and 2033, Option-2 is the most advantageous in terms of time saving, followed by Option-3-2 (four-lane). However, the differences among Option-2, Option-3-2 (four-lane) and Option-3-1 (two-lane) are of minuscule amount. It means that the effectiveness of these three options in terms of time saving is almost same.

Note that an average of travel speed on evaluated route without junctions was set at 40km as a possible regulatory speed (80% of the design speed).

Travel Saving in the Road Network of GKMA

Travel saving, which is calculated as the difference between each option and Option-0 ("do nothing case") in the road network of GKMA, is also obtained from the results of the traffic assignment model. For 2023, Option-3-1 (two-lane) and Option-3-2 (four-lane) almost have the same advantage, while for 2033, Option-3-1 (two-lane) shows the highest potential as compared with the other options.

Taking the above evaluation factors into account, the comparison table was established to see which options have greater advantages.

Table S7-4 Initial Evaluation of Traffic Aspects

2023	Demand on FO		Investment Effect		Contribution to decongestion			
					Roads		Junctions (Inflow Traffic)	
	pcu/day	Score	Cost/pcu-km	Score	Impact	Score	pcu/day	Score
Weight		20		10		10		10
Option-1	80,700	12	1,065	2	Low (limited)	1	-169,448	9
Option-2	61,800	4	1,053	2	Low (limited)	1	-152,075	8
Option-3-1 (two-lane)	69,700	6	931	5	Low (limited)	1	-125,536	7
Option-3-2 (four-lane)	71,000	8	1,142	1	Low (limited)	1	-116,189	6
2033								
Option-1	106,000	20	806	7	Low (limited)	1	-178,894	9
Option-2	91,700	16	685	10	Low (limited)	1	-184,519	10
Option-3-1 (two-lane)	98,300	18	655	10	Low (limited)	1	-151,864	8
Option-3-2 (four-lane)	99,900	18	811	7	Low (limited)	1	-127,067	7

2023	BRT Crossing		Time Saving (at Flyover point)		Travel Saving in National Road		Score	Total Score
	pcu/day	Score	veh-hour/day	Score	veh-km/day	Score		
Weight		20		20		10		
Option-1	-9,965	6	7,439	4	81,586	5	39	
Option-2	-25,050	14	10,076	6	68,214	4	39	
Option-3-1 (two-lane)	-28,152	14	8,897	4	135,807	7	44	
Option-3-2 (four-lane)	-29,402	14	9,046	4	126,749	7	41	
2033								
Option-1	-2,185	2	27,712	12	38,272	3	54	93
Option-2	-12,419	8	47,577	20	-60,166	0	65	104
Option-3-1 (two-lane)	-40,335	20	42,902	18	165,973	9	84	128
Option-3-2 (four-lane)	-32,803	16	43,218	18	14,485	1	68	109

Source: JICA Survey Team

Based on the evaluation results, the following results were derived:

- ✓ Considering the short-term aspects, Option-3-1 (two-lane) is the most advantageous followed by Option-3-2 (four-lane).
- ✓ Even in a long-term perspective, Option-3-1 (two-lane) has a high potential.
- ✓ Considering both short-term and long-term aspects, the total score of Option-3-1 (two-lane) indicates superiority over the other options.

7.4.3 Consistency with Existing/Higher Plans

Consequently, evaluation items for "consistency with existing/higher plans and projects" were selected to be consistent with the plans of KCCA, MoWT, and UNRA. Scoring has been made for each option as shown in following table.

Table S7-5 Scoring Results for Category 2 (Existing Projects)

Item	Weight	Evaluation Score and Criteria			
		Option-1	Option-2	Option-3-1	Option-3-2
KCCA's plan/project	40%	1	2	4	4
MoWT's plan/project	30%	2	4	4	2
UNRA's plan/project	30%	2	3	4	4
Total (Weighted Score)		1.6/5.0	2.9/5.0	4.0/5.0	3.4/5.0

Source: JICA Survey Team

7.4.4 Environmental Impacts

Environmental and social considerations are one of the most important aspects for project implementation. The following four evaluation items have been chosen:

- ✓ Land Acquisition/Resettlement
- ✓ Impact on Business Operation
- ✓ Impact on the Living Environment
- ✓ Impact on the Existing Landscape

Table S7-6 Scoring Results for Category 3 (Environment)

Item	Weight	Evaluation Score and Criteria			
		Option-1	Option-2	Option-3-1	Option-3-2
Land Acquisition/Resettlement	40%	1	1	3	3
Impact on Business Operation	30%	2	3	4	4
Impact on the Living Environment	20%	1	2	3	3
Impact on the Existing Landscape	10%	1	3	3	2
Total (Weighted Score)		1.3/5.0	2.0/5.0	3.3/5.0	3.2/5.0

Source: JICA Survey Team

7.4.5 Construction Cost

Construction cost is another important and direct issue on the feasibility of the project. At this stage, since accurate cost estimation is not possible, only an indicative cost comparison was made using the unit cost per bridge surface area estimated based on actual construction cost data in Uganda.

Table S7-7 Evaluation Criteria and Index for Scoring of Category 4 (Construction Cost)

Item	Evaluation Criteria and Score				
	1	2	3	4	5
Construction Cost (Ratio)	R > 1.3	1.2 < R ≤ 1.3	1.1< R ≤ 1.2	1.0< R ≤ 1.1	Lowest (1.0)

Source: JICA Survey Team

Table S7-8 Scoring Results for Category 4 (Construction Cost)

Item	Evaluation Score and Criteria			
	Option-1	Option-2	Option-3-1	Option-3-2
Score	1	3	5	3
Construction Cost (Ratio)	1.35	1.19	1.00	1.20

Source: JICA Survey Team

7.4.6 Technical Issues

(1) Evaluation Items and Weighting

The technical issues to be compared among the options are constructability and affected utilities. In the case of this project, technical challenges are obviously focused on the realization of safe and effective construction works in the congested junctions and roads and in a limited area passing through the city centre.

Table S7-9 Scoring Results for Category 5 (Technical Issues)

Item	Weight	Scores			
		Option-1	Option-2	Option-3-1	Option-3-2
Constructability of Structures / Safety	70%	1	3	3	2
Affected Utilities	30%	3	2	2	2
Total (Weighted Score)		1.6/5.0	2.7/5.0	2.7/5.0	2.0/5.0

Source: JICA Survey Team

7.5 Overall Evaluation

(1) Qualitative Evaluation

Option-1 is contrary to the policy of reducing motorised vehicle volume in the CBD area. The vehicles would be introduced to Kampala Road, and the construction of the flyover on Kampala Road and Entebbe Road would prevent the development of tree-lined boulevards along these roads.

According to the results of the traffic analysis using the static traffic assignment model with user equilibrium assignment method, the flyover will enjoy a high traffic demand. However, since there is no continuity between the two flyovers located at Kitgum House Junction and Clock Tower Junction, further gridlock is unavoidable along the roads connecting the two flyover zones where the carriageway will be narrowed by BRT-dedicated lanes and the traffic signals will be controlled to give priority to the BRT buses.

On the other hand, since buildings are densely constructed along both sides of the four-lane Kampala Road, the impact to road users and residents during the construction works would be very serious due to lane reduction as well as environmental issues such as noise, vibration, air pollution, etc. Mitigation of these environmental impacts is more difficult as compared to the other options even after construction.

The flyover at Kitgum House Junction proposed in Option-2, Option-3-1 and Option-3-2 will help reduce traffic flow into the CBD, and be more advantageous than Option-1 in terms of construction space constraints. Option-2 also has the advantage of being able to pass over the congested Garden City Roundabout. However, Option-2 provides entrance/exit to/from Entebbe Road and Ben Kiwanuka Street, which does not suit KCCA's pilot project of developing NMT and a public transport-oriented zone for this area.

Option-3-1 and Option-3-2, although both propose a technically challenging S-shaped flyover at Kitgum House Junction, are compliant with and/or will support the policies and plans of KCCA, MoWT, and UNRA. In terms of contribution to decongestion, although these options are inferior to Option-1 in terms of some indexes, they will enjoy the best time and travel saving in 2033. Moreover, both options do not only improve a single junction such as in Option-1 but is a total improvement of the route starting from Jinja Road to Queen's Way, including widening of Mukwano Road and an underpass for Nsambya Junction. However, in order to realize the four-lane flyover, it requires not only a higher construction cost but also further widening of Queen's Way to six lanes at minimum (eight lanes in total including BRT-dedicated lanes), resulting in more land acquisition. Option-3-2 is also disadvantageous in terms of conservation of Clock Tower.

Accordingly, Option-3-1 is evaluated to be the most suitable option.

(2) Quantitative Analysis

In order to support the qualitative analysis results by presenting the result in a numerical way, the MCA method was employed and carried out by evaluating 17 items, which can be categorized according to the same five aspects.

Table S7-10 MCA Results

Evaluation Category			Evaluation Items			Score							
Category		Overall Weight	Items		Weight	Option-1		Option-2		Option-3-1		Option-3-2	
						Point	Weighted	Point	Weighted	Point	Weighted	Point	Weighted
1	Traffic and Socioeconomic Aspects	40%	(1)	Demand on Flyover	20%	16	3.2	10	2	12	2.4	13	2.6
			(2)	Investment Effect	10%	9	0.9	12	1.2	15	1.5	8	0.8
			(3)	Contribution to Decongestion; Roads	10%	2	0.2	2	0.2	2	0.2	2	0.2
			(4)	Contribution to Decongestion; Junctions (Inflow Traffic)	10%	18	1.8	18	1.8	15	1.5	13	1.3
			(5)	BRT Crossing	20%	4	0.8	11	2.2	17	3.4	15	3
			(6)	Time Saving (at Flyover)	20%	8	1.6	13	2.6	11	2.2	11	2.2
			(7)	Travel Saving	10%	8	0.8	4	0.4	16	1.6	8	0.8
			(A) Subtotal Score (Weighted)			**18.6**		**20.8**		**25.6**		**21.8**	
2	Consistency with Existing/ Higher Plans and Projects	15%	(1)	KCCA (KPDP, Boulevard)	40%	1	0.4	2	0.8	4	1.6	4	1.6
			(2)	MoWT (BRT, NTMP)	30%	2	0.6	4	1.2	4	1.2	2	0.6
			(3)	UNRA (Link Between New Jinja Highway and Kibuye-Busega-Mpiji Expressway)	30%	2	0.6	3	0.9	4	1.2	4	1.2
			(B) Subtotal Score (Weighted)			**4.8**		**8.7**		**12.0**		**10.2**	
3	Environmental Impact	15%	(1)	Land Acquisition/Resettlement	40%	1	0.4	1	0.4	3	1.2	3	1.2
			(2)	Direct Impact on Existing Business Operation	30%	2	0.6	3	0.9	4	1.2	4	1.2
			(3)	Impact on the Living Environment (Noise, Vibration, Emissions, and Sunlight)	20%	1	0.2	2	0.4	3	0.6	3	0.6
			(4)	Impact on the Existing Landscape	10%	1	0.1	3	0.3	3	0.3	2	0.2
			(C) Subtotal Score (Weighted)			**3.9**		**6.0**		**9.9**		**9.6**	
4	Construction Cost	20%	(1)	Construction Cost (ratio)	100%	1	1.0	3	3.0	5	5.0	3	3.0
			(D) Subtotal Score (Weighted)			**4.0**		**12.0**		**20.0**		**12.0**	
5	Technical Issues	10%	(1)	Constructability of Structures / Safety	70%	1	0.7	3	2.1	3	2.1	2	1.4
			(2)	Affected Utilities	30%	3	0.9	2	0.6	2	0.6	2	0.6
			(E) Subtotal Score (Weighted)			**3.2**		**5.4**		**5.4**		**4.0**	
Overall Score (A)+ (B)+(C)+(D)+(E)						**34.5 / 100**		**52.9 / 100**		**72.9 / 100**		**57.6 / 100**	

Source: JICA Survey Team

7.6 Justification of Option-3-1 (Two-lane)

7.6.1 Travel Time Saving at Present Conditions

(1) Present Travel Time within the Project Site

For justification of Option-3-1, travel time between the cemetery near Africana Roundabout on Kampala and Jinja roads and Clock Tower Junction on Queen's Way was recorded from 29 July to 3 August 2013.

(2) Expected Travel Time of Vehicles on Flyover

The design speed of the flyovers and the widened Mukwano Road is 50 km/h. On a conservative estimate, 40 km/h or 80% of the design speed is employed to estimate the expected time of vehicles on the flyover. As a result, the expected travel time was calculated at 5 minutes and 15 seconds from Clock Tower Junction on Queen's Way to the cemetery on Kampala and Jinja roads.

(3) Expected Travel Time of Vehicles on the Improved Existing Road

As for travel time on the existing roads via Mukwano and Nsambya roads, the waiting time at five junctions will be reduced by junction improvement. Consequently, travel time will be became shortened an amount of time of approximately from 3 to 2 minutes on ground level.

7.6.2 Review of Future Traffic Demand

(1) Purpose of Review

As for traffic demand, both BRT pilot routes and some road projects listed in Table 7.6.12 had been assumed to have been completed until 2013. On the other hand, in case that these projects were not completed before the completion of the flyover project, decrease of traffic demand and effectiveness of the flyover project are a concern. Therefore, the additional cases listed in following table are analyzed for review of these concerns.

Table S7-11 Additional Review for Traffic Demand on Flyover

Cases	Road Network	BRT	OD pattern	Assignment Model Used
Original	Completion (in 2023)	with	2023	User Equilibrium Assignment Model
Case-1	Present (in 2013)	without	2023	All-or-Nothing Model
Case-2	Present (in 2013)	with	2023	All-or-Nothing Model
Case-3	Completion (in 2023)	with	2023	All-or-Nothing Model

Source: JICA Survey Team

(2) Results of the Review

The following table shows the results of traffic demand review. That is to say that Flyover has a high traffic demand regardless of completion of the other road and transport projects.

Table S7-12 Results of the Traffic Demand Review for 2023

Cases	Flyover	2023		Remarks
		pcu	Total	
Original	Clock Tower Flyover	38,200	69,700	Option-3-1
	Kitgum House Flyover	31,500		
Case-1	Clock Tower Flyover	31,800	69,700	Network in 2013 Without BRT
	Kitgum House Flyover	37,900		
Case-2	Clock Tower Flyover	44,300	111,800	Network in 2013 With BRT
	Kitgum House Flyover	67,500		
Case-3	Clock Tower Flyover	67,900	114,100	Network in 2023 With BRT
	Kitgum House Flyover	46,200		

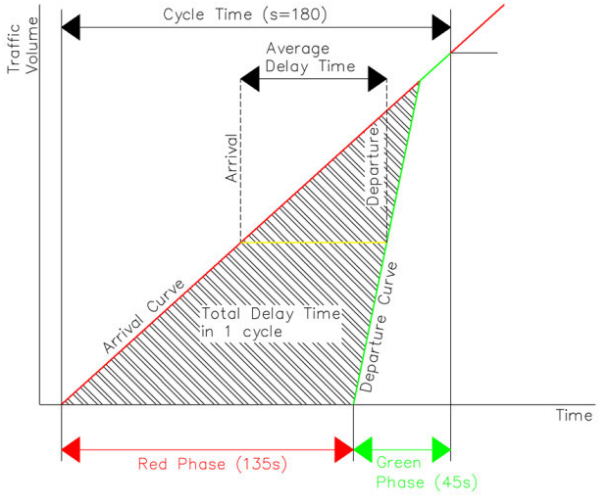
Source: JICA Survey Team

8 Further Examination and Adjustments on Selected Project Options and Branch-Ways

8.1 Unresolved Issues

8.1.1 Rationale of Further Examination

Even if Option-3 is realized, traffic congestion at junctions would not be solved completely. Table S8-1 below shows delay time at critical junctions. Delay time can replace waiting time. According to the table, the delay time of all junctions in Option-3 will be improved by realization of Option-3. However, the delay time of Option-3 is still longer than the target time of 67.5 s which achieves a one-time stop at the most.



Delay Time = (Travel time with signal) – (Travel time without signal)
As simple indicator
Acceptable average delay time
(180 s – 45 s) / 2 = 67.5 s > Acceptable
So about 60 s of average delay time is one of the simple criteria for ramp and/or branch-way selection.
Note: The results discussed below are directly proportional to cycle time. Therefore, the results are not dependent on the assumed cycle time.

Source: JICA Survey Team

Figure S8-1 Overview of Delay Time

8.1.2 Further Options

Further options including junction improvement with capacity increase, and ramp and/or branch-way with decrease of inflow traffic to junctions have been examined to shorten delay time and expansion of effects.

8.2 Clock Tower Flyover

8.2.1 Potential Direction

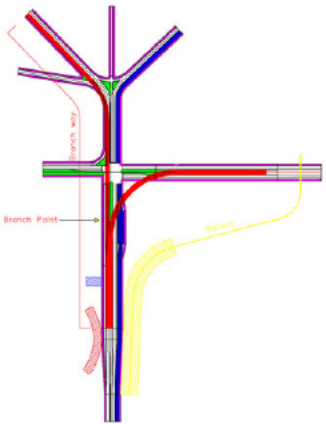
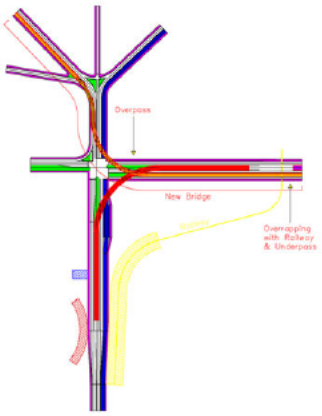
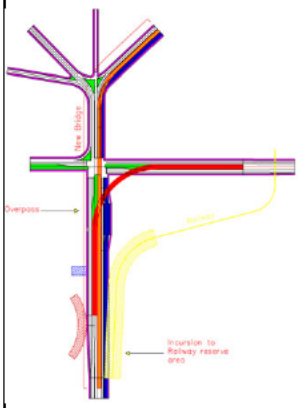
The traffic volume consists of residual traffic on the ground level after completion of the flyover (Option-3). According to the results of traffic analysis, the following three directions are the candidates for the branch-way that would carry high demand traffic:

- ✓ Queen's Way → Ben Kiwanuka
- ✓ Nsambya → Ben Kiwanuka
- ✓ Entebbe → Queen's Way

8.2.2 Possibility of Branch-way

Following explains the possibility of branch-way. The concept of the branch-way is that it would contribute in traffic decongestion, together with Clock Tower Flyover. However, both Nsambya → Ben Kiwanuka and Entebbe → Queen's Way require a complete separate bridge which crosses the main flyover. In addition, both separate bridges will have a negative impact on the railway reserve area and/or Nsambya Underpass. For this reason, Branch-1 is the only candidate for the branch-way.

Table S8-1 Possibility of Branch-Way

	Branch-1	Separated Bridge-2	Separated Bridge-3
Outline			
Possibility	Yes	No	No
Reasons	-	It crosses the main flyover, therefore would not be a ramp and/or branch-way (separated bridge). The approach section on Nsambya's side overlaps the railway crossing and the new underpass resulting to an unacceptable plan.	It crosses the main flyover, therefore would not be a ramp and/or branch-way (separated bridge). The approach section on Queen's Way's side runs into the railway reserve area resulting to an unacceptable plan.

Source: JICA Survey Team

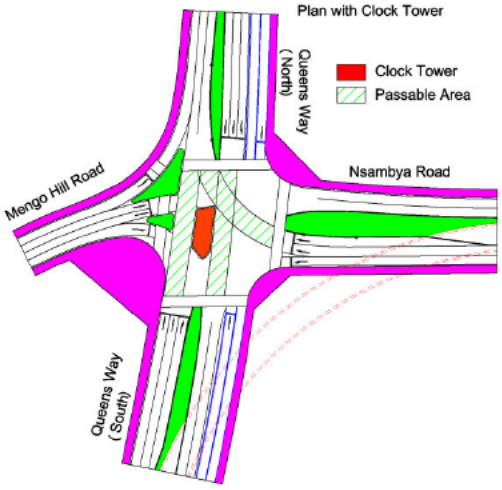
As a result from both quantitative and qualitative evaluation, Branch-1 would result in some negative impacts. Therefore, Branch-1 is not recommended.

8.2.3 Alternative by Junction Improvement

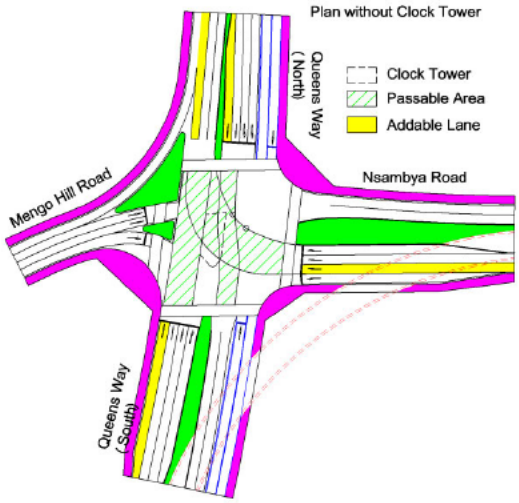
(1) Relocation of Clock Tower

Instead of Branch-1, which has a low efficiency, the improvement of Clock Tower Junction is recommended. In concrete terms, the relocation of Clock Tower would lead to:

- ✓ Upgrade of junction capacity with increase in the number of lanes.
- ✓ Upgrade of traffic safety by securing high visibility.



In case of the Plan with Clock Tower, Clock Tower will confine a passable area for traffic movement. As a results, lane numeber will be decided by the Clock Tower which is a obstacle on the intersection. obstIn addition, it deteriorats a visibility of vehicles with right turn from Queens way to Nsambya road.



In case of the Plan without Clock Tower, a passable area will be expanded as shown in the figure above. As a result, intersection capacity will be improved with adding some lanes. In particular, reduction of width of median strip on Queens way and adding lane for right turn from Nsambya Road to Queens way by relocation of Clock Tower has a large impact to intersection improvement.
And a visibility of vehicles with right turn from Queens way to Nsambya road will be improved.

Source: JICA Survey Team

Figure S8-2 Advantage of Clock Tower Relocation

Following table shows the calculated results of delay time. As mentioned before, in case of Clock Tower Flyover + Branch-1, the delay time at Clock Tower Junction would be 67.6 s, which does not meet the criteria. In contrast, in case of Clock Tower Flyover + junction improvement with Clock Tower relocation, the delay time would be reduced down to 58.0 s. In fact, the relocation of Clock Tower has a high effect as compared to Branch-1 in terms of providing smooth traffic and traffic safety.

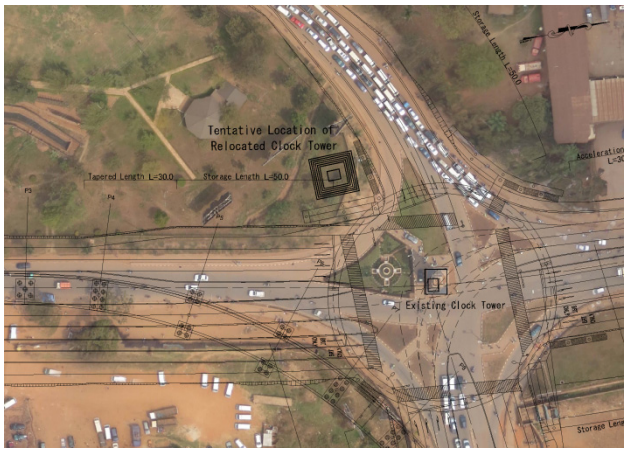
Table S8-2 Impact on Clock Tower Junction with Clock Tower Relocation

Junction	Inflow	2023 (Option-0)		2023 (Clock Tower Flyover)		2023 (Flyover with Branch-1)		2023 (Option-3 w/o Clock Tower)	
		Control Delay (s)	Intersection Delay (vehicle/s)	Control Delay (s)	Intersection Delay (vehicle/s)	Control Delay (s)	Intersection Delay (vehicle/s)	Control Delay (s)	Intersection Delay (vehicle/s)
Clock Tower Junction	Queen's Way	91.6	72.8>67.5	66.4	68.3>67.5	59.1	67.6>67.5	61.1	58.0<67.5
	Mengo Hill	65.3		63.7		63.7		58.1	
	Shoprite	54.3		65.1		69.3		62.4	
	Nsambya	80.0		78.2		78.2		50.4	
Plan/Option-0	-	-	-	-	94.1%	-	93.1%	-	79.7%
Plan/with Flyover	-	-	-	-	-	-	99.0%	-	84.9%

Source: JICA Survey Team

Hence, the relocation of Clock Tower is recommended as a suitable plan.

Note that an assured place for relocation of the Clock Tower is not decided. The right figure is one of the possible options. As for the place for relocation, detail design team will make a decision through discussion with Uganda side in detail design stage.



Source: JICA Survey Team

Figure S8-2
Draft Relocation Plan for the Clock Tower

8.3 Kitgum House Flyover

8.3.1 Potential Direction

The traffic volume consists of residual traffic on the ground level after completion of the flyover (Option-3). According to the results of traffic analysis, the following two directions are the candidates for the branch-way:

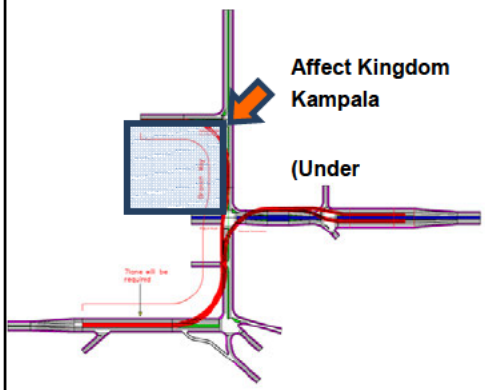
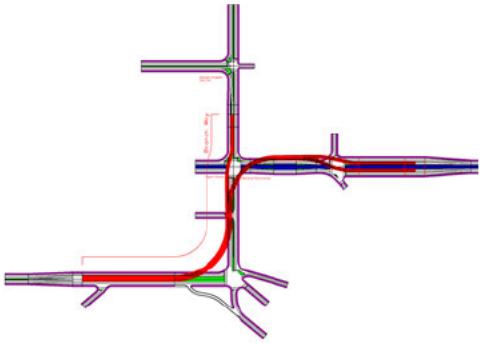
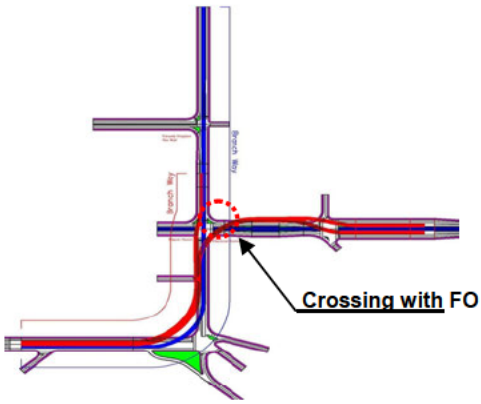
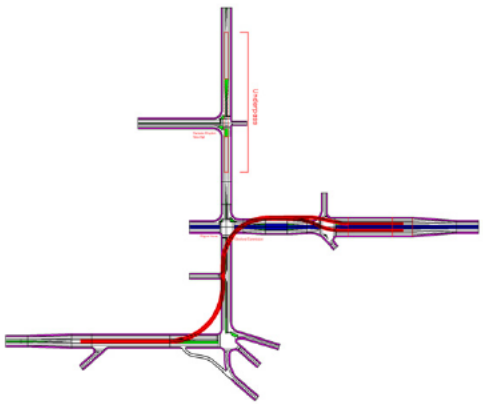
- ✓ Mukwano → Nile Avenue
- ✓ Yusuf Lule → Mukwano

Note that the flyover connecting Nile Avenue and Yusuf Lule is not considered because it is not a ramp and/or branch-way.

8.3.2 Possibility of Branch-way

Followint table illustrates an outline of planned branch way including underpass. The concept of the branch-way is that it would contribute in traffic decongestion, together with Kitgum House Flyover. Branch-1 follows Mukwano Road → Nile Avenue, and Nile Avenue's direction, which is dominated by residual traffic on the ground level. Branch-2 is usable for traffic not only from Mukwano Road to Nile Avenue, but also traffic from Mukwano Road to Yusuf Lule Road. Branch-3 follows a southbound direction from Yusuf Lule Road (north) to Mukwano Road, and should pass 20 m above from ground level in order to cross over the original flyover. A higher and longer branch-way will be required. The underpass will pass below Garden City Junction by use of the center of Yusuf Lule Road. This plan will contribute to the decongestion of Garden City Junction.

Table S8-3 Potential Branch-ways

	Branch-1	Branch-2
Outline		
Possibility	No	Yes
Length (m)	1,210 m (branch-way)	780 m (branch-way)
Traffic for	Only from Mukwano Road to Nile Avenue	Two directions: from Mukuwano Road to Nile Avenue, and from Mukwano Road to Yusuf Lule Road (north)
	Branch-3	**Garden City Underpass**
Outline		
Possibility	Yes	Yes
Length (m)	1,220 m (branch-way)	Underpass L=565 m
Traffic for	Only from Nile Avenue to Mukwano Road	Two directions (two-way): connecting Yusuf Lule Road (north) and Yusuf Lule Road (south)

Source: JICA Survey Team

8.3.3 Overall Evaluation of Branch-2, Branch-3 and the Underpass

Table S8-4 Impact on Critical Junctions

Junction	Option-0	With Flyover without Branch	With Branch-2	With Branch-2 and Branch-3
	Intersection Delay (vehicle/s)	Intersection Delay (vehicle/s)	Intersection Delay (vehicle/s)	Intersection Delay (vehicle/s)
Mukwano	1,990.2	76.2	53.0	**51.0**
Kitgum	87.7	84.2	65.5	64.9
Africana	47.6	45.3	42.6	42.7
Garden City	3,119.9	242.9	52.9	57.8
Total	5,245.4	448.6	214.1	216.4
Plan/Option-0	-	8.5%	4.1%	4.1%
Plan/with Flyover	-	-	47.7%	48.2%
Plan/with Branch-2	-	-	-	101.1%
Junction	**Garden City Underpass**	**-**	**-**	**-**
	Intersection Delay (vehicle/s)	**-**	**-**	**-**
Mukwano	76.2	-	-	-
Kitgum	84.2	-	-	-
Africana	45.3	-	-	-
Garden City	56.4	-	-	-
Total	318.5	-	-	-
Plan/Option-0	6.1%	-	-	-
Plan/with Flyover	71.0%	-	-	-
Plan/with Branch-2	148.8%	-	-	-

Source: JICA Survey Team

- ✓ Branch-2 (northbound branch) has a high demand. In contrast, the demands of Branch-3 (southbound branch) and Garden City Underpass are very low.
- ✓ Contribution to decongestion of traffic by Branch-3 and the underpass is very limited and low.
- ✓ In particular, Branch-2 would result in a higher construction cost because of a longer bridge (1,220 m).

As a result, the acceptance of Branch-3 and the underpass leads to a low feasibility of the whole project.

As for social impacts:

- ✓ Both Branch-2 and Branch-3 contribute to the smooth operation of the BRT.
- ✓ However, Branch-3 will affect Garden City (removal of approach road).

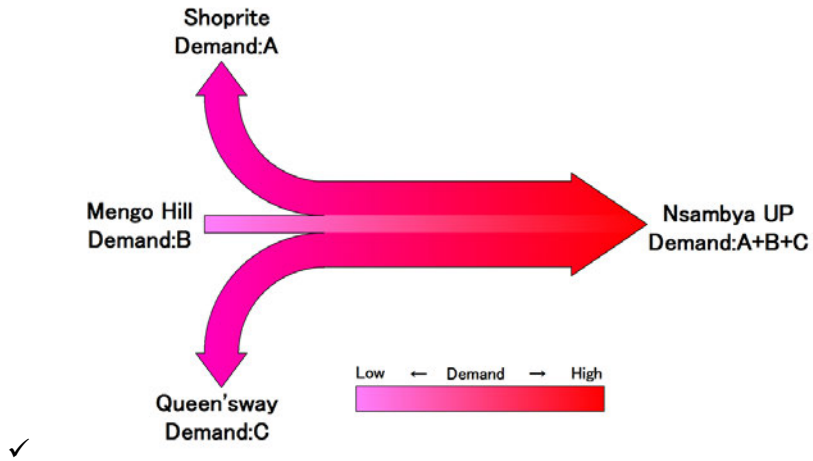
As a result, the acceptance of Branch-3 would lead to larger social impacts and concern of project delay due to land acquisition.

From these reasons, Branch-2 is recommended as a suitable traffic improvement in the Kitgum House Junction area.

8.4 Nsambya Underpass

8.4.1 Background of Examination for Nsambya Underpass

A precondition for lane number of Nsambya Underpass was two lanes so far. However, as shown in the following figure, Nsambya Underpass should be took charge of demand A+B+C. Assignment of Clock Tower Flyover is demand C. In short, Nsambya Underpass has the highest traffic demand at Clock Tower Junction Area. For this reason, insufficient capacity of Nsambya Underpass is concerned.



✓

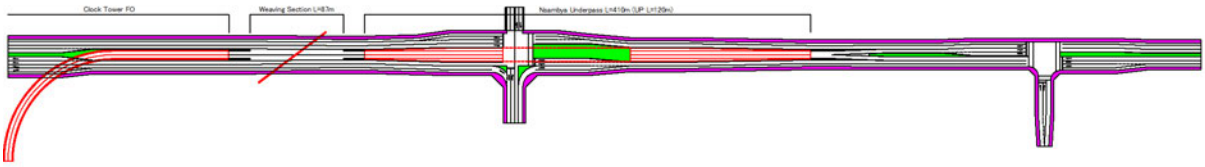
Source: JICA Survey Team

Figure S8-3 Outline of Traffic Demand at Clock Tower Junction Area

In addition, length of a weaving section between Clock Flyover and Nsambya Underpass is about 90m, for this reason, complicated traffic flow and increase of accident risk are also concerned. Hence, lane number of Nsambya Underpass and traffic control at the said section are examined.

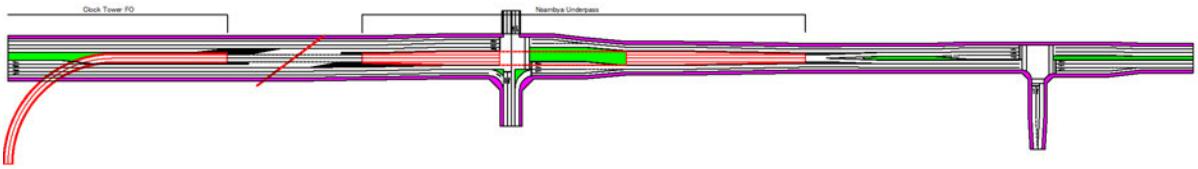
(2) Outline of Comparison Plans

Plan-1: 2-lane without Traffic Control (Draft Final Plan at the time of DFR)



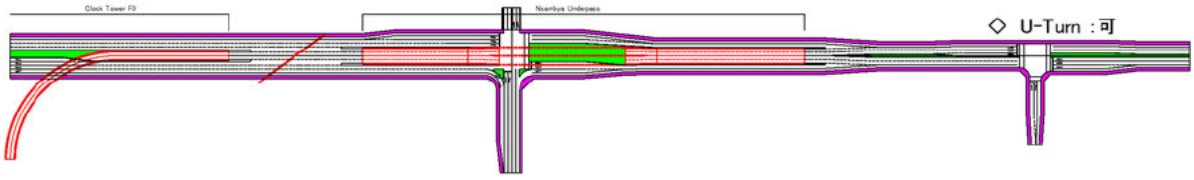
Traffic Control: N/A

Plan-2: 2-lane UP with Traffic Control



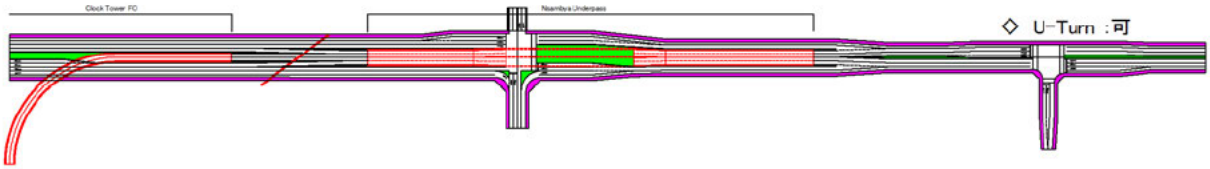
Traffic Control
Eastbound: FO→UP : Available, FO→Ground : Available, Ground→UP : N/A, Ground→Ground : Available
Westbound: UP→FO : Available, UP→Ground: Available, Ground→FO : N/A, Ground→Ground : Available

Plan-3: 4-lane UP without Traffic Control



Traffic Control: N/A

Plan-4: 4-lane UP with Traffic Control



Traffic Control

Eastbound: FO→UP : Available, FO→Ground: N/A, Ground→UP : Available, Ground→Ground: Available

Westbound: UP→FO : Available, UP→Ground: Available, Ground→FO : N/A, Ground→Ground: Available

8.4.2 Evaluation

Following table shows evaluation result for the lane number and traffic control of Nsambya Underpass.

Table S8-5 Total Evaluation

Plan	Weaving Length	Traffic Demand	Delay Time	Social Impact	Construction Cost	Total
Plan-1 (2-lanw without control)	3	2	2	3	3	13
Plan-2 (2-lane with control)	3	1	1	3	3	11
Plan-3 (4-lane without control)	3	3	3	2	2	13
Plan-4 (4-lane with control)	3	1	1	2	2	9

3: High Adaptation or Low Risk, 2: Middle Adaptation or Middle Risk, 1: Low Adaptation or High Risk

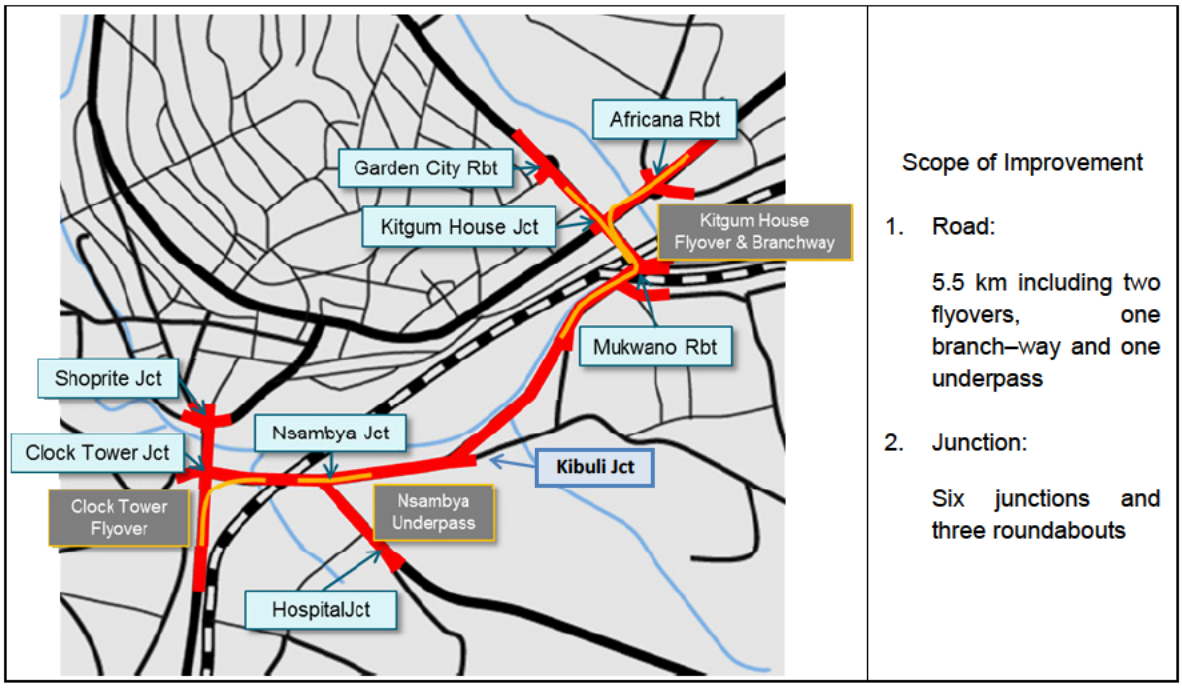
Source: JICA Survey Team

Plan-1 and Plan-3 have an even score. From this result, stage construction (to transition from short-term 2-lane to completed 4-lane) is one of the options to place in service. However, Plan-3 (completed 4-lane) will be recommended from following reasons:

- ✓ New bridge will be set at Nsambya Jct. by KCCA.
- ✓ Scale and cost of additional construction work from 2-lane to 4-lane will be large, as a result, total cost for stage construction is costly.
- ✓ High-priced materials such as steel sheet-pile will be required for additional works.
- ✓ High traffic volume will derive chaotic situation at construction area during additional construction works.

8.5 Proposed Project Scope

As result of the examination mentioned above, the project scope shown in Figure S8-4 was proposed.



Source: JICA Survey Team

Figure S8-4 Proposed Project Scope

9 Natural Condition Surveys

9.1 Topographic Survey

The survey contains the following work items:

(a) Control Point Survey

(b) Planimetric Survey (Topographic and three dimensional building/structural surveys)

(c) Mapping and Reporting (DTM, three dimensional structure modeling)

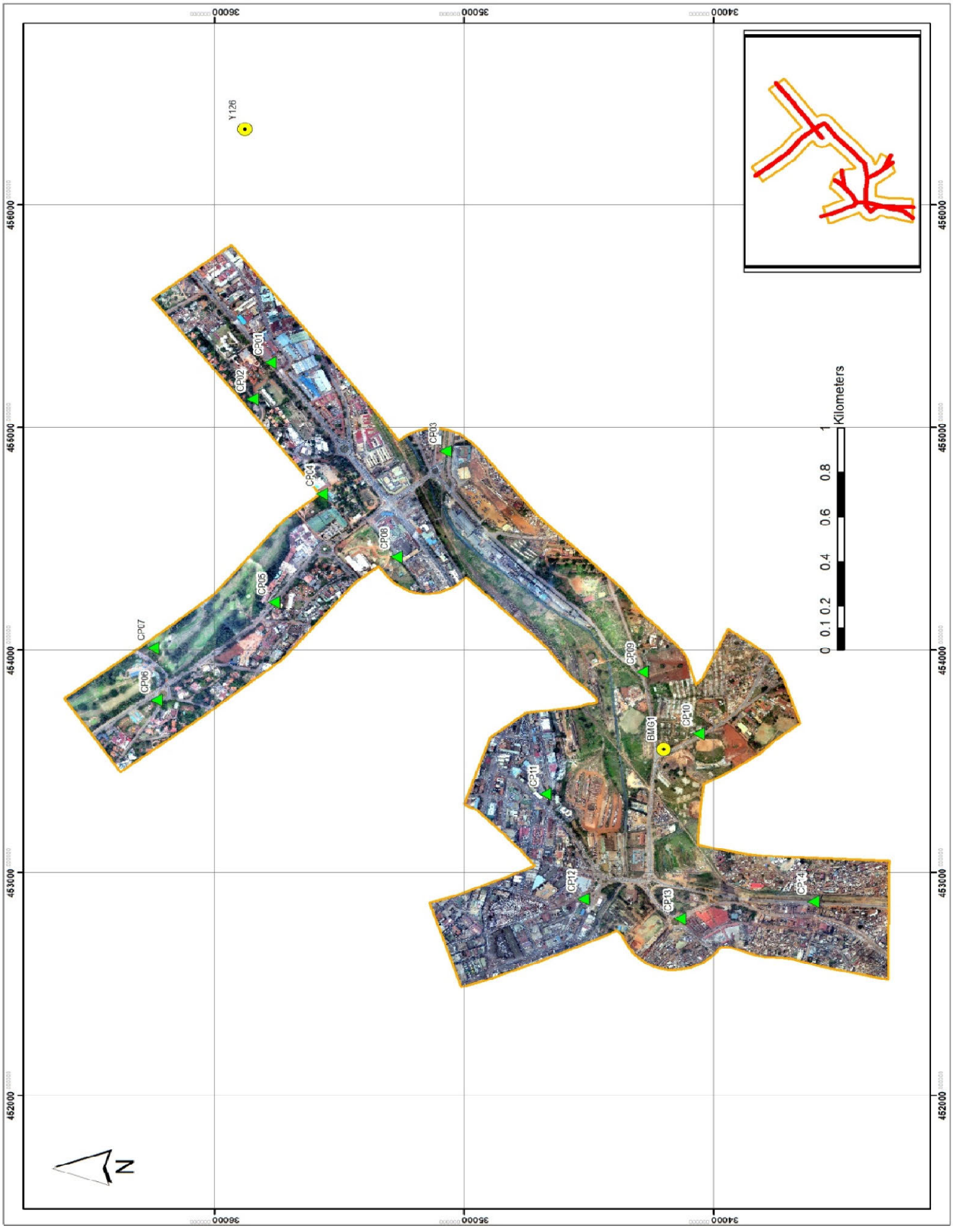
It was decided to produce topographic maps by data processing of aerial photos taken by unmanned aerial vehicle (UAV). This is because UAV mapping can provide the following data within a short period of time:

(a) Latest high resolution (3-20 cm) orthophoto with a certain accuracy (10-20 cm in X, Y, Z)

(b) Digital terrain model (DTM) and ground contour lines which can be used for the design

(c) Height information of the buildings which can be used for landscape consideration

The orthorectified aerial photo mosaic is shown in the following figure.



Source: JICA Survey Team

Figure S9-1 Orthorectified Aerial Photo

9.2 Geotechnical Survey

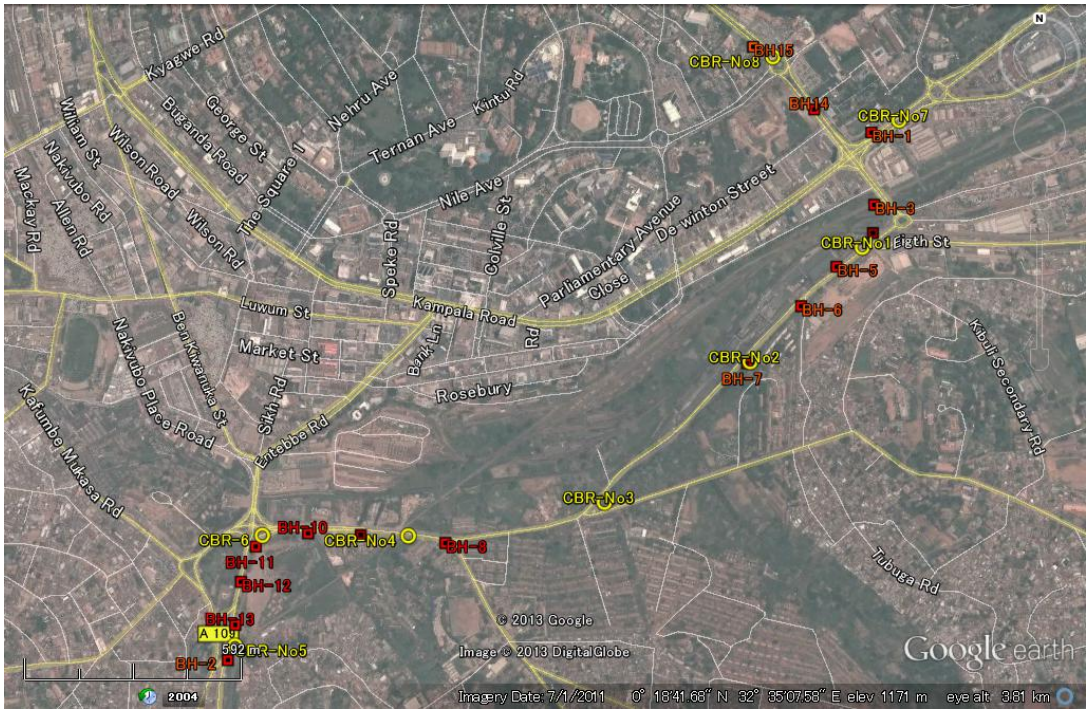
9.2.1 Scope of the Geotechnical Investigation

The ground investigations were required to determine the ground conditions as well as to obtain design parameters for the proposed structural foundations and any associated infrastructure. The geotechnical investigations were conducted taking into account BS 5930: 1999, "Code of Practice for Site Investigations".

The scope of the geotechnical investigations is comprised of the following:

- ✓ Drilling of 15 boreholes with depths ranging from 12 m to 17 m;
- ✓ Logging of all the boreholes for strata profiles;
- ✓ Performance of standard penetration tests at 1.0 m interval;
- ✓ Registering the groundwater level (depth of water table) for each borehole;
- ✓ Recovering undisturbed samples for strength and deformation tests;
- ✓ Excavation of eight trial pits for CBR tests;
- ✓ Laboratory testing of disturbed and undisturbed samples for classification of properties, i.e., particle size distribution and grading curve, moisture content, and unit weight.

The location map of boreholes and trial pits for CBR tests are shown in the following figure.



Source: JICA Survey Team

Figure S9-2 Location of the First Geotechnical Investigations

After the first survey, additional trial pits investigation for the pavement design was carried out for the following reasons;

A) African Development Bank who is one of the candidates of co-financing for the Project required raising the precision of estimated construction cost to the level of detail design.

B) Gaba Road (approximately 500m) which was out of scope in the first investigation was added to the candidate of road improvement.

Given this request, additional geotechnical investigation was carried out as following contents;

- ✓ Excavation of trial pits to subgrade layer along the designated route
- ✓ Carrying out of laboratory tests i.e. Proctor Test and California Bearing Ratio Test

The location map of additional trial pits for CBR tests are shown in the following figure.

Source: JICA Survey Team

Figure S9-3 Location of Additional Geotechnical Investigations

9.2.2 Geological Profile

The site investigation (desk study, exploratory holes including results of testing) confirmed that the geological sequence at the site generally consists of clay, silt, and sand overlying completely the weathered bedrock (tropical residual soils), which are in turn underlain by the undifferentiated gneisses. The average N-values in the quaternary stratum consisting of clays and sandy silts are about 12 – 14. On the other hand, the N-values in the weathered rock consisting of gneisses and phyllites are greatly varied because the degree of weathering is very different according to the location and depth. However, at all the boreholes, weathered rock layer that can be considered as a bearing strata are found 10 m to 15 m deep from the ground surface.

10 Public Utilities

The JICA Survey Team requested and received the layout plans of the utilities from Uganda Electricity Transmission Company Limited (UETCL), Umeme (electricity distribution), National Water and Sewerage Corporation (NWSC) and several telecommunications companies (at least ten different entities) showing the location of their service facilities buried along flyover route so as to help in planning for UNRA to relocate them before the commencement of the construction works of the Project. According to the providers, with the exception of the power lines, the rest of the utilities are located along the road reserve or sometimes buried below pedestrian walkways, Although in some instances, they cross the road or are laid below the road pavement.

All the obtained information was presented in the utilities map provided with Volume 3 of this Final Report (Drawings) of the Survey.

11 Selection of Flyover Structures

11.1 Introduction of General Applicable Conditions for Each Bridge Type

The structure type of the flyover will be selected considering safety, adaptability to the purpose of the structure, maintenance, economic efficiency, and environmental considerations. General bridge types and their characteristics are introduced in the main report.

11.2 Comparative Studies of Flyover Structures

The total length of the project is about 4 km, in which the bridge section is approximately 1.5 km. General conditions for bridge planning, such as alignment, topography, applicable construction method, and environmental conditions, are different in each location. Therefore, the type of bridge structures that is applicable to each location may vary. As a result of the studies for identifying the bridge type for each section, five superstructure types (steel plate girders, steel box girders, PC I/T girders, PC box girders, and PC hollow slab), and two substructure types (steel and concrete piers) are selected as applicable structures for the entire project flyover. These superstructure and substructure types were comparatively analyzed to come up with the recommended structure type combinations for each of the two flyovers.

(1) Clock Tower Flyover

The Clock Tower Flyover starts at about 300 m south of the Clock Tower Junction on Queen's Way, turns to Nsambya Road and ends 100 m before the railway crossing. The flyover consists of a 50 m long embankment on the approach of Queen's Way and a 90 m long embankment on the approach of Nsambya Road. Since the flyover needs to provide adequate safe distance from the end of the flyover on Nsambya Road to the at-grade railway crossing as well as Nsambya Underpass, the total flyover length is desired to be minimized.

(2) Kitgum House Flyover

The three-lane flyover starts at approximately 400 m southwest of Mukwano Junction on Mukwano Road, turns northeast towards the Access Road, then passes above Kitgum House Junction, turning northeast towards Jinja Road and ends after Africana Junction near Jinja Road Cemetery. Embankment sections are provided at both ends. The two-lane superstructure then separates into two independent structures along Jinja Road because the BRT lanes will be occupying the center of Jinja Road. A single lane branch-way separates the Kitgum House Junction and the lands on Yusuf Lule Road before Garden City Junction.

11.3 Evaluation of Structural Options

Continuity of the same type of structure is preferable not only for aesthetical purposes, but also for facilitating construction and maintenance works. The construction of various types of structure in a continued bridge brings complicates the construction procedures. Such requires more materials, equipment, and manpower which may result in higher construction cost and lower quality. Therefore, it is desirable that the number of structure types to be minimized in a single continuous bridge unless there is a particular reason. Considering these points, the combination of structure types for the two continuous flyovers, namely, Clock Tower Flyover and Kitgum House Flyover, were examined based on the preliminary selection studies explained in the above 11.2. After evaluation of the different structural options, the following combinations for the different sections were selected for further evaluation:

(1) Combinations of Superstructures for Clock Tower Flyover

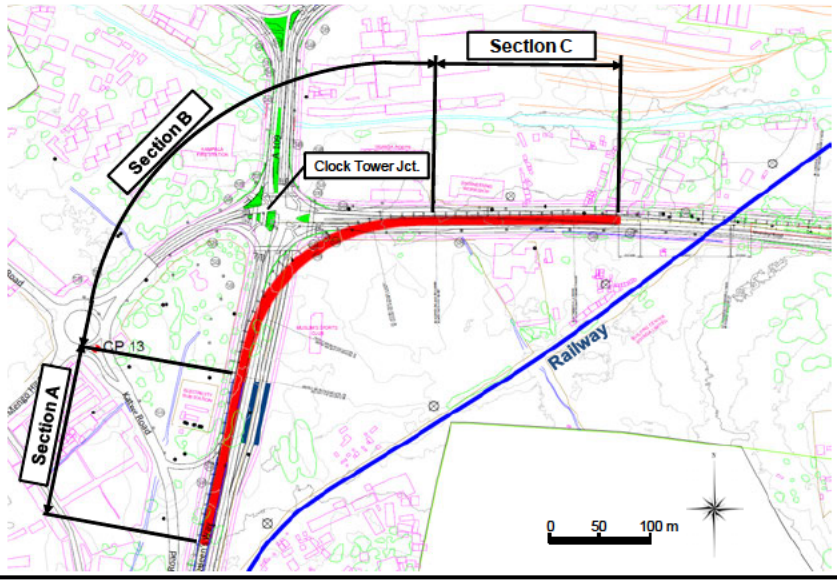
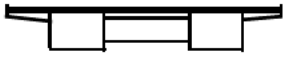
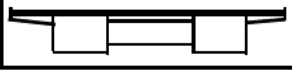
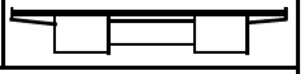
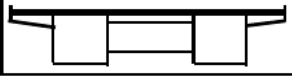
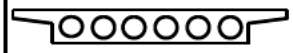
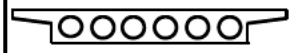
Option 1: Steel Box

Option 2: PC Slab + Steel Box + PC Slab

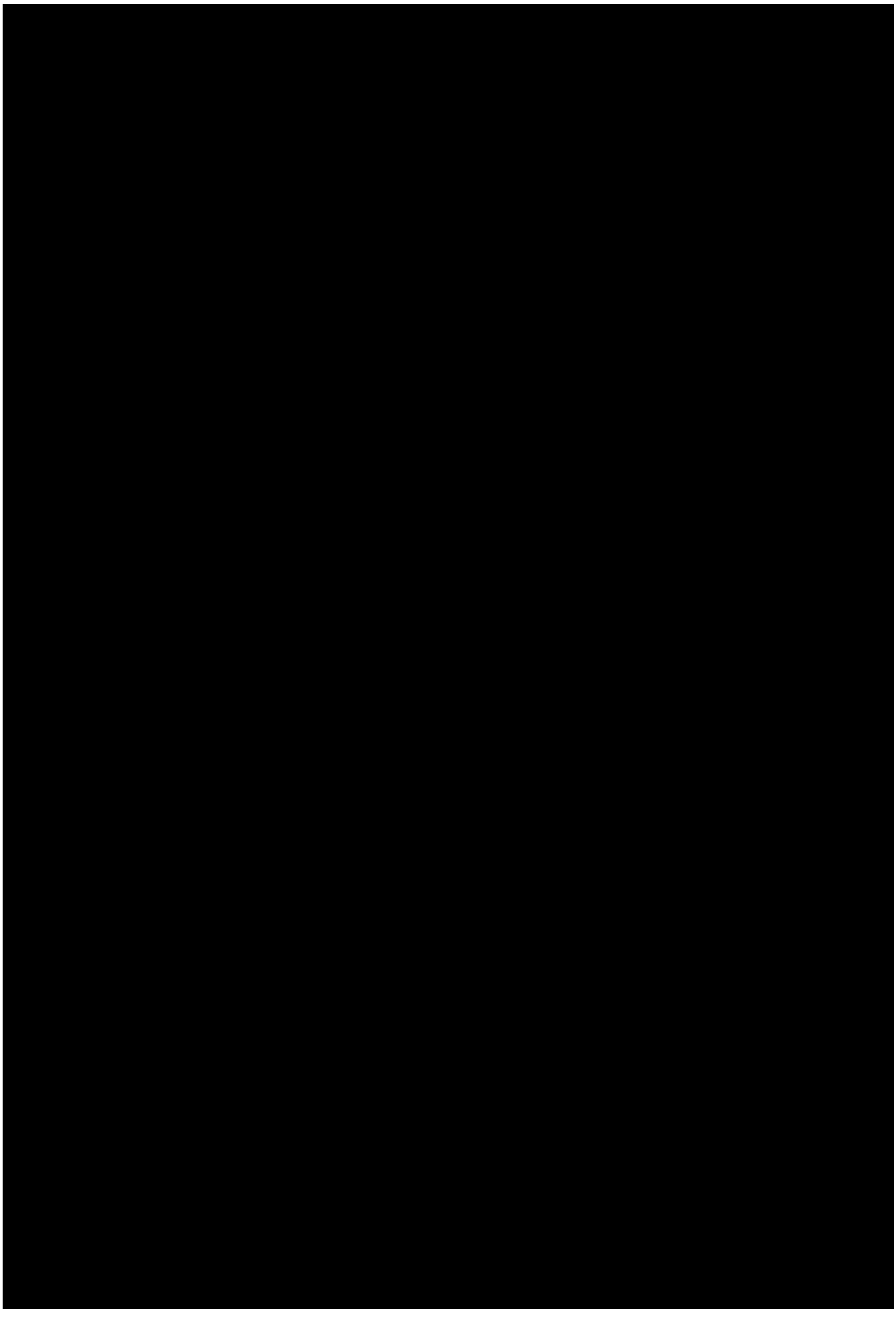
Option 3: PC Slab

For all the selected combinations above, monochord Lohse Bridge can substitute the structure at Africana Junction for the purpose of providing a unique landmark. Comparative tables of these options are shown in Table S11-1 and S11-2.

Table S11-1 Comparative Structural Options for Clock Tower Flyover

		Section A	Section B	Section C
		Straight section on Queen's Way	Curve section at Clock Tower Jct.	Straight section on Nsambya Rd.
Approx. Total length		135m	250m	80m
Curve Radius		R=∞	R=150m	R=∞
Section Plan				
Option 1	Combination	Steel Box		
	Span Length	45m	50m	40m
	Cross Section			
Option 2	Combination	PC Slab	Steel Box	PC Slab
	Span Length	24m	50m	24m
	Cross Section			
Option 3	Combination	PC Slab		
	Span Length	24m	24m	24m
	Cross Section			
Substructure		Steel Pier Concrete Pier	Steel Pier Concrete Pier	Steel Pier Concrete Pier

Source: JICA Survey Team



11.4 Selection of Flyover Structures

(1) Clock Tower Flyover

As a result of comparative evaluation, **Option 3 (PC hollow slab bridge for whole section)** was selected for Clock Tower Flyover. It has a slim concrete structure which would not give negative impacts to the surrounding landscape. Moreover, no crucial technical and structural problems were observed. A summary of the evaluation is shown in Table S11-3.

12 Preliminary Design of the Project

12.1 Applicable Design Standard

12.1.1 General

The design and construction standards for new roads and bridges have been established by MoWT in Uganda. These design standards were published as the Road Design Manual of which the latest version was published in January 2010.

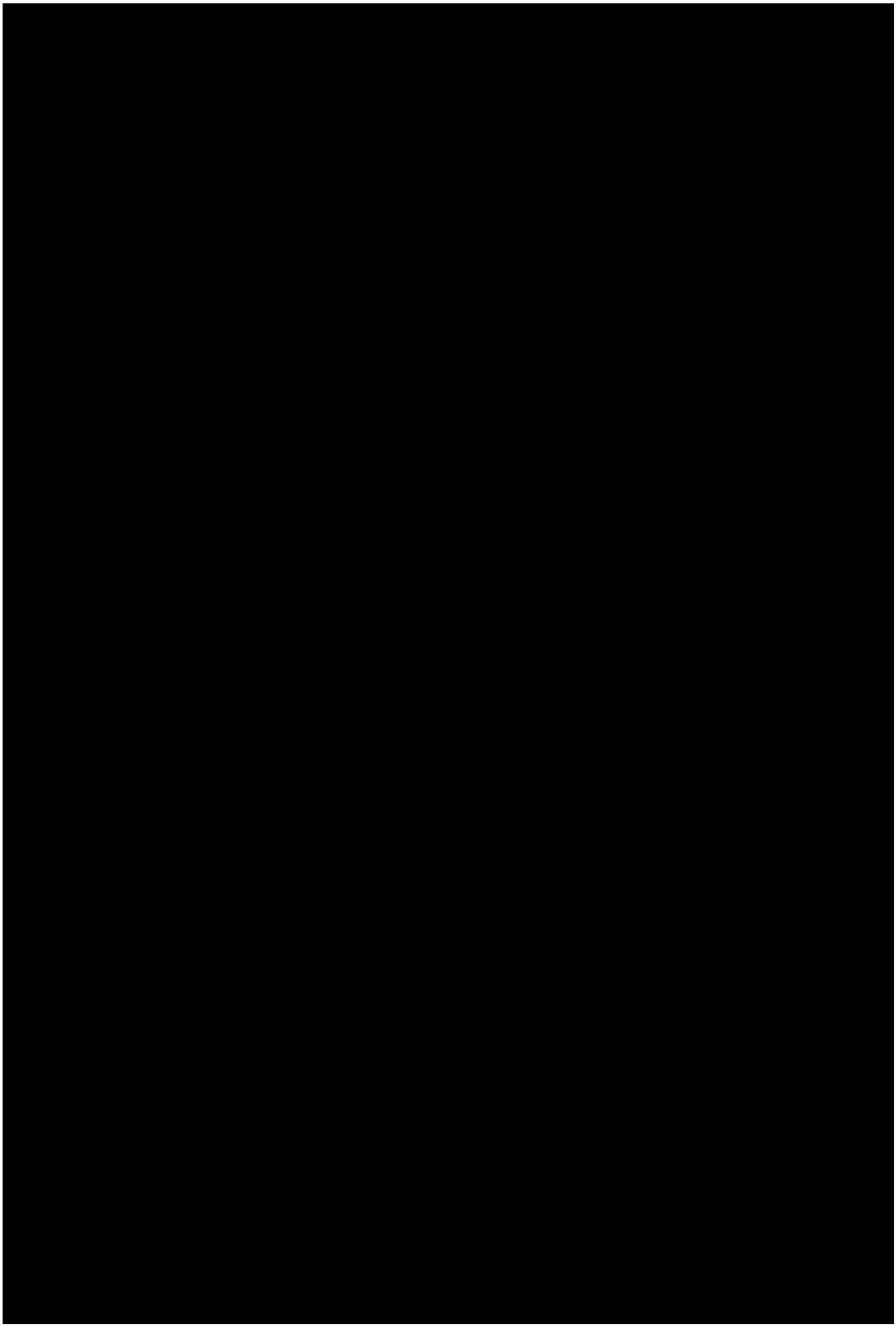
The Road Design Manual is intended for use in the design of all rural roads in Uganda. The purpose of the manual is to give guidance and recommendations to the engineers responsible for the design of rural roads. Accordingly, as only limited description is available for urban roads in the manual, it would be necessary to refer to other design standards and manuals (such as KCCA Urban Roads Classification (draft), AASHTO, and Japanese Urban Road Standard) to set out some specific parameters which are not stipulated in the Road Design Manual of Uganda. Particularly, the design of important bridges has been conducted applying Eurocodes as mentioned in the next section.

Table S11-3 Evaluation of Structural Options for Clock Tower Flyover

Evaluation Items		Option 1 Steel box girder	Option 2 Steel box + PC hollow slab	Option 3 PC hollow slab
(1)	**Construction Cost Ratio**	1.45 ★	1.31 ★	1.00 ★★★
(2)	**Structure**	Suitable for R=150 m curve utilizing less piers. ★★★	Suitable for R=150 m curve utilizing less piers. ★★★	Applicable for R=150 m curve with more piers. Requires one portal pier. ★★
(3)	**Constructability /Safety**	Steel girders are prefabricated in factories thus less site work is required. Erection takes a shorter time ★★★	Steel girders are prefabricated in factories and less site work is required. PC hollow slab is cast-in-situ and requires more site work time. ★★	All structures are cast-in-situ concrete, but space for detour during the construction will be available. ★★
(4)	**Construction Period***	21 months ★★	21 months ★★	21 months ★★
(5)	**Landscape (Number of Structural Types)**	Steel box girders only ★★★	Different structure types are mixed over a small section, which is not preferable aesthetically. ★	PC slab only ★★★
	Landscape (Impact /harmony)	Girder depth is larger due to steel box girders covering long spans which give the structure a massive impression. Girders can be easily painted in any colour as may be required. ★★	Girder depth is larger at the curve section because of steel box girders. ★★	Slim superstructure. More piers required but can be slim ones. ★★★
(6)	**Environment**	All steel (less site works) ★★★	Steel and concrete (very few people will be affected) ★★	All concrete (very few people will be affected) ★★
(7)	**Maintenance**	Maintenance of bridge components (such as bearings, expansion joints, railings, and asphalt pavement) replacement of street lights, and repainting (every 30 years) will be required. Easy to replace damaged parts due to factory-based fabrication ★★	Maintenance of bridge components (such as bearings, expansion joints, railings, and asphalt pavement) replacement of street lights, and repainting (every 30 years) of steel section will be required. ★★	Maintenance of bridge components such as replacement of bearings, expansion joints, railings, asphalt pavement, and street lights will be required. ★★★
Overall Evaluation		Advantageous in the aspect of engineering but steel box girder is not recommended for straight approach sections as it is disadvantageous in terms of construction cost as well as the massive appearance of the structure (girder depth). ★★	Structurally reasonable but disadvantageous aesthetically due to the different structural types in the mix. ★★	Evaluated as the optimal option. Advantageous in terms of cost and landscape aspects with no crucial disadvantage. ★★★

*by one construction party
★★★: Excellent, ★★: Favourable, ★: Acceptable

Source: JICA Survey Team



12.1.2 Bridge Design Standards

The main standard for bridge design shall be based from Eurocodes as agreed with UNRA. However, where local conditions are required, these shall be in accordance with the provisions of MoWT's Road Design Manual – Vol. 4: Bridge Design or other applicable volumes. In addition, in cases where specifications are silent or inadequate for any specific design area, specifications from other codes such as the British Standard, which is the basis of MoWT's manual and Japanese standards, will be applied.

12.1.3 Design Criteria for Highways

Geometric design of the Project is to be made in accordance with geometric parameters for a design speed of 50 km/h, as described in Vol. 1. Geometric Design of the Road Design Manual. As the parameter for the minimum length of curve is not standardized in the manual, the parameter applied in Japanese standards is used for the Survey.

12.1.4 NMT Facilities

Footways and cycleways are specified in the Road Design Manual. The manual requires that raised, kerbed footways should be provided in built-up areas while cycleways should be constructed behind footways, wherever necessary. Instead of raising the footway, where appropriate, combined footway and cycleway separated by kerbs can be adopted.

12.1.5 Headroom Requirements

Headroom is the required height to allow traffic to pass safely under an object. It should normally be provided over the full width of the carriageway. In accordance with the Road Design Manual, the standard headroom specified for the class of road on which the flyover is to be built is 5.0m and the specification for footway and cycleway is 2.5m

The maximum legal height for a vehicle in Uganda is 4.0 m. However, it was determined through discussions with UNRA that the additional extra height of 1.0 m, in addition to the standard headroom of 5.0 m, should be incorporated to cater for extraordinary oversized vehicles far exceeding the regulation.

The proposed routes and plans will cross a railway and high-voltage transmission line at Access Road, Mukwano Roundabout and Nsambya. Hence, the JICA Survey Team confirmed the regulations on headroom for railway and high-voltage transmission lines through discussions with UETCL and URC.

Table S12-1 Headroom for Railway and Transmission Line

Objects	Headroom (m)
Under High-voltage Cable	7.5[*1] (8.0[*2])
Railway	7.0 (8.0*[3])

[*1] ESI Standard 43-7,
[*2] Applied for 33 kV in the report on Distribution System Planning, Design and Loss Reduction Study, UEB
[*3] Applied in the Preliminary Designs for the Standard Gauge Railway Network, MoWT

Source: UETCL and URC

12.1.6 Landscaping

The project flyovers will be planned as a whole and shall be harmonized with the surrounding landscape in an economical manner. In this preliminary design phase, the bridge structure were evaluated on the basis of structural type, continuity, balance of superstructure and substructure, harmony of bridge accessories and main structures, and material surface (texture).

In examining harmony with surrounding landscape, the main criteria are land use of surroundings, landscape and topography of surroundings, development of the space under the viaduct, and colouring.

12.2 Preliminary Design of Flyovers

Preliminary designs of flyovers were made based on the selected structure combinations as discussed in the former chapter. It is noted that further adjustments on pier location and span arrangement were made due to modifications on the configuration of junctions after the alternative study on the flyover structures.

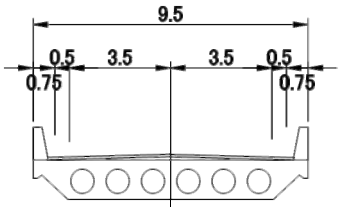
For pile foundations of the flyovers, screwed steel piles are selected for the purpose of minimising construction period, construction spaces and environmental impacts such as noise, vibration, and disposal of waste soil.

12.2.1 Clock Tower Flyover

Type of the superstructure is pre-stressed concrete (PC) hollow slab as selected in Chapter 11. Depth of the superstructure is 1.3 m for span length of 24 m and maximum 2.0 m for the longer spans. Piers and abutments are designed with reinforced concrete (RC). Piers are oval wall type except for three portal-shaped piers.

A design outline of Clock Tower Flyover is shown in Table S12-2.

Table S12-2 Design Outline of Clock Tower Flyover

Bridge Type			Continuous pre-stressed concrete hollow slab bridge
Configuration of bridge superstructure			Bridge length: 366 m Span arrangement: 4@24 m+2@30 m+2@24 m+2@33 m+4@24 m
Number of lanes			Two lanes
Typical Cross Section			
Bridge components	Superstructure		PC hollow slab bridge (Depth: 1.0-2.0 m)
	Substructure	Abutments	Reinforced earth abutment
		Piers	Wall type pier: P1-P4, P7, P8, and P10-P13 Portal frame pier: P5, P6, and P9:
		Foundations	Screwed steel pile ϕ1,0 m (ϕ1.5 m at the bottom)
Live loads	Traffic load		Eurocode EN.1991.2.2003
Construction material	Superstructure	Concrete	PC: σ_c = 40 N/mm^2 RC: σ_c = 30 N/mm^2
	Substructure	Concrete	RC: σ_c = 30 N/mm^2

Source: JICA Survey Team

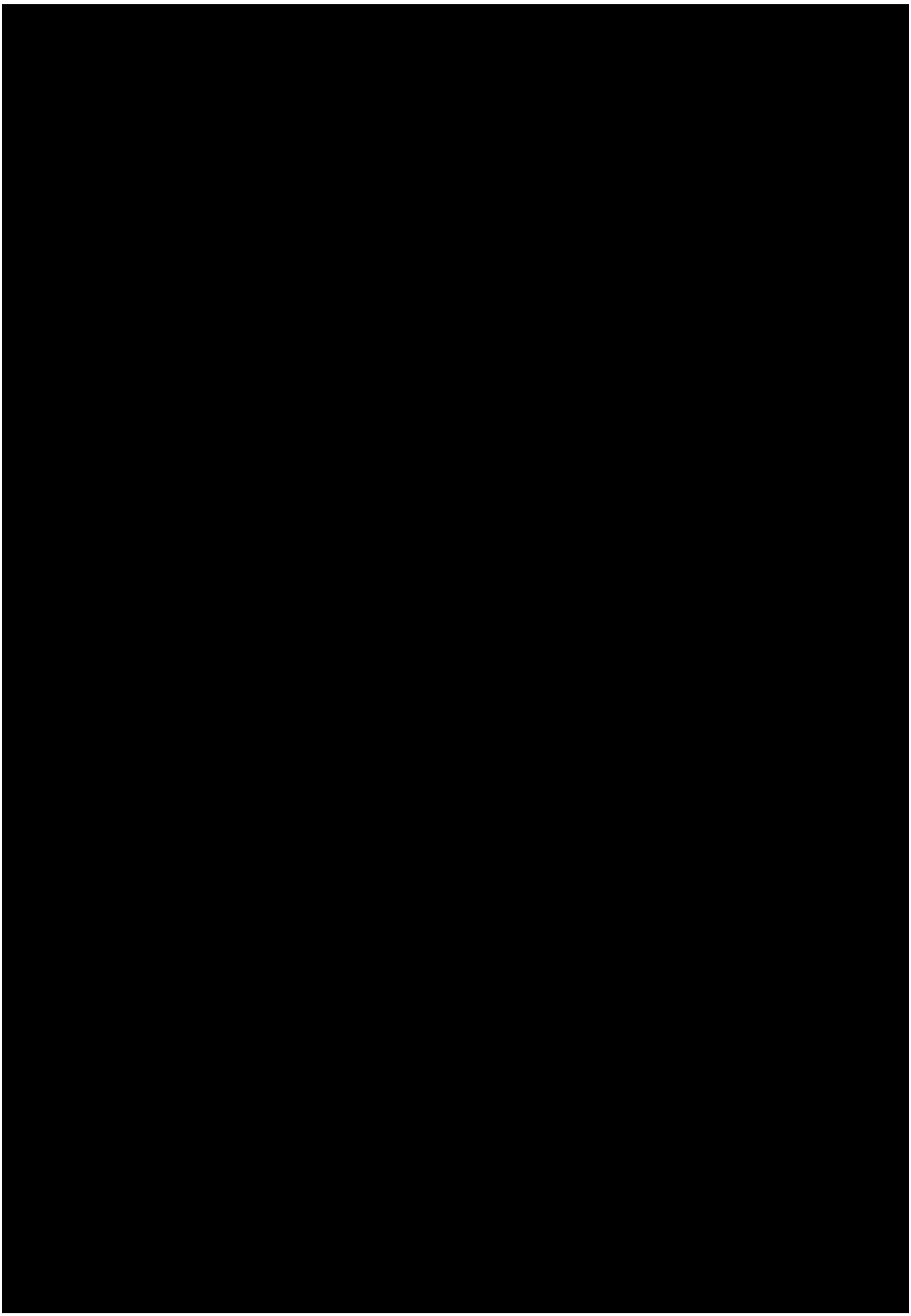
12.2.2 Kitgum House Flyover

Steel box girders are selected for the flyover considering the curve radius, span length, and construction condition except for the approach section of Mukwano Road where a PC hollow slab bridge is applied. Taking into account the workability and durability, composite deck slab (steel and concrete) is selected for the main section. With this deck slab, width of the box girder can be reduced which will contribute to transportability (e.g., transportation of the girder from Mombasa Port to the site and within the site) and constructability owing to its simplified structural system. As for substructures, Steel and RC piers are applied. Steel structures are applied for the piers on narrow median strips as well as for portal frame piers, making the most of its slenderness. For the foundation, screwed steel piles are selected for the same reason as Clock Tower FO.

Three dimensional frame analyses were carried out for curved steel bridges to examine the sections of steel girders and piers. As a result of the analyses, SBHS (Steels for Bridge High-performance Structure) is proposed for the lower flange of the girder and corners of steel piers in order to reduce the thickness of steel plates and to improve the quality of welding and high tension bolt joints of the members.

A weathering steel is proposed to apply for the steel superstructures and piers. The weathering steel exhibits increased resistance to atmospheric corrosion because the steel forms a protective layer made of fine and stable rust on its surface under the influence of the weather.

A design outline of Kitgum House Flyover is shown in Table S12-3.



12.3 Road and Junction Improvement

12.3.1 Mukwano Road and Gaba Road Widening

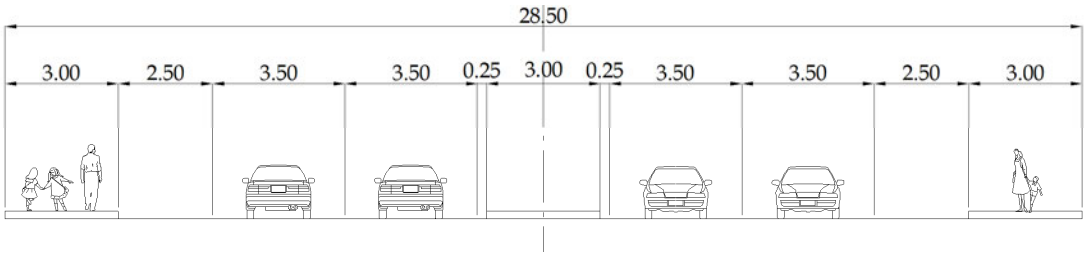
(1) Horizontal and Vertical Alignments

The upgrading of the target road will satisfy the geometric standards for road safety. However, it is important that the impacts to both social and natural environments will be minimized. Accordingly, the following concepts of road alignment were applied, as a general rule:

- ✓ Realignment plan is based on the upgraded road keeping its existing alignment (except where minor realignment is required for rectifying bends) to accommodate the design speed.
- ✓ Realignment plan should minimize the number of affected houses and people.
- ✓ Realignment plan should be considered to minimize the negative impacts to public facilities (schools, hospitals, etc.) and social facilities.
- ✓ Realignment plan should be considered to minimize the negative impacts to the living environment of residents.
- ✓ Realignment plan should be considered to reduce the number of level crossings from aspect of road safety.
- ✓ As for the underpass section, it is desirable to apply straight or large-radius curved horizontal alignment for the underpass section. A one-directional gradient (between 0.3% and 3.0%) should be applied to the vertical alignment of the underpass section in terms of drainage and ventilation.

(2) Typical Cross Section

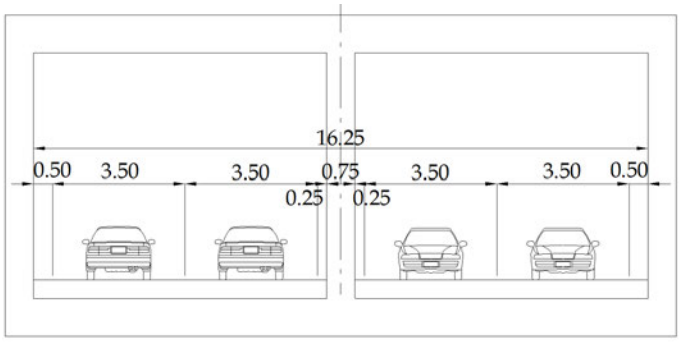
The carriageway lane width of 3.5 m which is of IB class pavement is applied to Mukwano Road. A median strip of 3.0 m, NMT lane of 2.5 m, and pedestrian way of 3.0 m are also considered for road safety.



Source: JICA Survey Team

Figure S12-1 Typical Cross Section of Mukwano Road

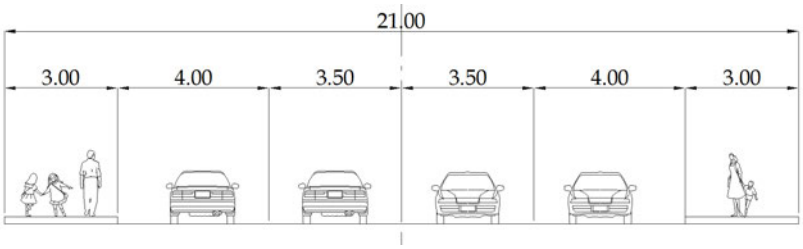
Cross section of the underpass section has to accommodate the traffic demand, the required headroom and typical carriageway width of Mukwano Road. In particular, space for maintenance, wall cleaning, and periodic inspection are very important. These activities will be conducted in off-peak hour with lane closure of one lane.



Source: JICA Survey Team

Figure S12-2 Typical Cross Section of Underpass Section

The widening of Gaba Road from two lanes to four lanes is recommended between Nsambya and Hospital junctions.



Source: JICA Survey Team

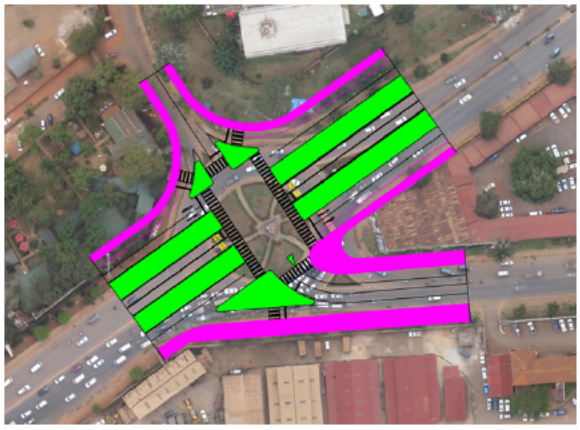
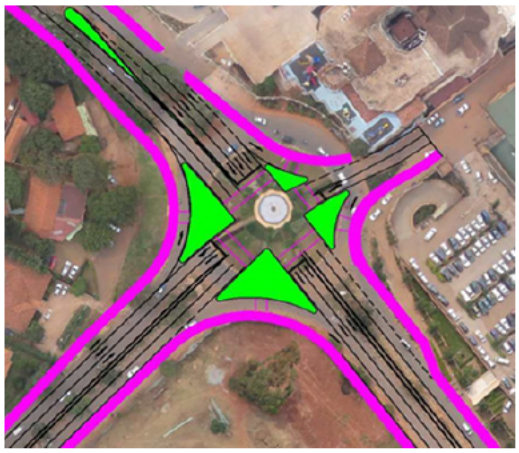
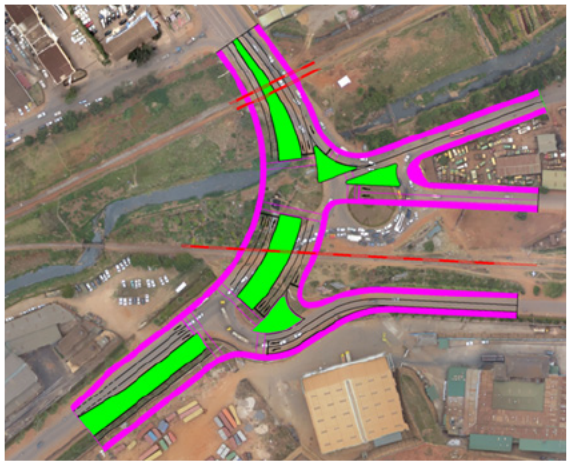
Figure S12-3 Typical Cross Section of Gaba Road

12.3.2 Junction Improvement including Signalization

Mukwano, Africana and Garden City junctions operate by roundabout system. In general, when traffic volume is low, roundabouts are more suitable in terms of smooth traffic movement and traffic safety. However, when traffic volume is high, roundabouts become bottlenecks due to their low capacity. Thus, all target roundabouts in the Project will be improved to signalized junctions.

(1) Improvement Plan for Roundabouts

The following figures show the improvement plan of each roundabout. Outline of improvement, effectiveness, operation and configuration are explained.

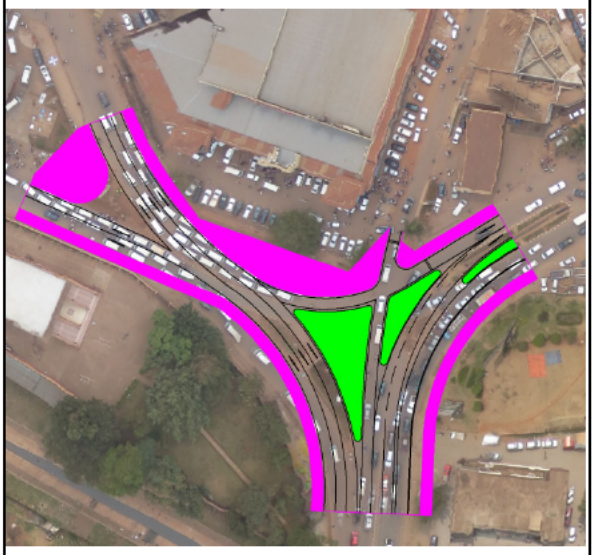
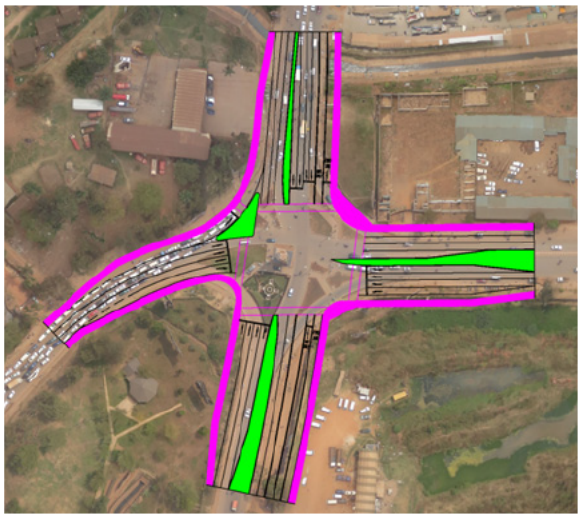
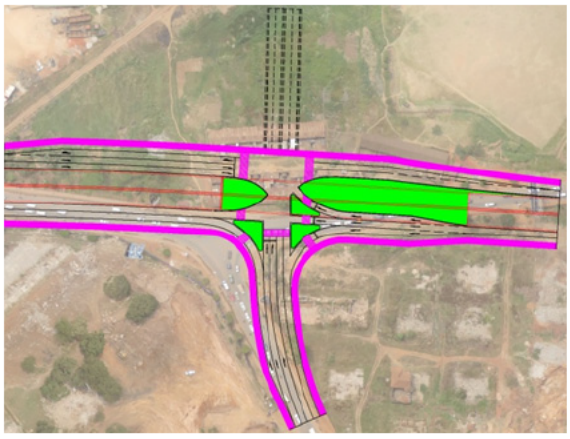
Africana Roundabout	**Garden City Roundabout**
	
Delay Time and Capacity Delay time: without improvement (100.4 s), with improvement (42.8 s) Capacity: without improvement (2,400 pcu/h), with improvement (4,400 pcu/h)	**Delay Time and Capacity** Delay time: without improvement (949.5 s), with improvement (54.4 s) Capacity: without improvement (1,700 pcu/h), with improvement (4,400 pcu/h)
Mukwano Roundabout	
	
Delay Time and Capacity Delay time: without improvement (617.5 s), with improvement (53.3 s) Capacity: without improvement (2,300 pcu/h) with improvement (4,900 pcu/h)	

Note: Without improvement is the roundabout evaluation result for 15minites.
Source: JICA Survey Team

Figure S12-4 Improvement Plan for Existing Roundabouts

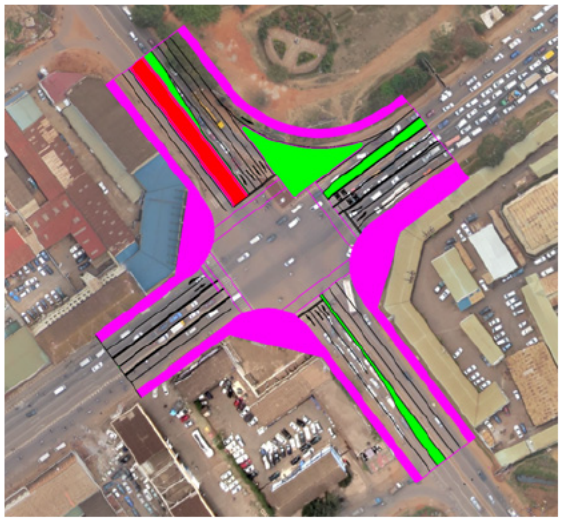
(2) Improvement of Standard Junction

In addition, four major standard junctions with traffic signal (Shoprite, Clock Tower, Nsambya, Kitgum House) and two minor junctions (Hospital and Kibuli) controlled by stop signs are on the Project road. These junctions will be improved for securing high capacity and better traffic safety.

Shoprite Junction	**Clock Tower Junction**
	
Delay Time and Capacity Delay time: - Capacity: -	**Delay Time and Capacity** Delay time: without improvement (73.73 s), with improvement (55.38 s) Capacity: without improvement (7,483 pcu/h), with improvement (10,114 pcu/h)
Nsambya Junction	**Hospital Junction**
	
Delay Time and Capacity Delay time: without improvement (390.6 s), with improvement (55.7 s) Capacity: without improvement (4,200 pcu/h), with improvement (6,000 pcu/h)	**Delay Time and Capacity** Delay time: without improvement (84.5 s), with improvement (70.0 s) Capacity: without improvement (2,000 pcu/h), with improvement (2,900 pcu/h)

Source: JICA Survey Team

Figure S12-5 (1/2) Improvement Plan for Standard Junctions

Kibuli Junction	Kitgum House Junction
	
Delay Time and Capacity Delay time: - Capacity: -	**Delay Time and Capacity** Delay time: without improvement (73.1 s), with improvement (65.0 s) Capacity: without improvement (4,100 pcu/hr), with improvement (5,500 pcu/hr)

Source: JICA Survey Team

Figure S12-5 (2/2) Improvement Plan for Standard Junctions

(3) Proposed Traffic Signal Operation

In this Project, ten junctions will be controlled by traffic signals. Traffic control by signals assures better junction operation.

Table S12-4 Proposed Traffic signal System for each Junction

Junction	Configuration	System
Shoprite	Crossroad/four-way	Multi-stage control
Clock Tower	Crossroad/four-way	Multi-stage control with BRT priority system
Nsambya	Crossroad/four-way	Multi-stage control
Hospital	T-junction	Multi-stage control
Mukwano West	T-junction	Multi-stage link coordination control
Mukwano East	T-junction	Multi-stage link coordination control
Kitgum House	Crossroad/four-way	Multi-stage link coordination control with BRT priority system
Garden City	Crossroad/four-way	Multi-stage link coordination control
Africana	Crossroad/four-way	Multi-stage link coordination control with BRT priority system

Source: JICA Survey Team

12.4 Pavement Design

(1) Design Approach

KCCA has its own standard for pavement composition. Target roads in the Project are categorized under KCCA's New Road Class A. Accordingly, pavement composition indicated by KCCA's Guideline is applied as initial composition. However, this composition has not been checked mechanically. Therefore, this composition is checked by the Guide for Design of Pavement Structures, 1993 of AASHTO.

(2) Design Conditions

- ✓ Design Life: 15 years
- ✓ Vehicle Equivalent Factors (VEFs)
- ✓ Large Bused: 2.00
- ✓ Medium Goods Vehicle: 3.60
- ✓ Heavy Goods Vehicle: 5.27
- ✓ Design Traffic Loading: 9 – 25 x 106
- ✓ Design CBR: 7 - 10%

(3) Applicable Pavement Structure

In the AASHTO design manual, pavement composition is determined by the structural number (SN) based on the resilient modulus of the sub-grade and the design traffic loading (in million ESAL).

Using a reliability factor of 80-90%, standard deviation of 0.45, and effective resilient modulus, the required structural numbers and each layer thickness were derived from the AASHTO formula. The following table shows the proposed pavement composition based on KCCA's draft standard.

Table S12-5 Proposed Pavement Composition based on KCCA Standards (Draft)

Package		Package-1		Package-2	
Road Name		Queens Way	Nsambya	Mukwano-1*	Mukwano-2**
PAVEMENT COMPOSITION	AC Wearing Course(cm)	5	5	5	5
	AC Binder Course(cm)	5	5	10	5
	Crushed Stone(cm)	25	20	20	20
	Lime Stabilization(cm)	40	40	35	40
Package		Package-2	Package-3		
Road Name		Gaba	Jinja	Access	Yusuf Lule
PAVEMENT COMPOSITION	AC Wearing Course(cm)	5	5	5	5
	AC Binder Course(cm)	5	5	5	5
	Crushed Stone(cm)	20	20	15	15
	Lime Stabilization(cm)	25	30	35	0

Source: JICA Survey Team

12.5 Drainage Design

(1) Drainage System in Kampala

Kampala City has eight main drainage systems. Each main drainage system is divided into a major system and numerous minor systems. The major system consists of all primary and secondary channels.

The Project Road is located in Drainage System-1 (Nakibuvo). The primary channel of this drainage system forms the boundary between Makindye to the south and the Central Division and Nakawa to the north. The catchment covers the entire Central Division, the southern portion of Nakawa, and the northernmost portion of Makindye.

(2) Design Concept

The Kampala Drainage Master Plan provides the design approach and procedures for drainage design in Kampala. The preliminary design of the Project should be made by applying the processes and parameters specified in the master plan with some departures where deemed reasonable.

(3) Applicable Drainage System for Roads and Bridges

Surface water is collected along the kerbs and discharged into stormwater pipes by means of kerb inlets (or catchpits) positioned at specific points in a controlled manner for maximum traffic safety. Flow should be transferred along a kerb into a piped system when the surface flow is still sub-critical at Froude number of less than 0.8. However, in most cases, this is not possible and special attention is required in the design of kerb inlets for critical or super-critical surface flow conditions. The norms for positioning kerb inlets is based on the guidelines of Vol. 2: Drainage Design of the Road Design Manual, Uganda.

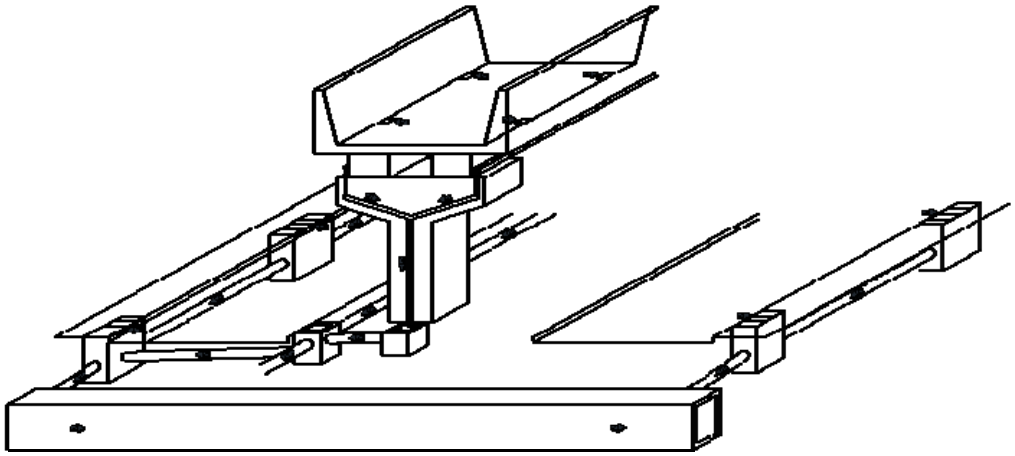
(4) Drainage Design

Examinations should be made for the following major design items in the preliminary design:

- ✓ Design Return Period: 5 years (Kampala Drainage Master Plan)
- ✓ Design Rainfall Intensity: 169.5 (Road Design Manual, Vol. 2 Drainage Design)

Details of the kerb inlets being used along the roads in Kampala are shown in the following figure. A wider inlet system can intercept more surface water as compared to a standard inlet system. The number and spacing of these kerb inlets can be determined on the basis of capacity and the related stormwater discharge to be accommodated. As the results of calculation of catchpit interval:

- ✓ Interval of Catchpit on Road: 20-30m
- ✓ Interval of Catchpit on Bridge Decks: 9-20m

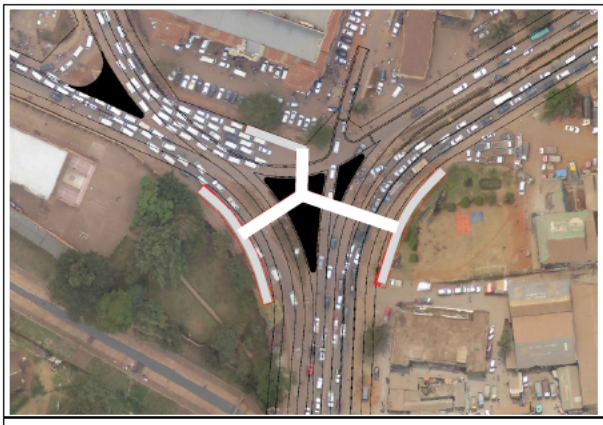
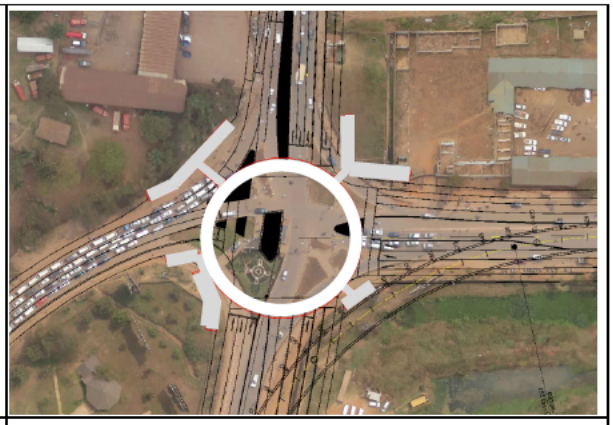


Source: JICA Survey Team

Figure S12-6 Image of the Drainage System for Flyover and Ground Level Road

12.6 Planning and Designing of Pedestrian Bridges

After the widening project of the road between Shoprite and Clock Tower junctions and the implementation of the BRT project, NMT will be more likely to be endangered when crossing roads because of the longer distance to cross roads and the faster traffic speed. The area is the busiest section for pedestrian and cyclist traffic at peak hours in Kampala City, and as an improvement for NMT crossing roads in this area, pedestrian bridges are proposed to be installed between Shoprite Junction and Clock Tower Junction. From the results of the NMT survey, areas that need to be installed with pedestrian bridges are proposed as below.

	
Proposed Pedestrian Bridge for Shoprite Junction Bridge Type: Steel Box Girder Bridge Length: 23.0 m + 14.0 m + 34.0 m Width: 3.0 m Crowd Loading: 5 kN/m^2 (EN 1991-2)	Proposed Pedestrian Bridge for Clock Tower Junction Bridge Type: Steel Box Girder Diameter: 60.0 m Bridge Length: 188.0 m Width: 3.0 m Crowd Loading: 5 kN/m^2 (EN 1991-2)

Source: JICA Survey Team

Figure S12-6 Proposed Pedestrian Bridges between Shoprite and Clock Tower Junctions

13 Environmental and Social Considerations

13.1 Environmental and Social Impact Assessment

(1) Environmental and Social Consideration Requirements for the Project

The project is classified as 'Category B' by JICA environmental guidelines. Furthermore, NEMA required conducting detailed environmental impact study for the project.

(2) Alternative Evaluation

Evaluation of alternatives were conducted from five viewpoints, i.e., i) traffic and socioeconomic aspects, ii) consistency to existing/upper level plans, iii) environmental impact, iv) construction cost, and v) technical issues. The environmental impact items are as follows: i) land acquisition/resettlement, ii) direct impact on existing operation, iii) impact on living environment, and iv) impact on existing landscape. According to overall evaluation results, Option3-1 is evaluated to be the best options. In case zero option, no project in the area, temporary environmental impacts will be minimized. However, without any mitigation measures for existing traffic networks, not only obtrusion of economic development, environmental impacts such as degradation of air quality and noise level caused by traffic jam and impact on local livelihoods will be expected.

(3) Environmental Impact Assessment Results

Table S13-1 Summary of Key EIA Results Compared with Scoping Results

Environmental items		Phase				Analysis and Evaluation
		Scoping		EIA		
		D/C	O	P/C	O	
1	Air pollution	B-	B-/B+	B-	B-/B+	(Design/construction phase) During construction phase (24 months), emission of dust and exhaust gas from passing and operating construction equipment and vehicles would cause air pollution in and around the construction sites. However, the impact is only temporary and the proposed mitigation measures will alleviate the impact. (Operation phase) Although the traffic volume diverted to the flyover will increase in the future, emission of air pollutants will be suppressed because existing traffic jam will be solved by the project.
2	Noise and Vibration	B-	B-	B-	B-	(Design/Construction phase) As to the results of noise level monitoring, the existing noise levels for both day time and night time at two survey locations have already exceeded the maximum permissible level for construction site under the Uganda Noise Level Standard. In addition, noise and vibration caused by construction works would cause damage to residents, existing houses, and other building structures. However, the impact was expected temporary with installing adequate mitigation measures such as sign board of speed limit, adequate management of construction schedule, and others. (Construction phase) Traffic noise and vibration created by traffic jams will decrease because the existing traffic jam in the Kampala City centre will be alleviated through the project. However, in surrounding area of flyovers and expanding roads, traffic noise and vibration will increase caused by future traffic volume. Mitigation measures such as installation of noise barrier walls for the entire line of Kitgum Flyover and speed restrictions others should be implemented.
3	Involuntary Resettlement	B-	D	B-	D	(Design/construction phase) Three URC official quarters will be affected by the project. 21families (approximately 88 persons) who live in the quarter will be required to relocate. In addition, approximately 6 ha of land will be acquired along the existing roads. Compensation policy for the PAPs was identified in Resettlement Action Plan (RAP) for the Project officially based on field survey, stakeholder meetings and meeting with Chief Land Valuar.
4	Local economies (employment, livelihood, etc.)	B-/B+	B+	B-/B+	B+	(Design/construction phase) The project does not involve a construction of new road but an improvement of the existing road network. Basically, there is no possibility that the project will adversely affect the existing means of transportation and the associate workers. Also, it is not expected that there will be a significant change in the land use and livelihood of local people. In addition, the local community is likely to be employed as casual labourers and service providers (e.g., food vendors). On the other hand, some small flower shops along the existing roadside, about five groups, will be affected by land acquisition. Compensation policy for the PAPs was identified in Resettlement Action Plan (RAP) for the Project officially. (Operation phase) With the project, local economies will be improved because the project will alleviate the existing traffic jam impact.
5	Cultural heritage	D	D	A-	D	(Design/construction phase) The Clock Tower Monument is proposed to be relocated in the Survey from an engineering point of view because the existing location of the monument blocks the traffic flow at the junction. The Ministry of Tourism, Wildlife, and Antiquities being the responsible authority of heritages gave permission with a condition for the structure to be relocated; however, the relocation is still a sensitive issue. The project proponent should continue to discuss with relevant authorities about relocation methods, location, and schedule.

Environmental items		Phase				Analysis and Evaluation
		Scoping		EIA		
		D/C	O	P/C	O	
6	Working conditions (including occupational safety)	B-	N/A	B-	D	(Design/construction phase) The project proponent shall comply with the laws and regulations related to securing healthy working conditions in Uganda. Safety considerations to prevent injuries and accidents to individuals, such as first-aid kit, personal protective equipment (PPE), secure tamper-proof fence, security lighting, and regular security patrols shall be considered. As for the management of workers, adequate measures will be planned by the constructors during construction as described below. -Ensure that first-aid kits are available in all work areas, supplied with adequate material to treat common workplace injuries; - Training of all construction workers on basic sanitation and healthcare issues, general health and safety matters, and specific hazards of their work; - Dedicated transport should be provided at all work sites to take injured persons to hospitals, if needed.

Note: D/C:Design/Construction phase, O:Operation phase
A+/-: Significant positive/negative impact is expected, B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown, D: No impact is expected, N/A : Not applicable

Source: JICA Survey Team

(4) Environmental Management Plan and Monitoring Plan (EMP and EMoP)

Table D13-2 summarizes key Environmental Management and Monitoring Plan.

(5) Stakeholder Meeting

Large scale stakeholder meeting for RIA and RAP were held six times, and small scale meeting for affected individual and direct impacted people were several times from July to October 2014.

13.2 Resettlement and Land Acquisition Plan

(1) Necessity of Resettlement and Land Acquisition Plan

Basically, most of the project area will be located inside the existing ROW. However, some land along the existing roads will be required for road widening. The project area is a commercial/industrial area and many structures such as petrol stations, factories, and large office buildings located along the existing roadsides are difficult to relocate. Thus, the Project will ensure a minimum 30 m wide ROW in order to minimize relocation impacts to the surrounding area.

(2) Census and Socio-economic Survey (2013)

The census and socioeconomic surveys for all households living inside the Project area was done from August 2013 to March 2014, which was conducted by UNRA supported by the JICA Survey Team. The existing land use of the Project area is not a residential area but commercial/industrial area. However, three quarters belongs to URC (Block 15-17) will be affected by the Project. PAPs living in the affected quarters are 21 families in total (approximately 88 persons). The household heads of these affected families are regular staff of URC.

Table S13-2 Key Environmental Management and Monitoring Plan

No	Environmental Impacts	Environmental Management Plan (Mitigation Measures)	Monitoring	
			Indicators	Monitoring Section
1	Land acquisition and loss of road side trees and ornamental crops	• Land acquired must be fully compensated for in accordance with the law.	• No of complaints recorded. • Amount of money paid out. • Area planted and • Species of grasses planted	• Resident Engineer • Environmental Specialist • Road Committees
2	Air Quality (Increased dust and air pollution)	• Place speed controls at suitable intervals along the haulage routes and within / close to busy areas (during construction) near schools / places of worship; • Dust suppression through wet crushing at crusher units and when appropriate by spraying dusty road surfaces with water to be enforced	• Occurrence of dust in the air. • Complaints from other residents • Number of water bousers in use; • Source of water and holding capacity /tanks at crusher area.	• Resident Engineer • Environmental Specialist
3	Increased Noise levels and vibration	• Limit noise due to haulage/quarry traffic by keeping the construction fleet in good condition, well fitted with efficient silencers. Place and maintain speed controls (speed humps) at specified intervals; • Install of noise insulation (barriers) walls for whole of Kitgum flyover	• Noise levels. • Complaints from local residents • Complaints from workers	• Resident Engineer • Environmental Specialist
4	Road safety during the operation of the road / flyover	• The traffic code should be enforced by the police; • Road furniture must be cleaned and inspected regularly to check its condition; • The traffic code must be enforced by the police. • UNRA and the Uganda Road safety Council are recommended to continue sensitizing local communities of the Highway Code.	• Presence of road signs • Number of sensitization and training seminars with number of attendance; • No of complaints from local residents • No of traffic mishaps / accidents	• Resident Engineer • Environmental Specialist
5	Workers Occupational Safety and Health	• The Contractor must have in place a risk assessment and Safety & Health management plan; • Personal Protection Equipment (PPE) (including masks, hard hats, boots, reflective vests, safety harnesses and gloves) for the workforce shall be mandatory, foremen to ensure compliance; • First-Aid kits to be provided at every active working site as well as a clinic supplied and staffed by the Contractor in accordance with UNRA guidelines • Speed controls to be placed at suitable intervals along haulage routes and within and busy sections • Sanitation facilities provided at camps, workshop areas, crusher areas and at any other place where groups of workers are likely to concentrate	• Number of sanitation facilities; • Availability of bins • Presence of a Safety Officer; • Presence of PPE • Record of trainings for workers;	• Resident Engineer • Environmental Specialist
6	Relocation of Infrastructure and Utilities	• When working with Utilities (communications, Power lines, Water mains, sewer lines), it will be done in collaboration with the service provider and a due notice of at least one month is to be given. The same will be done for the relocation of major sign posts and road furniture where they exist; • The contractor will design ways of working around the utilities so that relocation is minimized.	• Number of utility lines etc. relocated • Complaints raised	• Resident Engineer • Environmental Specialist

Source: JICA Survey Team

(3) Inventory of Loss of Lands and Assets (Lands and Structures)

Based on inventory survey, affected land plot by the project is shown in below table. In addition, 47 structures including three residential houses will be affected by the project.

Table S13-3 Affected Land Plot by the Project

Owner		Plot Number	Area (acres)	Area (ha)
Official	KCCA	5	2.00	0.81
	Uganda Railways Corporation	8	4.99	3.08
	Uganda Police Force	3	2.95	1.82
	Uganda Telecom	1	0.36	0.22
	Posta	1	0.23	0.14
	Subtotal	**18**	**10.53**	6.08
Private	Religious Place	3	1.25	0.77
	Private Company	23	2.82	1.74
	Individual	3	0.75	0.46
	Licensee	20	Nil	-
	Sub Total	**49**	**4.82**	2.98
Grand Total		**67**	**15.36**	9.05

Source: JICA Survey Team

(4) Vulnerable Persons

There is no official definition of vulnerable groups by Uganda in the project area. However, people who work for the small flower shops along the existing roads might be clarified as below poverty line. According to KCCA which is management responsible section of existing roads, KCCA do not give them authority to use the roadside lands.

(5) Entitlement Matrix

Entitlement matrix of the project shows the following: i) range of assistance measures ii) eligibility, iii) entitlement/compensation policy, and iv) arrangement for implementing assistance measures smoothly, in accordance with the nature of loss to restore economic and social livelihood of PAPs. The entitlement matrix for this project is presented in Table below.

Table S13-4 Entitlement Matrix

	Category	Entitled Person (EP)	Type of Loss	Entitlements/Compensation	Rehabilitation Assistance
1	Government or institutional land	Government authorities	• Loss of land	• Cash compensation for land value based on market price	• Not required
2	Private land (commercial and industrial land)	Owners	• Loss of land	• Cash compensation for land value based on market price	• Disturbance allowance to be paid.
3	Cultivated land (no land title)	Cultivator/ farmer/ Kibanja owner/license	• Loss of crops • Loss of income • Loss of trees and structure and assets	• Entitled to harvest of the present crops; • In case of damage to crops, cash compensation as per rates provided by the District Land Board; • Compensation for loss of trees at rates provided by the KCCA Land Board; • Compensation for loss of assets at full replacement value; and • If possible allow farmers to harvest fruits as supplemental source during 'transition period'.	• Allowed to harvest crops, compensated and paid the disturbance allowance.
4	Small businesses, small traders (Commercial structure/establishment, shop, bar, kiosks, etc.)	Owners	• Loss of structure • Loss of income generating assets	• Cash compensation for structure and assets as determined by Government approved Surveyor/Valuer • For loss of income - cash compensation equal to 36 months of average affected income from the establishment (calculated using verifiable accounting methods)	• No business is affected except for the tenants renting in Centenary Park whose tenancy is due to expire in two years. They will be paid three months rent in lieu.
5	Small businesses (small flower shops along the road)	Flower shop groups	• Loss of trees • Loss of space	• Cash compensation for permanent trees based on the market price. • Disturbance allowance. • Sufficient time to remove or relocate their movable flowerpots.	• Moved a step back and paid the disturbance allowance.
6	Residential structure and other assets	Owners	• Loss of structure • Loss of assets (such as fencing, well, hand pump, storage room, etc.)	• Cash compensation for structure and assets as determined by the government as approved by the surveyor/valuer.	
7	Residential/quarter of Uganda Railway Corporation(URC)	Tenants URC	• Loss of rented quarter	• Sufficient time to find and shift to alternative residential quarter. • Relocation cost to alternative quarters (Three month rental fee and 15% disturbance allowance)	• URC will support their employees by giving them an alternative accommodation, or by supporting renting their houses.
8	Community structures, common property	Trustees/ community leaders	• Loss of structure, assets, etc.	• Cash compensation for structure and assets as determined by the government as approved by the surveyor/valuer. • Link up with local administration to provide additional infrastructure facilities.	
9	Public utilities	UMEME/ National Water/ Uganda Telecom/ Orange/MTN/Airtel/NITA Uganda Police	• Loss of underground electric cables, • Loss of underground water mains, • Loss of underground telecommunication /internet cables • Loss of police boxes • Loss of junction boxes	• To conduct reconstruction/relocation for the structure during construction phase under the responsibility of the project component, as necessary.	

Source: JICA Survey Team

(6) Grievance and Redress Mechanism

UNRA will put in place an extra-judicial mechanism for managing grievances and disputes based on the explanation and mediation by a third party, preferably a committee comprising local leaders,

trusted citizens, and independent of the project. Regarding payment of compensation, it is expected that while UNRA is responsible for providing the funds to compensate, it will hire an independent consultant/entity who will conduct the actual compensation exercise. In this way, the conflict of interest will be minimized.

(7) Implementation Structure

UNRA is responsible for triggering off this RAP. There are three main actors involved in carrying out compensation/resettlement where involuntary relocation or resettlement is inevitable. These are the Ministry of Lands, Housing and Urban Development (responsible for compensation), and lead agency/ministry which is the Uganda National Road Authority and the donor agency (JICA) for donor-supported projects to ensure compliance with the donor's safeguards.

The KCCA Administration (local government) is a key stakeholder in this resettlement, relocation, and compensation until its successful completion. It is imperative that all projects which require resettlement closely liaise with the local government administration to ensure equity, acceptability, and compliance.

(8) Proposed Implementation Schedule

Proposed implementation period of RAP is nine months from starting resources mobilisation for compensation, Formation of Resettlement Committee and Grievance Committee, and Identification of alternative land. RAP consultant shall make final report by nine month later.

(9) Resettlement Budget

The compensation for the PAPs for land and structures/buildings are shown in below table. After finalizing the cost estimate, UNRA will submit the RAP report to the Chief Land Valuator of the Ministry of Lands, Housing and Urban Development for checking on the validity of cost evaluation and for obtaining the official approval.

Table S13-5 Preliminary Land Acquisition and Resettlement Cost (As of August 2014)

Type of cost	Amount in UGX	Amount in USD
1.Land Acquisition Cost	46,323,650,000	17,958,105
2. Other Compensation Package	1,609,455,702	623,931
1) Crops	8,694,050	3,370
2)Buildings or Improvements	1,553,449,934	602,220
3)Tenants (URC and Nalongo Estates)	46,506,000	18,029
4)Additional Top up for Flower garden Attendants	**805,718**	312
3 Disturbance Allowance	**7,189,965,855**	2,787,305
4.Total Compensation package(1+2)	55,123,071,557	21,369,342
5. 1% RAP Implementation Costs(3*0.01)	551,230,716	213,693
6.Total RAP Budget(3+4)	55,674,302,273	21,583,035

Source: Adapted from Valuer/ Surveyor's report (2013)
Exchange rate: 1$=UGX2579.54

(10) Monitoring and Evaluation

The UNRA sociologist of the supervising team will initiate the monitoring process. The sociologist will also conduct the monitoring and progress of the resettlement including its impacts. The UNRA land acquisition specialist will work closely with the sociologist of the supervising team to ensure that JICA/WB Safeguards will not be violated while the UNRA LAMS, which the UNRA Land Acquisition and Management System (LAMS) are followed for the monitoring, auditing and evaluation works of RAP.

(11) Stakeholders Meeting

Public stakeholder meetings for RAP were conducted at same time as stakeholder meeting for Environmental and Social Impact Assessment. In addition, Small scale meeting for directly impacted people were conducted in workplace.

13.3 Way Forward

(1) For EIA Process

For EIA Process, UNRA and related sections shall implement following contents;

- It is expected that NEMA will issue the EIA approval certificate by end of August 2014. If designs of the Project are modified drastically in the detailed design, the environmental impacts for the new design should be reflected to EIA report and Environmental Checklist, attached as Annex as accurately as possible,
- UNRA shall take stipulated procedures for information disclosure in accordance with the NEMA disclosure guidelines,
- After official EIA approval, UNRA will furnish a copy of the certificate of approval to JICA as soon as possible.
- UNRA shall implement environmental and social management and monitoring plan (ESMMP) contained in EIA report. Also, UNRA shall arrange ESMMP budget including salary of environmental and social experts during design and construction phases,
- UNRA shall prepare an organization framework for the environmental monitoring during the construction /operation phase,
- UNRA, KCCA and the Ministry of Tourism, Wildlife and Antiquities will conduct detailed structural surveys of the Clock Tower in order to prepare adequate relocation plan by end of August 2014. UNRA and KCCA will endeavour to relocate the Clock Tower before the commencement of civil work,
- Detailed design consultants shall support UNRA's in ESMMP activities, and
- Contractors of the Project shall implement the environmental monitoring during the construction phase based on ESMMP which was attached in EIA report.

(2) For RAP process

For RAP Process, UNRA and related sections shall implement following contents;

- Land acquisitions and resettlements shall be completed before the commencement of the construction. UNRA will start procurement of consultant for compensation from September 2014 to enable commencement of land acquisition in accordance with schedule,
- If designs of the Project are modified drastically in the detailed design and need additional land acquisition as a result, UNRA shall conduct additional RAP surveys and stakeholder meetings as necessary,
- UNRA shall arrange a RAP budget including salary of RAP experts based on the finalized RAP report,
- UNRA shall implement external/internal monitoring and reporting regarding land acquisition and resettlement until it confirms the issues have been properly addressed and solved, and
- A design consultant shall support UNRA on above activities.

14 Construction Plan and Cost Estimate

14.1 Construction Method and Plan

14.1.1 Basic Concept of Construction Method and Plan

The construction method and plan will be studied to satisfy the safety, time, cost and quality control requirements. Since most of the works will be carried out in the developed area of Kampala, the study on safety control including considerations of existing traffic flow will be very important.

14.1.2 Project Size and Quantities of Works

The Project can be expediently divided into three (3) packages considering the major infrastructure to be constructed. Their components and construction periods are: shown in the following table:

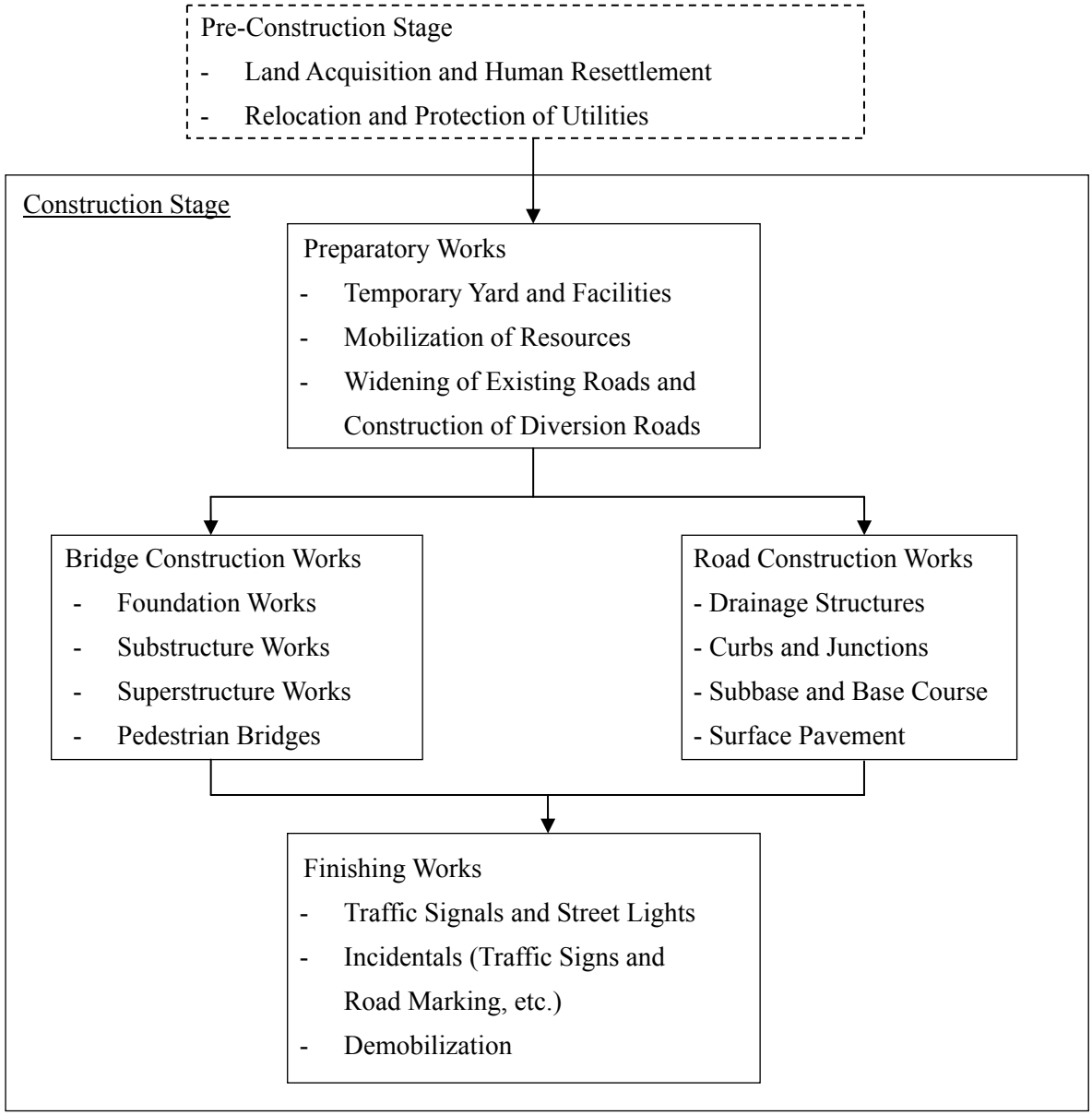
14.1.3 Working Days

Considering the several factors prevent the contractor from continuing the construction works on

site such as weekends, public holidays, adverse weather, machine break down and lack of materials etc., In this Project, a total of 104 days cannot be counted as working days. As a consequence, only 261 days can be counted as working days in a year. The ratio of working days to non-working days is 71.5%.

14.1.4 Construction Procedure

Construction procedure of the Project is summarized in the following figure:



Source: JICA Survey Team

Figure S14-1 Project Construction Procedure

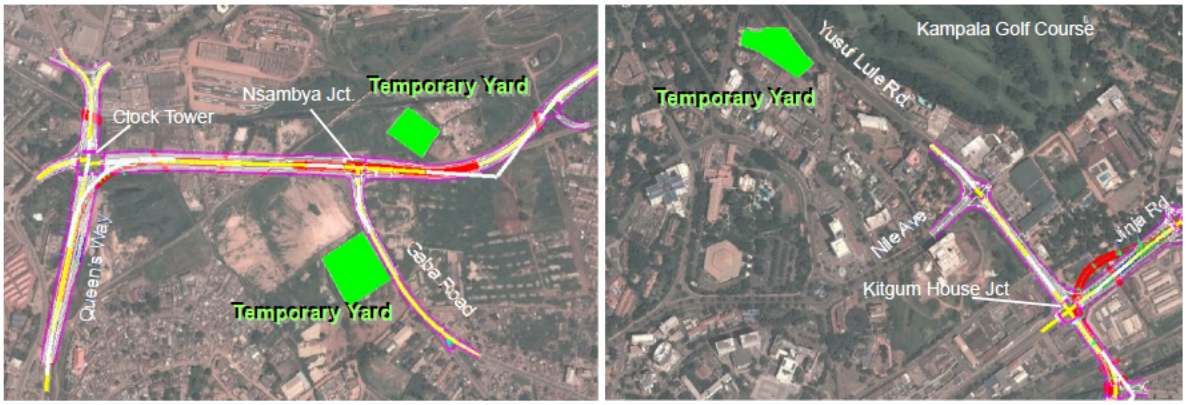
14.1.5 Preparatory Works

(1) Temporary Yard and Facilities

The necessary facilities for the construction site will be prepared as presented below.

i) Offices and accommodations of the contractor and the engineer will be set up in an existing building along or near the construction sites.
ii) The concrete batching plant and asphalt mixing plant with their aggregate stock yards will be set up outside the city area.
iii) Materials testing laboratory will be set up at the same area as item (ii).
iv) The temporary yards will be prepared at an adjacent area to the construction site

The required land for temporary yards adjacent to the site is approximately five hectares. At this present time, some of the public land where no building or structure exists on the ground can be found at adjacent to the permanent works area as shown in the following figure.

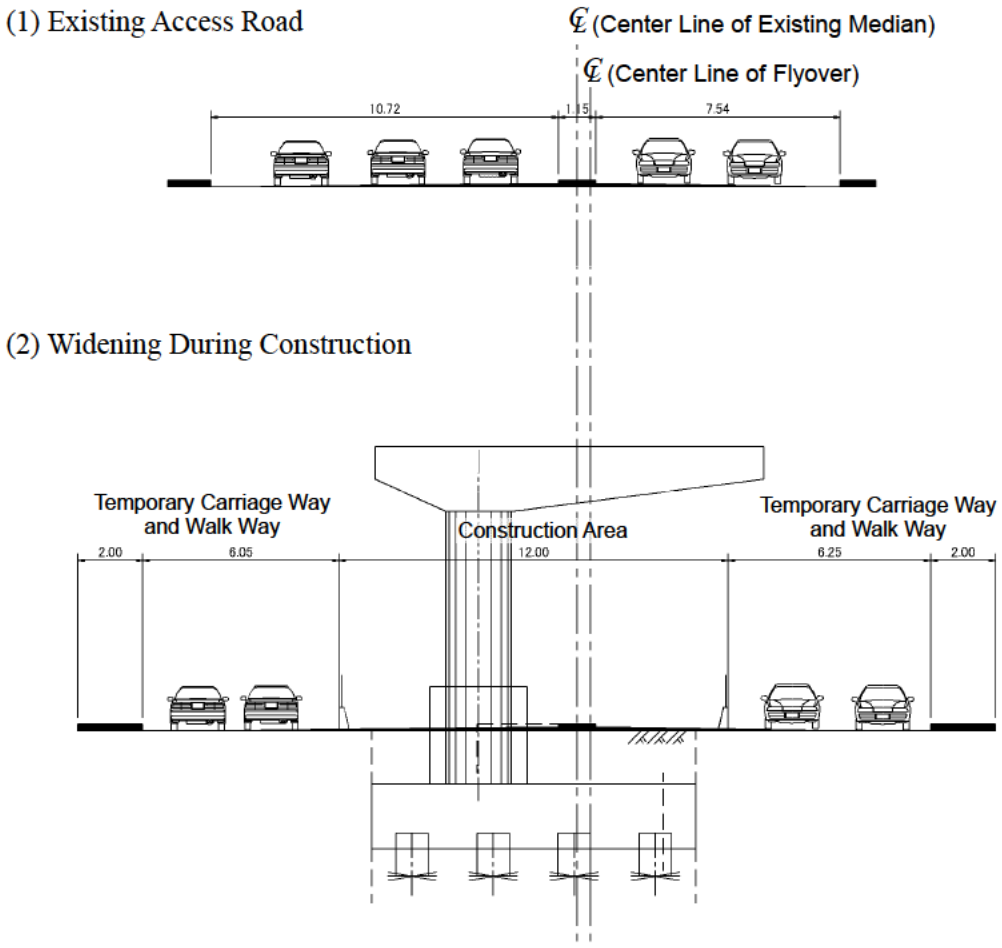


Source: JICA Survey Team

Figure S14-2 Public Lands where can be used as the Contractor's Temporary Yards

(2) Widening of Existing Roads and Construction of Diversion Roads

Flyover bridges will be constructed over Queen's Way, Nsambya Road, Mukwano Road, Access Road, Jinja Road, and Yusuf Lule Road, where the current traffic volumes on all of these roads are very large. Once bridge construction work has commenced, the central part of the existing roads will be utilized as construction spaces. Therefore, the existing roads shall be widened before the commencement of bridge works in order to provide temporary diversion roads. For example, the existing road will be widened to 28.5 m but a 12 m wide space at the center of the road will be utilized as construction space during construction. As a result, the current number of traffic lanes will be reduced by one and the width of each lane will also be reduced. Therefore, it will be difficult to proceed with construction works without disturbing the existing traffic flow in and around the Access Road.



Source: JICA Survey Team

Figure S14-3 Traffic Management during Construction at Access Road

(3) Superstructure Works

The PC hollow slab bridge and steel box girder (narrow and conventional) are selected as bridge superstructures.

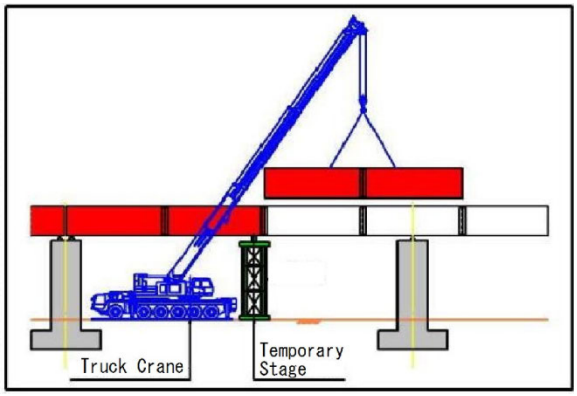
PC hollow slab will be constructed using cast-in-situ concrete method with temporary supports. Therefore, PC hollow slab bridges are planned only where sufficient traffic diversion can be secured.

The steel box girders are erected by crane with temporary supports. The crane erection method is the most common and safest method if the construction site satisfies the following conditions:

i) Adequate crane working space is available.
ii) A temporary stage can be provided between both piers.

The steel box girder bridge is designed for Access Road, Yusuf Lule Road, and Jinja Road and all the locations that satisfy the above conditions (i) and (ii). The girder erection works over Jinja Road

require the closure of a part of the existing road and it shall be carried out during the night when public traffic volume will be very little.



Source: JICA Survey Team

Figure S14-4 Erection Method of Steel Box Girder and Picture of Actual Construction Site

14.1.6 Construction Schedule

(1) Relocation Works of the Existing Utilities and Obstructions

In the project area where the permanent works will be constructed, many existing utilities have been identified and some of those utilities are required to be relocated. The relocation works of such utilities were agreed to be carried out by Uganda side (UNRA, KCCA and related organizations) before the commencement of the main construction works.

(2) Construction Schedule

The construction schedule of each package is shown in Figures S14-5 to S14-7.

The bars indicated in red colour are the critical activities of each package.

Package 1 :Clock Tower - Shoprite Area

No	Item & Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Preliminary and General																								
	Setting up Office and Construction Camp																								
	Survey Works and Concrete Trial Mix etc.																								
	Demobilization																								
2	Procurement from Foreign Countries																								
	Piling Machine																								
	Rotational Press-in Steel Pipe Pile																								
3	Fly-Over Bridge (PC Hollow Slab)																								
	Widening of Existing Roads and Detours																								
	Piling Works																								
	RC Piers																								
	PC Hollow Slab and Deck																								
4	Approach with Terre Armee Retaining Wall																								
	Manufacture of Concrete Skin for Terre Arme																								
5	Widening and Improvement of Existing Road																								
6	Pavement and Incidentals																								
7	Finishing Works																								

Source: JICA Survey Team

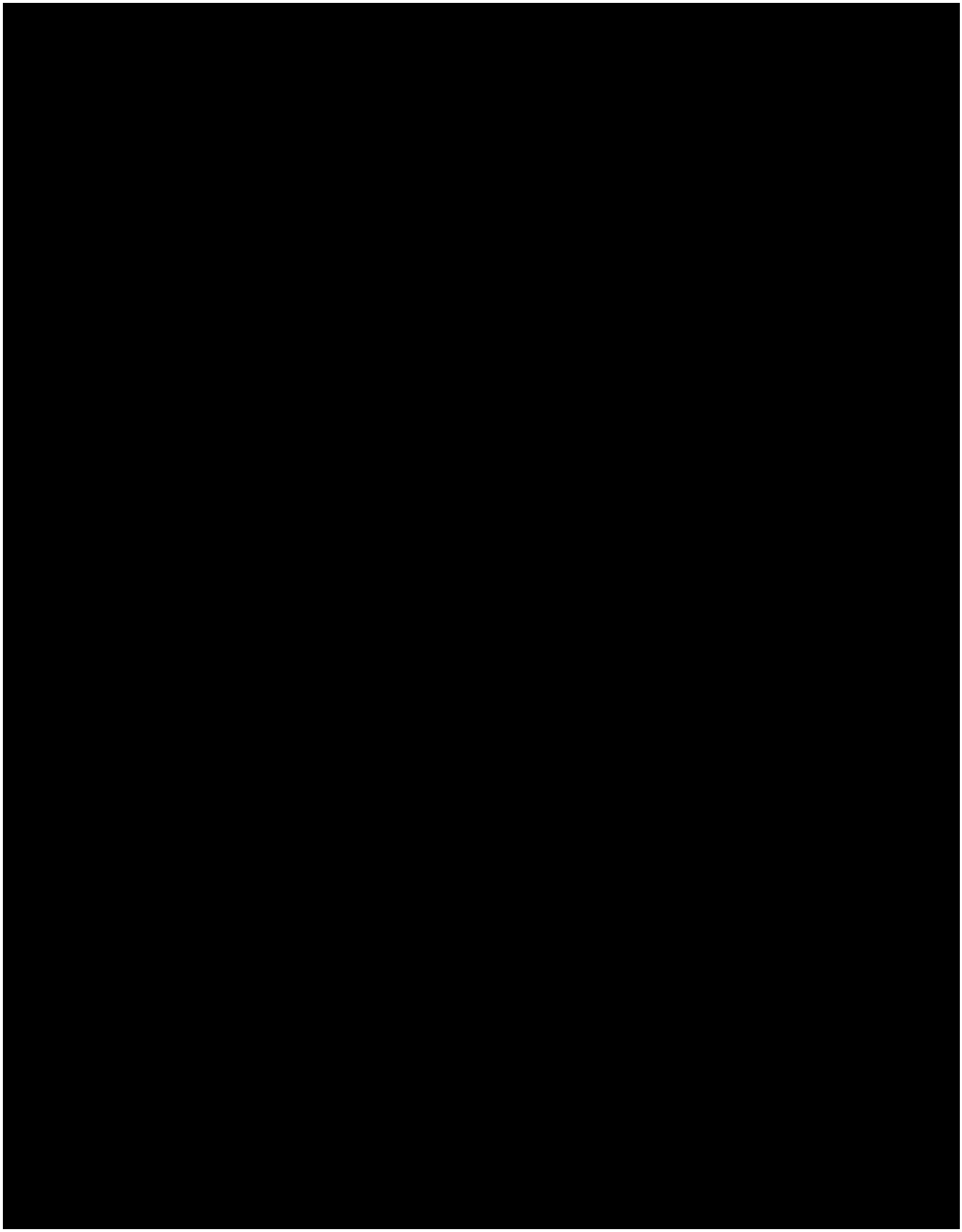
Figure S14-5 Construction Schedule for Package 1 (Clock Tower – Shoprite Area)

Package 2 Nsambya Junction - Mukwano Road

No	Item & Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Preliminary and General																				
	Setting up Office and Construction Camp																				
	Survey Works and Concrete Trial Mix etc.																				
	Demobilization																				
2	Nsambya Underpass and Retaining Walls																				
	Diversion Road																				
	Box Culvert Clock Tower Side																				
	Box Culvert Mukwano Side																				
	Retaining Wall Clock Tower Side																				
	Retaining Wall Mukwano Side																				
3	Drainage Structures and Kerbs																				
	Production of Precast Units																				
	Widening of Existing Road																				
	Installation Works at Mukwano Road																				
	Installation Works at Underpass Section																				
4	Pavement Works																				
5	Finishing Works																				

Source: JICA Survey Team

Figure S14-6 Construction Schedule for Package 2 (Nsambya Junction – Mukwano Area)



14.2 Cost Estimate

14.2.1 Time of Cost Estimate

The time of the cost estimate is November 2013.

14.2.2 Currency Exchange Rates

The currency exchange rates for the cost estimate shall be the average exchange rate for the six months before the end of October 2013 (from 1 May 2013 to 31 October 2013) announced by the Bank of Uganda. The currency exchange rates for the cost estimate are as follows:

USD 1 = UGX 2,579.54 = JPY 98.80, JPY 1 = UGX 26.11

14.2.3 Method of Cost Estimate

Construction cost is estimated based on bill of quantities made by the JICA Survey Team.

The current unit rate of each item in the bill of quantities has been obtained from leading domestic contractors and compared with UNRA's recent rate to confirm its reliability. If the proposed rates from leading domestic contractors are judged as not suitable, the rates made by the JICA Survey Team will be used for the cost estimate.

14.2.4 Cost Estimate

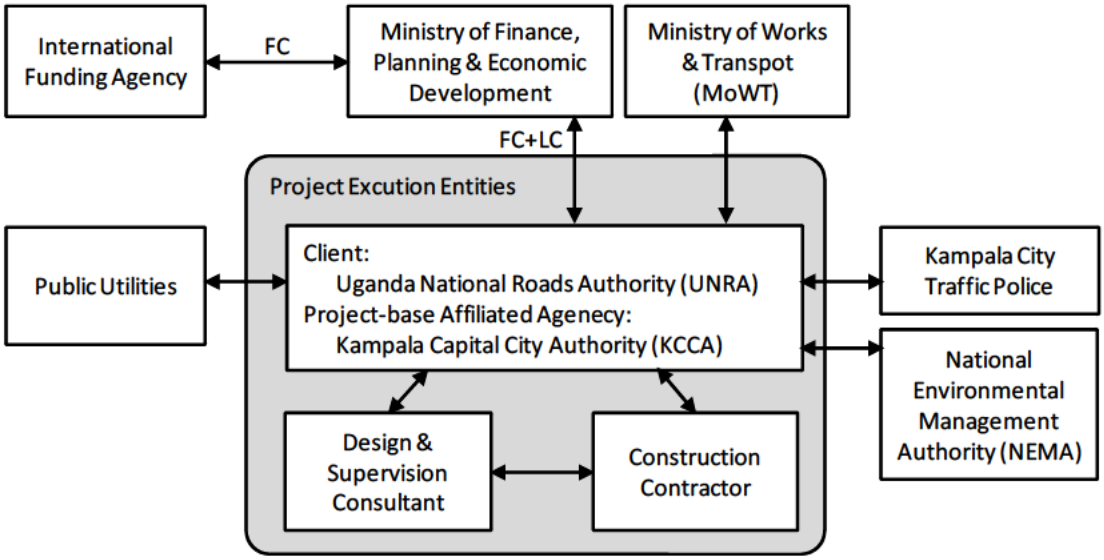
The Project Cost is estimated as shown in the following table.

In addition, relocation cost for public utilities undertaken by UNRA is estimated to be USD 6.5 million. Note that relocation cost of Clock Tower is included as part of civil work for contract Package 1 as item of provisional sum.

15 Implementation Structure and Schedule

15.1 Implementation Structure of Greater Kampala Roads Improvement Project

Because the size of the Project is large, an international funding agency is being considered for its implementation. Various entities will be involved in the implementation of the Project as shown in Figure S15-1.



Notes: FC=Foreign Currency, LC=Local Currency

Source: JICA Survey Team

Figure S15-1 Concerned Entities of the Greater Kampala Roads Improvement Project

15.2 Proposed Implementation Schedule

In this Project, JICA Yen loan is considered as the project source for the civil works and the supervision. As a result of a series of discussions among UNRA, JICA and the Survey Team, the implementation schedule for the Project was determined as shown in Figure S15-2 taking into consideration the following two measures to expedite the implementation process.

- Immediate Commencement of the Detailed Design and Tender Assistance by UNRA
- Integration of Pre-qualification and the bidding stages into one stage for procurement of Contractor

It is also noted that UNRA committed that the relocation of the utilities and Clock Tower will also be carried out by UNRA before the commencement of the construction works.

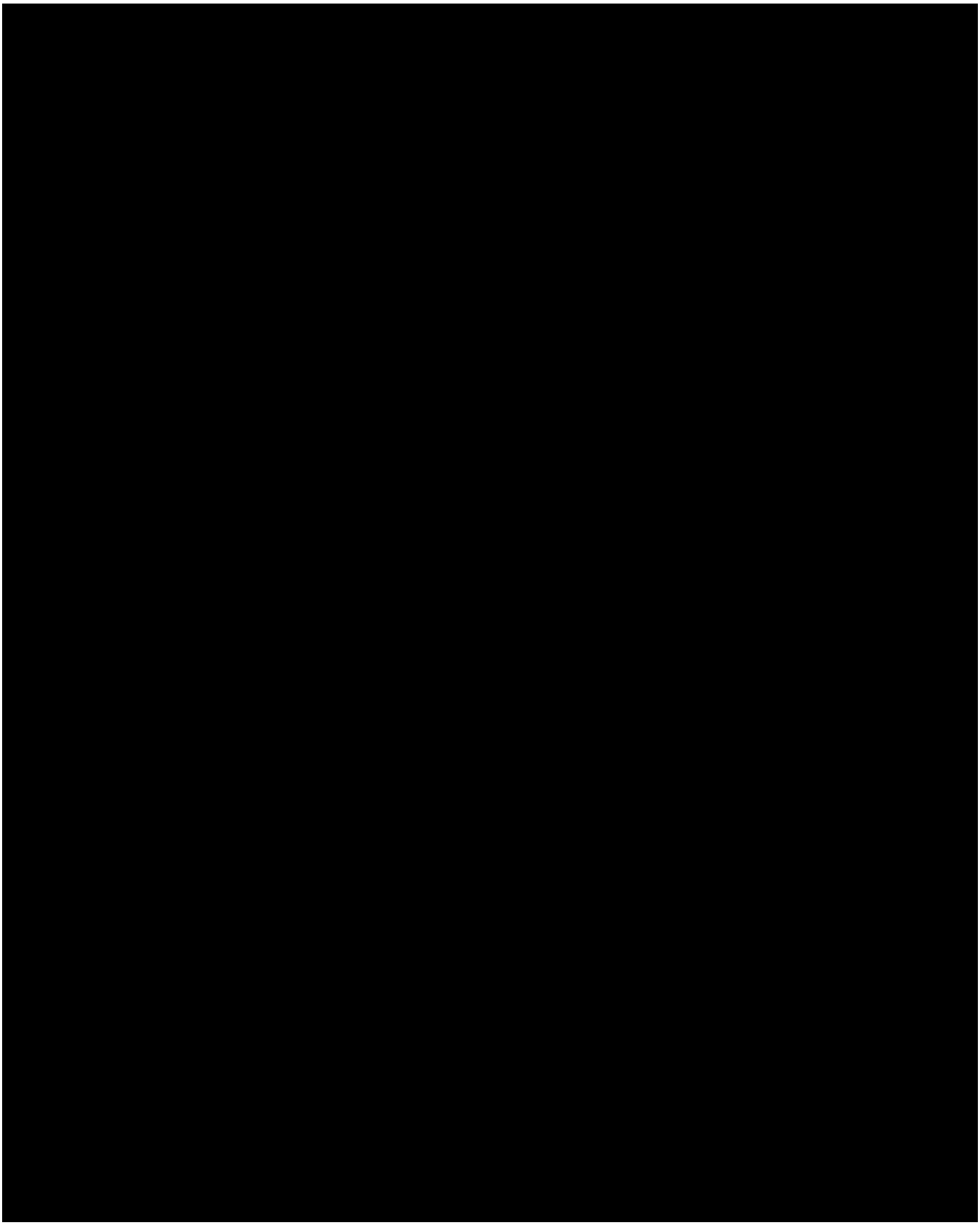
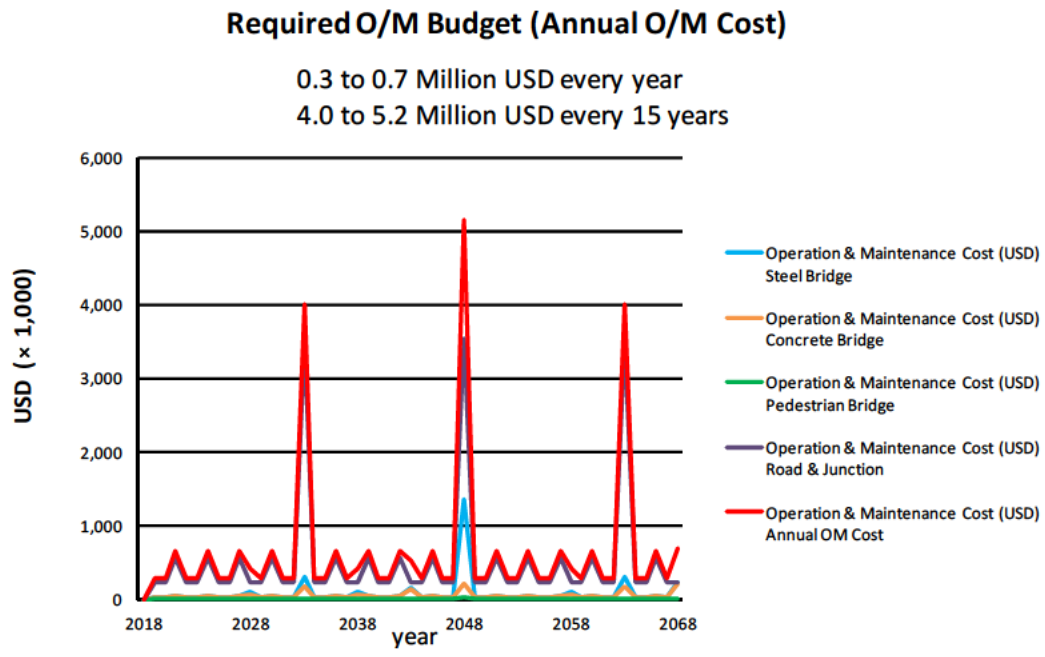


Figure S15-2 Proposed Implementation Schedule

Source: JICA Survey Team

Figure S15-3 Indicative Annual Fund Requirement for Implementation



Source: JICA Survey Team

Figure S15-4 Indicative Annual Fund Requirement for O&M

16 Operation and Maintenance

16.1 Maintenance of Flyover Structure

UNRA has been authorized as the executing agency for all the preparation and implementation aspects of the Kampala Flyover Project in accordance with a letter from the MoWT addressed to the chief representative of JICA Uganda office dated 30 July 2012. It is not yet clear as to whether UNRA will also be responsible for the operation and maintenance of the flyover structures. Capacities of UNRA and KCCA in terms of O&M of road infrastructures are summarized and compared in the following table:

Table S16-1 Evaluations and Recommendations regarding Future O&M Structures

	UNRA	**KCCA (Engineering and Technical Services)**
Jurisdiction	Facilities of national roads in the country	Roads and other public infrastructure/buildings in Kampala City
Number of O&M Related Staff	21 persons	22 persons (Some positions are vacant.)
Technical Capacity	Capable for both road and bridge maintenance, but no maintenance experience in major steel structures like the flyovers. UNRA has bridge management system. Evaluation: Superior to KCCA in terms of bridge maintenance technology.	Capable for road maintenance, but no maintenance experience in major bridge structures. Evaluation: Enough experience in urban road maintenance including daily cleaning of road surfaces, traffic signal operations and street light operations, but inferior to UNRA in terms of bridge maintenance technology.
Budgetary Situation (FY 2013/14)	USD 103 million	USD 6 million
Recommendation towards Future O&M	Favorable for O&M agency of flyover structures with more experience in bridge maintenance and budget allocation than KCCA.	Favorable for O&M agency of surface roads, junction and traffic signals. To manage O&M works of flyover structures, supplemental staff and appropriate trainings as well as sufficient budget allocation by URF will be required.

Source: JICA Survey Team

16.2 Inspection and Maintenance of Assets provided by the Project

16.2.1 Concept of Preventive Maintenance

Preventive maintenance is important in order to control maintenance cost and extend the service life of the assets. Table S16-2 presents the advantages of preventive maintenance in comparison with maintenance work after the problem has manifested.

Table S16-2 Advantages of Preventive Maintenance Method

Maintenance after Problems (Conventional Maintenance)		Preventive Maintenance (Method to be Applied)
✓ Repair/rehabilitation works after occurrence of the problem on structures.	⇨	✓ Repair/rehabilitation works are done before the condition of the structure gets worse by identifying and predicting the condition and damage level of the structure through regular inspection works.
✓ Tend to be large scale and expensive works.		✓ Relatively low-cost repair works will be sufficient because the damage is in its early stage.
✓ Unexpected budget will need to be arranged.		✓ Repair and maintenance works can be planned systematically within the prepared budget.
✓ Could be a fatal damage which shortens the service life of the structure.		✓ Development of the damage can be restrained; therefore, prolongation of the service life is expected.
✓ Can be compared to "receiving medical treatment after manifestation of symptoms".		✓ Can be compared to "maintaining one's health by having routine health checkups".

Source: JICA Survey Team

16.2.2 Flyover Structures

In order to realize preventive maintenance, inspection is the most fundamental and crucial work among the infrastructure management tasks in order to maintain the required service level of the structures. The purpose of the inspection work can be summarized as follows:

1) To systematically record actual condition and aging of structures.

2) To detect damages and deterioration earlier and to determine causes.

3) To evaluate soundness of the structure, to repair damages, and to assess the necessity of the reinforcement.

4) To collect information for effective and suitable repair and reinforcement works.

5) To evaluate propriety and quality of design, and construction and material used in the original structure, and to give feedback for future projects.

Inspection works can be divided into three types by their frequencies, namely: daily inspection, periodic inspection and occasional (ad-hoc) inspection. Purpose, frequencies, and inspection items for the project flyovers are detailed in the main report.

Regarding methodology of inspection, visual inspection is fundamental in any maintenance works. For periodic and ad-hoc inspections, detailed inspection works may be carried out in addition to the visual inspection. The purposes of detailed investigation are to identify the damage factors of the structures based on the results of visual inspection and testing, to evaluate the soundness of the structure, and to decide on the necessity of repair and/or reinforcement. Detailed testing can be divided into destructive and non-destructive testing. Document investigation is also important to

obtain basic data about the durability of the structure and the damage progress by investigating as-built drawings and construction work records.

16.2.3 Roads

An objective of inspection is to find damages to the road facilities and take the necessary actions to sustain smooth and safe traffic flows at all times. Inspection is often categorized into the following three kinds. Maintenance works shall be conducted based on the results obtained by these inspections.

(1) Routine Inspection

Routine inspection is undertaken visually from the shoulder or pedestrian way. Accordingly, inspections are confined to those which can be observed from the moving vehicle and/or when walking such as pavement, slopes, drainage, and cracks on concrete surface.

(2) Periodic Inspection

The items to be inspected are similar to the routine inspection but will be inspected more physically and in detail. The methods and locations for the inspection will be determined prior to the completion of the works.

(3) Emergency Inspection

Emergency inspection is mainly conducted after the occurrence of natural disasters such as torrential rains or earthquakes and accidents (road structure/facilities hit by vehicle). The main purpose of emergency inspection is to check the soundness of roads.

16.2.4 Traffic Signal

(1) Traffic Signal Manual

In 2012, Traffic Signal Manual 2012 was prepared by the technical assistance team. This manual consists of the following parts and appendix:

Part-1: Planning Manual
Part-2: Basic Mechanism of Traffic Signal
Part-3: Periodic Maintenance Manual
Appendices (Operation Manual)

As a result of discussions with KCCA, check sheets for signal maintenance were simplified and replaced for easy use and filing on the site.

(2) Maintenance of Traffic Signals

Maintenance of traffic signals should be carried out at specified intervals for each facility that has a

traffic signal. When failures are found by inspections, those facilities should be repaired or changed as soon as possible. Normally, inspection and/or maintenance of traffic signals are carried out for following two systems:

Traffic Signals

- ✓ Inspection of Distribution Board
- ✓ Inspection of Controller
- ✓ Inspection of Traffic Signals
- ✓ Inspection of Signal Poles
- ✓ Inspection of Hand-holes

Power Supply Unit

- ✓ Refueling of the Automatic Engine Generator (AEG)
- ✓ Inspection of AEG
- ✓ Inspection of Automatic Voltage Regulator (AVR)
- ✓ Inspection of Uninterruptible Power System (UPS)

16.3 Necessity of Capacity Building for Bridge Maintenance Technology

As the project flyovers will be the first major urban bridge in Uganda, implementation of the capacity development project on the operation and maintenance of the Project infrastructures especially for the bridges is desirable. The capacity development shall be a technology transfer conducted by overseas specialists during and after the project implementation.

17 Project Evaluation

17.1 Methodology

The following two kinds of economic benefits are estimated quantitatively in this Survey:

- ✓ Savings in Vehicle Operating Cost (VOC)
- ✓ Savings in delay time at intersections/roundabouts improved or with constructed flyovers

Quantification of economic benefits is based on the"With and Without Project" comparison method. The difference between "With Project" and "Without project" is that the project is implemented or not.

17.2 Economic Costs

The economic costs are calculated by removing transfer items such as import duties and taxes from the financial costs (at market prices) so as to convert them into real resource values.

The same treatment is applied to the operation and maintenance (O&M) costs which are necessary after opening the Project to the public.

Shadow Prices

The shadow pricing adjustments to the foreign exchange rate and wage rate are not applied in this Survey. In the Procedural Guide to Economic Road Feasibility Studies by RAFU (2006), it is mentioned that as the market of foreign currency exchange in Uganda is free and has no special controls, the Ugandan shilling is not overvalued with respect to international currencies. At the same time, there are no minimum wage laws or regulations. Therefore, it is judged that neither shadow exchange rate nor shadow wage rate is necessary.

17.3 Economic Benefits

(1) Unit VOC and Unit Travel Time Cost (TTC)

The values of unit VOC (in terms of USD/km/vehicle) and unit Travel Time Cost (TTC: USD/hour/vehicle) in this evaluation were prepared for the following two cases:

- ✓ Unit VOCs and unit TTCs based on the latest data provided by the Guidelines for LCCA Calibration Parameters and Key Assumptions for Long-Term Investment Planning, Version 1.0 (Draft), April 2013, UNRA.
- ✓ Unit VOCs and unit TTCs estimated in the previous study (Pre-F/S) for this flyover project by JICA in 2010.

(2) Application of HDM-4 Model (VOC Module)

In order to the obtain unit VOC (USD/km/vehicle), the HDM-4 (VOC Module) is considered to be the most suitable procedure. It should be noted, however, that the application of the HDM-4 model in this evaluation is limited only to the part of the VOC Module, and not necessary to use other models in HDM-4 such as road deterioration and maintenance effects models.

17.4 Cost-Benefit Analysis

(1) Preconditions for Cost-Benefit Analysis

The preconditions set for the cost-benefit analysis are as follows:

1) Price Level (Base Year) : 2013 prices
2) Opening Year of the Project : January 2019
3) Evaluation Period : 20 years after opening
4) Residual Values : No residual values are counted
5) Opportunity Cost of Capital (Discount Rate) : 12%

(2) Results of Analysis

The results of the economic evaluation for the base case are as follows.

1) Economic Internal Rate of Return (EIRR) = 25.2%
2) Benefit/Cost Ratio (B/C) = 2.34
3) Net Present Value (NPV), in USD million = 192.0

The above results indicate that the Project is economically feasible with a value of EIRR higher than the opportunity cost of capital (>12%), B/C ratio higher than 1.0, and positive value of NPV (>0).

17.5 Sensitivity Analysis

The sensitivity analysis is carried out in order to examine the robustness of economic feasibility by changing the values of cost and benefit within a probable range against the base case. The following cases are prepared for the sensitivity tests:

1) Project costs go up by: +10%, +15%, and +20%
2) Project benefits go down by: -10%, -15%, and -20%
3) Combinations of all the above

The results of the sensitivity analysis, as summarized in Table 17.3.11, show the robustness of economic feasibility of the Project. Even in the worst case, the EIRR value exceeds the opportunity cost of capital (EIRR=19.1% > 12%).

Table S17-2 Results of the Sensitivity Analysis (EIRR)

Sensitivity Analysis		Benefit			
		Base Case	- 10%	- 15%	- 20%
Cost	Base Case	25.2%	23.2%	22.2%	21.2%
	+ 10%	23.4%	21.5%	20.6%	19.6%
	+ 15%	22.6%	20.8%	19.8%	18.9%
	+ 20%	21.9%	20.1%	19.2%	18.2%

Source: JICA Survey Team

17.6 Qualitative Evaluation

(1) Contribution to Urban/Regional Socioeconomic Development

The urban road network is one of the essential facilities to support socioeconomic activities and the daily lives of residents by providing necessary access to economic/business opportunities in the CBD and industrial areas. The present traffic conditions in Kampala, however, are very severe, i.e. chronic congestion occurs at peak hours every day. If the present conditions are left without taking any countermeasures, the potential for sustainable economic development would be reduced. As GKMA is an engine of Uganda, the present traffic situation would result in stagnation of the economy not only in GKMA but also the national economy.

Under this circumstance, the Project will mitigate the daily traffic congestion and eliminate bottleneck points at major intersections with minimum land acquisition because road widening in populated urban areas is very difficult. The improved road network as a result of this Project and integration with the BRT system would contribute to the socioeconomic development of Uganda through provision of basic infrastructure in GKMA.

(2) Support of Daily Life Safety

It is occasionally observed that an ambulance sounding a siren stopped at an intersection/roundabout in a long queue. In order to transport a seriously injured patient to qualified health facilities quickly and smoothly, a reliable urban road network is essential. The case of fire engines is also in the same situation. The Fire Brigade Headquarters is located between the Shoprite and Clock Tower Junction. Therefore, the Project will contribute to daily urban safety by securing access to medical facilities and to the sites of accidents.

(3) Traffic Safety for Pedestrians at Shoprite and Clock Tower Junction

According to the results of the pedestrian survey at Shoprite and Clock Tower junctions conducted in the JICA study in 2010, pedestrian traffic were at 1,040 persons per hour and 2,600 persons in the morning and afternoon peak hours, respectively. These traffic volumes have been increased by 2.2 times and 4.4 times, respectively, as compared in 2009. Regarding pedestrian accidents in this area, about 1.2 persons are injured every week. The risk of pedestrian traffic accidents would increase if no measures are taken.

After the construction of pedestrian bridges proposed in this Project, all pedestrians will have to use the bridges, which would therefore avoid the possibility of pedestrian accidents. At the same time, considerations for handicapped or elderly users are also required, such as the provision of gentle slopes.

18 Conclusions and Recommendations

18.1 Conclusions

- As a result of the project evaluation, the economic evaluation indicators show relatively high values, viz.: EIRR = 25.2%, B/C Ratio = 2.34, and NPV = USD 192.0 million. Sensitivity analysis shows that even the worst case, when the cost increases by 20% and benefit is reduced by 20%, will still attain an EIRR of 18.2%. Accordingly, the JICA Survey Team states that the Project is very feasible.
- At present, it takes 16 to 29 minutes to travel from the Clock Tower Junction to Africana Roundabout and vice versa, and in case of severe traffic congestion, the travel time sometimes requires one hour or more. After completion of the Project, the travel time from the Clock Tower Junction to Africana Roundabout will be about five minutes.

- From the future traffic demand forecast by the JICA Survey Team, traffic volumes going through the Clock Tower Flyover were estimated at 33,200 pcu/day and 49,300 pcu/day and through the Kitgum House Flyover at 33,300 pcu/day and 44,100 pcu/day in 2023 and 2033, respectively. Meanwhile, traffic volumes through the branch-way connecting Mukwano Road and Yusuf Lule Road were 16,900 pcu/day and 20,900 pcu/day also in 2023 and 2033, respectively.

- The Project consists of three packages, viz.: Package-1, which includes the Clock Tower Flyover construction, widening of existing road between Clock Tower Junction and Shoprite Junction, and two pedestrian bridge construction at Clock Tower Junction and Shoprite Junction; Package-2, which includes the widening of Mukwano Road and Nsambya Road, Nsambya Underpass construction, construction of new signalized Kibuli Junction, and widening of Gaba Road along with signalization of Nsambya Hospital Junction; and Package-3, which includes the construction of Kitgum House Flyover and branch-way connecting Mukwano Road and Yusuf Lule Road, widening of Jinja Road and Access Road along with the improvement of Mukwano Roundabout to signalized junction, and widening of Yusuf Lule Road along with the improvement of Garden City Roundabout to signalized junction.

- The construction period is scheduled for 27 months followed by the defects liability period of 12 months. Before the construction starts, a construction contractor will be procured through ICB on the basis of traditional contract with the client's design through a contract with a design and supervision consultant.

- As the project site is located in the national capital of Kampala City where population and socioeconomic activities of Uganda are concentrated, it is considered in the Survey that the construction works should be carried out using safe construction methods and safe traffic management to provide mitigation measures against negative environmental impacts.

- New technologies of steel bridge construction are to be employed in the construction of flyovers and pedestrian bridges. It is expected that such technologies to be newly introduced to Kampala City can facilitate the effective development of infrastructures in GKMA.

- Design life of flyovers is expected at 100 years on the condition that appropriate maintenance works will be done by the Ugandan side. As both UNRA and KCCA have limited experience in maintenance works of steel girders and pre-stressed concrete girders, a capacity building program for maintenance works of steel girders and pre-stressed concrete girders is very important and technical assistance for capacity building is urgently needed.

18.2 Recommendations

- This project, by itself, cannot solve the future traffic congestion problem. Road capacity of Kampala will need to keep improving in order to accommodate the ever-increasing traffic demand.
- Flyover constructions at Jinja-Lugogo Junction, Fairway Roundabout, Murago Junction, Wandegeya Junction, and Buwaize Junction can be the next targets as recommended in the Pre-F/S.
- Widening of Queen's Way and improvement of Kibuye Roundabout are necessary for the effective use of the Clock Tower Flyover.
- Implementation of the BRT maximizes the project's effectiveness.
- Since it is predicted that Kampala will be a city as large as Johannesburg in the next 20 years, large transport infrastructure such as mass transit system and/or intra-urban expressway will be necessary.
- The owner of the Project will need to have an adequate maintenance capacity. Since the flyover structures will be the first major steel bridges in the country, appropriate capacity building should be made and adequate budget should be allocated.
- Further discussion on the relocation of Clock Tower shall be continued in a detailed design stage.