SUMMARY OF THE STUDY

PART B: FEASIBILITY STUDY

8. INTRODUCTION

As the result of the Master Plan Study (Part A of the Study), high priority projects to be implemented in the short term plan were selected.

The high priority projects selected in the Master Plan Study consists of two (2) types of projects; namely, (A) Improvement of bottleneck points in urban traffic and (B) Improvement of road sections as the linehaul of the urban traffic as described below:

Project descriptions for the Feasibility Study are as follows:

(Bottleneck Junction Improvement)

- Natete Junction Improvement

  To convert the existing roundabout to a signal controlled one with enlarged traffic capacity and safety measures.

- Makerere Junction Improvement

  To increase the traffic capacity of the junction via improvement of the existing roundabout with the provision of safety measures.

- Kibuye Junction Improvement

  To increase the traffic capacity of the junction via improvement of the existing roundabout with the provision of safety measures.

- Port Bell /Jinja Road Junction Improvement

  To convert the existing junction to a signal controlled one with enlarged capacity and improved safety measures.

- Wandegeya Junction Improvement

  To convert the existing rotary junction to a signal controlled one with enlarged traffic capacity and improved safety measures.

- Jinja Road Junction Improvement

  To increase the traffic capacity of the junction via improvement of the existing roundabout and improved safety measures.

(Road Section Improvement)

- Natete Road Improvement (L = 3.8 Km)

  Overlay of surface pavement on road section of 3.8 Km and uniform widening of carriage way to 7.0m, reconstruction of shoulder, side ditch and sidewalk, and raising of carriage way at two (2) sections of the road. Total length of the section of raising is 0.4 Km.

- Gaba Road Improvement (L = 9.1 Km)

  Overlay of surface pavement on road section of 9.1 Km, and widening of carriage way to 7.0m. Improvement of shoulder, side ditch and side walk. Raising of carriage way at one section, with length of 0.5 Km.

- Port Bell Road Improvement (L = 4.8 Km)

  Overlay of surface pavement on road section of 4.8 Km, and widening of carriage way to 7.0 m, reconstruction of shoulder, side ditch and side walk.

- Gayaza Road Improvement (L = 4.6 Km)

  Overlay of surface pavement on road section of 4.6 Km. Widening of carriage way to 7.0 m. Improvement of shoulder, side ditch and side walk.

- Hoima Road Improvement (L = 8.5 Km)

  Overlay of surface pavement on road section of 8.5 Km. Widening of carriage way to 7.0 m. Improvement of shoulder, side ditch and side walk. Raising of carriage way at one section, with length of 0.4 Km.

9 DESIGN STANDARD

9.1 General

The design was carried out in consideration of the present right-of-way for the identified roads and junctions. The design standards have been determined based on the MOWTC Road Design Manual considering present speed levels, land-use pattern along the road, characteristics of traffic movement and anticipated future traffic demands.

9.2 Design Standards

The main design elements such as the number of lanes, carriageway width, type and dimension of shoulder/verge, sidewalk, bicycle lane, bus lane, and so on were determined as explained below:

(1) Carriageway

The carriageway width has been determined on the basis of traffic characteristics, traffic volume and their speed and the right-of-way situation. Since each of the captioned roads is expected to function as a trunk road catering for heavy traffic, the lane width has been determined at 3.5 m in principle.

(2) Shoulder

Shoulder is proposed to be located along the whole carriageway and its width was proposed to be 2.0 m in principle, referring to the MOWTC Road Design Manual. However, the width of shoulder between carriageway and raised sidewalk in urban areas is proposed to be 0.5 m.

(3) Sidewalk

The sidewalk is proposed to be provided along the whole section with a width of 2.0 m in principle. Wider sidewalks are necessary where there are many pedestrians and/or where under-ground utilities are being provided. The combined usage of sidewalks by bicycles and pedestrians is recommended to reduce construction costs.

(4) Vertical Clearance

According to the MOWTC Road Design Manual, typical maximum truck heights are 4.2 m. The vertical clearance from the top of the pavement shall be greater or equal to 4.2 m considering the local condition of traffic including additional loading on the top of trucks or buses. With this consideration, it is reasonable to adopt a vertical clearance of 5.0m.

A standard cross section is shown in Fig. 9.1.

9.3 Junctions

The policies of junction design have been set up as below:

- Existing junction type would be maintained as much as possible.
- Capacity analysis of each of the junctions should be carried out using computer software for junction traffic analysis such as OSCADY 3 and/or ARCADY3, which are internationally authorized junction traffic analysis models.
- Bicycle traffic should be separately handled from motorized traffic.
- If any roundabout junction can not accommodate increased future traffic, it is recommended that it be changed into a signalized junction with optimum size and operation methods.

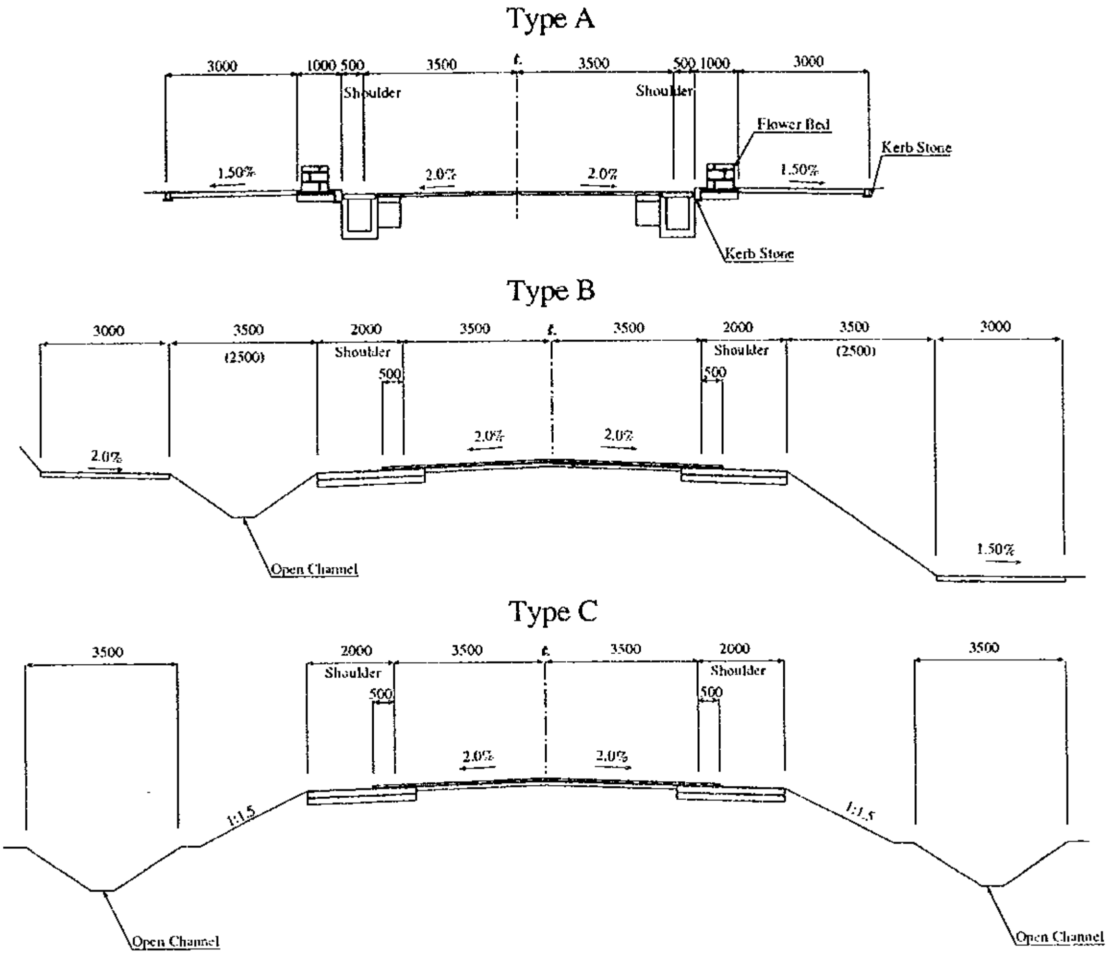


Figure 9.1 Typical Cross Section

10. ENGINEERING SURVEY AND ANALYSIS

10.1 General

The engineering survey was performed to obtain engineering data and information to be used for the preliminary design of the project roads.

The survey consisted of the following:

1) Geological investigation, including subsoil investigations at the bottleneck portions on the proposed roads crossing swamps.

2) Materials investigation, including the subsoil and pavement structure on the proposed roads as well as the investigation of borrow pit areas and quarry sites.

3) Hydrological study and analysis.

4) Topographic survey at intersections and low road sections.

10.2 Geological Investigation

The bore holes for the boring test were drilled at each selected site on Hoima Road, Natete Road, Queens Way and Gaba Road. The drilling depths were 6.0m at the site on Hoima Road and 10m at the other 3 sites. The locations of the investigation sites are shown in Fig. 10.2.

The layers in boreholes were found to be predominantly of clay type, with silty-sandy mixtures of CH class in terms of the unified soil classification system. At the locations of Hoima road and Gaba road, a spread foundation or short end bearing pile is to be considered for the major structures. There seems to be no problem with the embankment foundation. At the location of Natete road, there is no problem with embankment foundations. Should a major structure be proposed, it will be necessary to carry out a more detailed investigation at the stage of detailed design.

10.3 Investigation for Existing Pavement Structure and Base Materials

The test pits were dug to a size of 1.0 m width, 1.0 m length and 1.0 m depth at 45 selected points along the proposed roads and at each point of Kibuye Roundabout and Jinja Roundabout. The locations of the test pits are shown in Fig. 10.1. At each test pit, the pavement layer thicknesses were recorded and the soil profiles were observed.

The existing pavement is generally composed of a lime stabilized gravel base of minimum thickness 100 mm with a double bituminous surface treatment as a wearing course. However, base course in a section of Bombo Road is made of crushed stone base material. Jinja road uses asphalt concrete for the wearing course. The asphalt concrete was 300 mm to 400 mm deep for road sections and was up to 500 mm at Jinja Road Roundabout.

The average thickness of the base and subbase were 186 mm and 180 mm, and the in-situ CBR of the base and subbase were 98% and 58% respectively. The in-situ CBR of the base was rather low.

Investigation for Embankment Material and Aggregates were carried out at following borrow pits and a quarry site are available for the execution of the project.

Borrow Pit (1)	Mbuya, Nakawa-along Port Bell Road
Borrow Pit (2)	Katale, Mayanja-along Entebbe Road
Borrow Pit (3)	Mutundwe, Rubaga-along Masaka Road
Borrow Pit (4)	Nansana, Nansana-along Hoima Road
Borrow Pit (5)	Kikaya, Kawempe-along Gayaza Road
Quarry (1)	Kiwatu, Makindye East-along Gaba Road

Two samples were taken at each site for the laboratory test. The samples were tested in accordance with BS 1377. The types of the test undertaken are as follows:

- Grain Size Analysis
- Specific Gravity Test
- Natural Moisture Content Test
- Atterberg Limit (LL (%), PL (%), PI (%)) Test
- CBR (OMC (%), MDD (t/m^3)) Test
- Modified CBR (4 days soaked (%)) Test

As the results, the Study Team judged that the materials from the supplementary sites investigated are usable for road construction work.

10.4 Hydrological

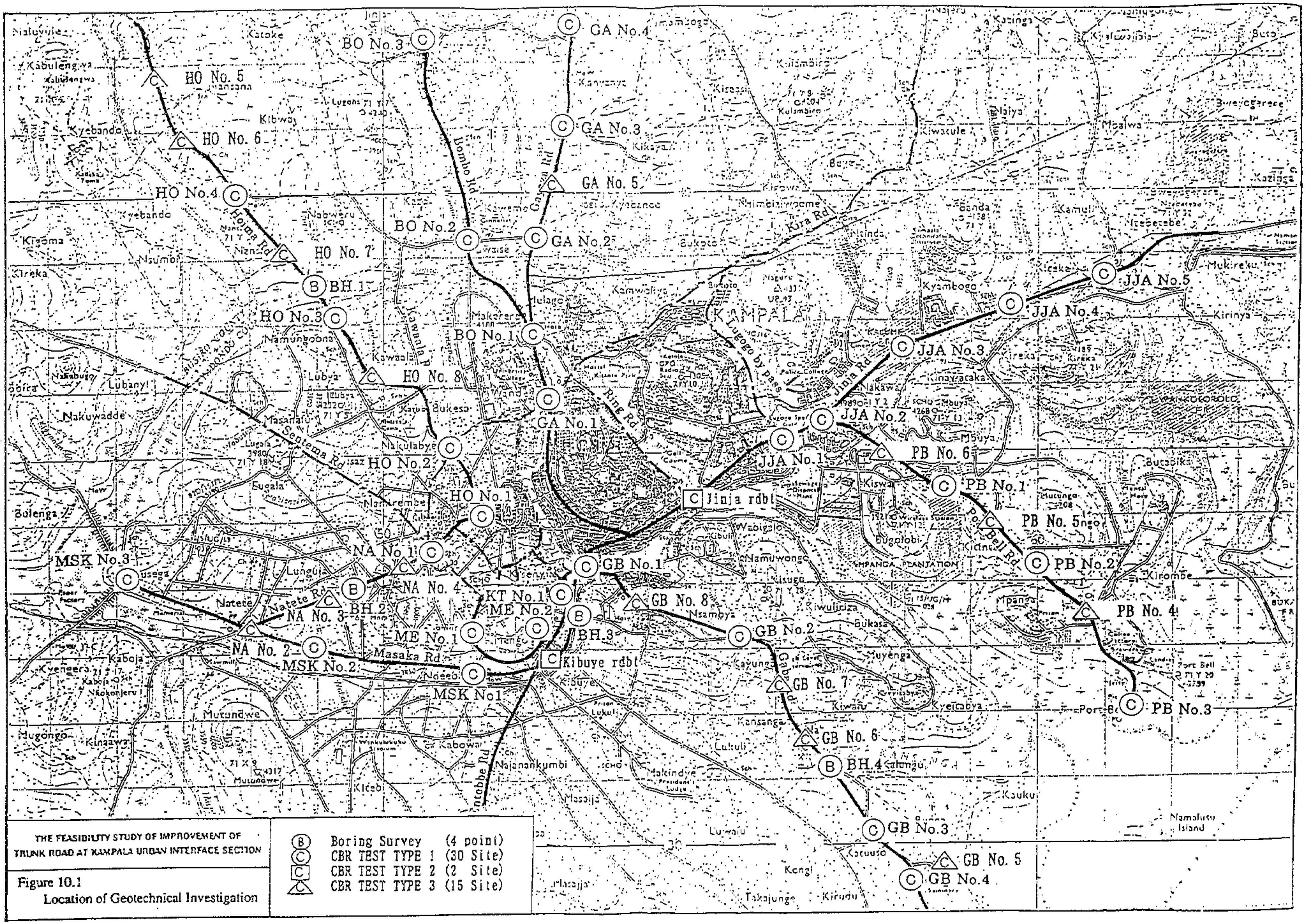
The rainfall data from 1974 to 1996 was obtained from the Meteorological Department. According to this data, annual mean rainfall during the past 22 years is more than 1,100 mm. As most of the flood water from the catchment area drains into Lake Victoria, analysis was focused on the water levels of the lake.

Flood discharge at each point in catchment areas was calculated applying the "Rational" formula. Alignment and required size of the culvert on proposed roads were analyzed. The result of calculation and the recommended size of additional culvert for other proposed roads are shown in Table 10.1.

10.5 Topographical Survey

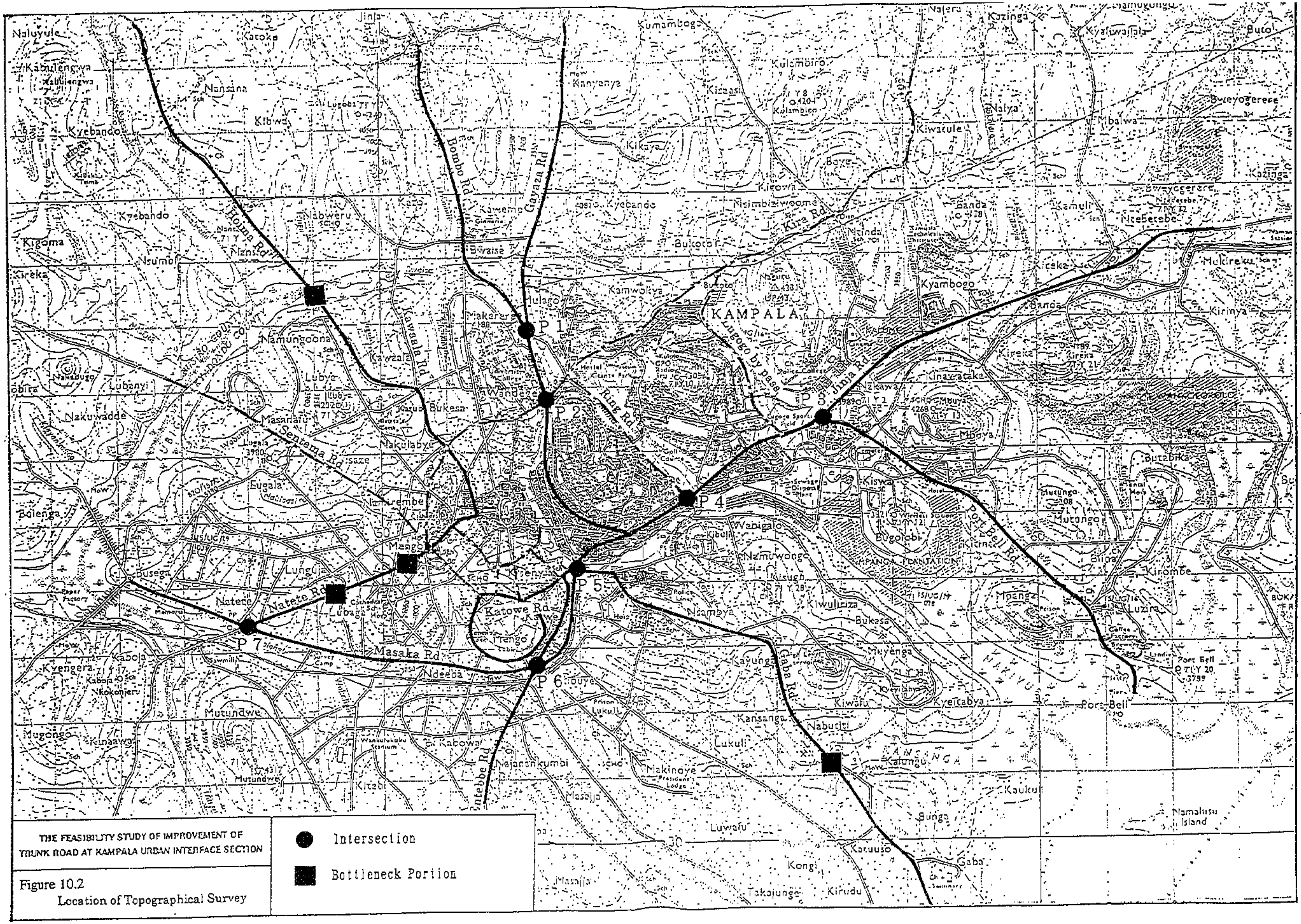
The objective of this survey was to prepare a topographical map to be used for the preliminary design of intersections and road section passing in low areas. The National Control System in Universal Transverse Marcator Zone 36 was transferred from the nearest GPS stations to the newly set up station by using the Modern Sokkia Set 2C Total Station. From the new stations, detailed information on the intersection automatically recorded into the Autocad program using a reflector.

The topographic maps are prepared with a proper scale for designing each intersection and low road section . The topographic maps include the location of the new benchmarks established on the roadside for each intersection and low road sections.



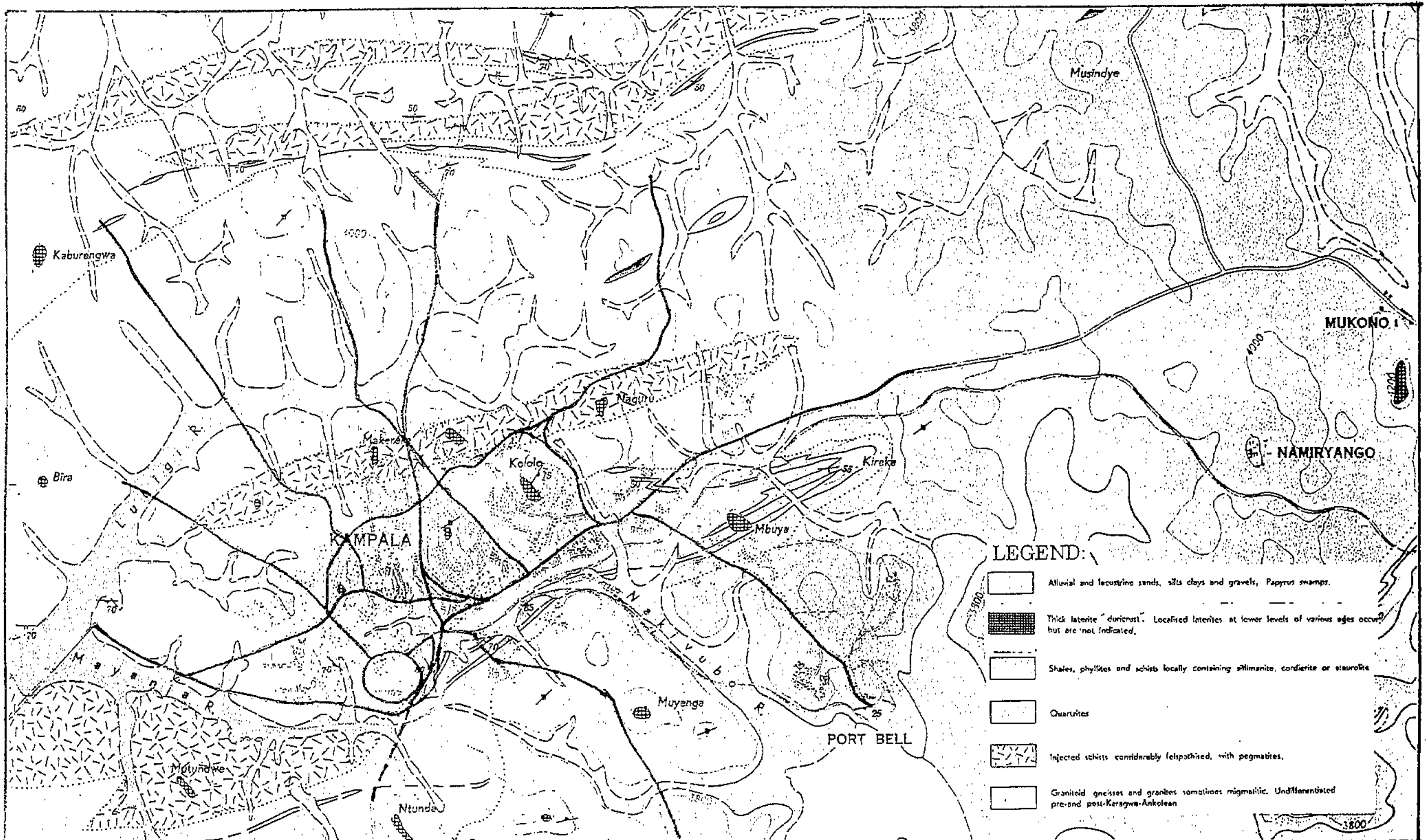
THE FEASIBILITY STUDY OF IMPROVEMENT OF TRUNK ROAD AT KAMPALA URBAN INTERFACE SECTION

Figure 10.1
Location of Geotechnical Investigation



THE FEASIBILITY STUDY OF IMPROVEMENT OF TRUNK ROAD AT KAMPALA URBAN INTERFACE SECTION

Figure 10.2
Location of Topographical Survey



THE FEASIBILITY STUDY OF IMPROVEMENT
OF TRUNK ROAD AT KAMPALA URBAN INTERFACE SECTION

Figure 10.1 General Geological Map in Kampala Area

Table 10.1 Design Discharge and Size of Additional Culvert on Other Proposed Road

Proposed Point	Dischage (m^3/s)	Flow Velocity (m/s)	Size of Existing Culvert	Capacity of Ex. Culvert (m^3/s)	Design Dischage (m^3/s)	Size of Additional Culvert
Mubende	71.39	3.0	φ800×3Vents	4.52	66.87	B.C 2.0m×3.0m×4Vents
Sentema	61.88	3.0	φ800×3Vents	4.52	57.36	B.C 2.0m×2.5m×4Vents
Hawaala	47.83	3.0	φ800×3Vents	4.52	43.31	B.C 2.0m×3.0m×3Vents
Bombo	39.50	3.5	φ800×2Vents	3.52	35.98	B.C 2.0m×3.0m×2Vents
Gayaza (1)	17.99	3.5	φ600×3Vents-3nos	8.90	9.09	B.C 1.2m×1.5m×2Vents
Gayaza (2)	15.25	3.5	φ800×1Vent	1.76	14.75	B.C 1.2m×1.5m×3Vents
Masaka (1)	17.16	3.0	-	-	17.16	B.C 1.2m×1.5m×3Vents
Masaka (2)	26.20	3.0	-	-	26.20	B.C 1.5m×2.0m×3Vents
Masaka (3)	13.29	3.0	-	-	13.29	B.C 1.5m×1.5m×2Vents
Jinja (1)	23.56	3.0	φ800×1Vent	0.85	22.71	B.C 1.5m×2.0m×3Vents
Jinja (2)	4.62	3.0	-	-	4.62	C.S.P.C φ1000×2Vents
Jinja (3)	11.67	3.0	φ800×1Vent	1.50	10.17	B.C 1.2m×1.5m×2Vents
Jinja (4)	6.44	3.0	-	-	6.44	C.S.P.C φ1000×3Vents

11. ENGINEERING DESIGN

11.1 General

On the basis of the data and information obtained through the field surveys, the basic engineering design was carried out using the existing topographical map at a scale of 1/2,500 for the road design. A supplemental topographical map at a scale of 1/500 was prepared by the Study Team for junction design.

The basic engineering design was carried out for the following items of engineering works:

- Road Design
- Junction Design
- Road Drainage Design
- Pavement Design
- Road Facilities Design
- Public Utilities Design

11.2 Road Design

(1) Basic Concept of Road Design

Prior to the execution of the engineering design, the following concepts were introduced:

1) The Project will constitute a basic framework for the urban road network in Kampala, so the geometric design including the alignment should meet the requirement of the expected function as an arterial road.

2) The Project should be designed paying due attention to the characteristics of the traffic components and locality of Kampala where rate of traffic accidents is extremely high due mainly to mixture of vehicles, pedestrians and bicycles.

3) Widening of the existing road should be executed inside the present right-of-way strip in principle to avert the removal and relocation of houses.

4) Road related facilities including the road drainage and sidewalks should be provided, since most of these facilities have been neglected in the past, which has resulted in the present chaos in urban traffic in Kampala.

5) Public utilities including water mains, sewerage, telephone cables, electric wires/poles, etc., that are located inside the right-of-way strip should be thoroughly investigated. Relocation and/or protection of these utilities should be executed at minimum level and in an efficient manner taking into consideration the maintenance work afterward.

6) Since bus services including matatu are the main means of public transport in Kampala, road design should be carried out taking their operation into consideration.

7) Intersection design should be carried out taking the prospect of road development in Kampala into account with the recognition that intersections are parts of the roads. Characteristics of traffic and future traffic volume of each arm of the intersections have also to be carefully examined.

(2) Geometric Design Standards

Geometric design standards to be applied for each road project are shown in Table 11.1.

Table 11.1 Geometric Design Standards

	Natete Road	Gaba Road	Port Bell Road	Gayaza Road	Hoima Road
Category	A	A	A	A	A
Design speed(km/hr)	60 - 40	60 - 40	60 - 40	60 - 40	60 - 40
Lane width(m)	3.5	3.5	3.5	3.5	3.5
Carriageway width(m)	2 x 3.5=7.0	2 x 3.5=7.0	2 x 3.5=7.0	2 x 3.5=7.0	2 x 3.5=7.0
Shoulder width(m)	0.5-2.0 m	0.5-2.0 m	0.5-2.0 m	0.5-2.0 m	0.5-2.0 m
Buffer zone width(m)	1.0-3.0 m	1.0-3.0 m	1.0-3.0 m	1.0-3.0 m	1.0-3.0 m
Sidewalk width(m)	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m
Cycle lane width(m)	2.0 m	2.0 m	2.0 m	2.0 m	2.0 m
Cross fall(%)	2.0 %	2.0%	2.0%	2.0 %	2.0 %

(3) Traffic Capacity of the Project Roads

Traffic capacity of the proposed roads are analyzed by referring to the Highway Capacity Manual (USA) and the Road Capacity Manual (Japan Road Association).

Traffic capacity of the proposed roads are calculated applying the following traffic elements:

1) The capacity of two-lane roads under ideal conditions: 2,800 pcu
2) Width of lane
3) Lateral clearance
4) Heavy vehicle proportion
5) Motorcycle proportion
6) Directional factor
7) Volume/Capacity Ratio

Table 11.2 and Table 11.3 show traffic characteristics and the design capacity of the proposed road in 2005.

Table 11.2 Traffic Characteristic on the Project Roads (2005)

Road Name	Natete	Gaba	Port Bell	Gayaza	Hoima
Basic Capacity (pcu/hr)	2,800	2,800	2,800	2,800	2,800
Volume/Capacity Ratio	1.0	1.0	1.0	1.0	1.0
Width of Lane (m)	3.5	3.5	3.5	3.5	3.5
Lateral Clearance (m)	≥ 0.75	≥0.75	≥0.75	≥0.75	≥0.75
Heavy Vehicle Ratio (%):T	7.3	5.1	4.6	5.1	6.3
Passenger Car Equiv.	2.0	2.0	2.0	2.0	2.0
Motorcycle Ratio (%):PM	3.3	0.5	3.0	0.5	4.1
Passenger Car Equiv.	0.5	0.5	0.5	0.5	0.5
ADT in 2005	23,835	26,066	13,313	26,066	18,404

Table 11.3 Analysis of Proposed Road Capacity (2005)

Road Name	Natete	Gaba	Port Bell	Gayaza	Hoima
Width of Lane	1.0	1.0	1.0	1.0	1.0
Lateral Clearance	1.0	1.0	1.0	1.0	1.0
Heavy Vehicle	0.93	0.95	0.96	0.95	0.94
Motorcycle	0.98	1.00	0.99	0.97	0.98
Directional Factor	1	1	1	1	1
Design Capacity	2,567	2,657	2,637	2,592	2,581
ADT in 2005	23,835	26,066	13,313	25,567	18,404
Design Hour Factor	0.1	0.1	0.1	0.1	0.1
Design Hour Volume (DHV)	2,384	2,557	1,840	2,607	1,331

(4) Typical Cross Section

1) Basic Concept

Typical cross sections to be adopted for the project roads were designed based on the following concepts:

- Sufficient carriageway width to accommodate increasing traffic,
- Segregation of vehicles from pedestrians and non- motorized vehicles,
- Protection of roadside environment and enhancement of roadside amenity,
- Consideration of available right-of-ways depending on the location of the individual roads, and
- Provision of drainage system to prevent rapid deterioration of road surface.

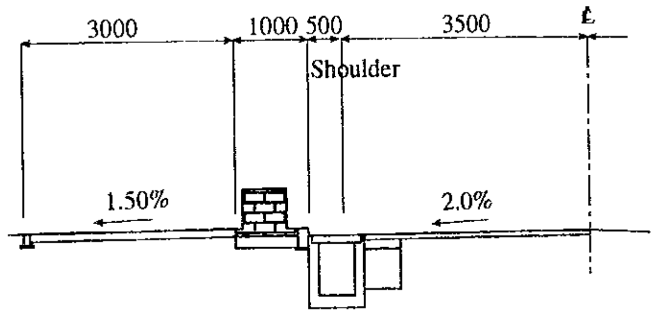
Components for road cross section including carriageway shoulder, sidewalk and median width have been designed for each project road.

2) Lane width of 3.5 m is adopted referring to the Japan's Road Standard and British Standard for all the project roads.

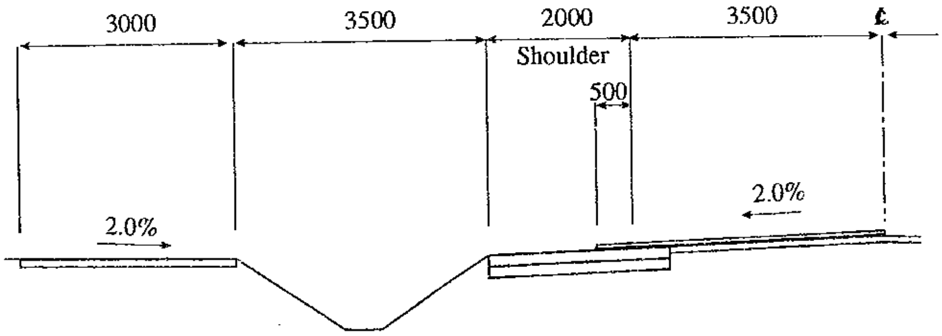
3) Shoulder

Two types of shoulder have been designed taking into account the right-of-way width constraint. Along the road sections located in urban areas where rights-of-way are relatively narrow compared with those in suburban areas, shoulder width of 0.5 m has been adopted, whilst in suburban areas shoulder width of 2.0 m has been adopted. Shoulder designs by type are illustrated as below:

- Shoulder width 0.5 m



- Shoulder width 2.0 m



4) Side walks

A sidewalk of 3.0 m width has been adopted for the passage of pedestrians and bicycles.

5) Buffer zone

Two types of buffer zone with planted trees have been proposed taking land use along the roadside into consideration:

<u>3.0 m Wide buffer Zone</u>
This type of buffer zone has been adopted for the roads located mainly in suburban areas.

<u>1.0 m wide buffer zone</u>
This type of buffer zone has been adopted along the road sections located in urban areas.

11.3 Intersection Design

(1) Observed Turning Counts

Classified turning counts were carried out at each of the six existing junctions. The counts were carried out at two peak periods (7:30 - 9:30, 16:30 - 18:30) of week days and number of vehicles by six (6) vehicle types were counted. The survey results are shown in Fig. 11.1 where the turning movement at each junction is shown by peak hour period.

(2) Analysis of Junction Designs

The new junction designs were carried out applying UK Transport Research Laboratory computer programs OSCADY3 for signalized junctions and ARCADY3 for roundabouts. The junction delays simulated in the morning and evening peak hours of traffic are shown in Table 11.4.

Table 11.4 Junction Delays

	Peak Hour (each 2 hours)	Queuing Delay (vehicle-minutes)	Geometric Delay (vehicle-minutes)
Natete	AM	4,346 (9,871)	248 (691)
	PM	4,008 (5,200)	265 (668)
Makerere	AM	28,015 (171,550)	1,208 (1,508)
	PM	13,756 (60,735)	1,248 (1,513)
Kibuye	AM	75,314 (521,983)	2,034 (2,362)
	PM	133,217 (658,637)	2,302 (2,658)
Port Bell/Jinja Road	AM	27,983 (231,360)	631 (631)
	PM	17,036 (196,320)	599 (599)
Wandegeya	AM	306,244 (800,925)	1,115 (2,196)
	PM	296,344 (495,120)	1,196 (2,116)
Jinja Road	AM	688,795 (1,268,656)	3,849 (2,946)
	PM	534,145 (1,299,067)	3,840 (2,939)

( ) - without improvement case.

The proposed junction designs are shown in Fig. 11.2.

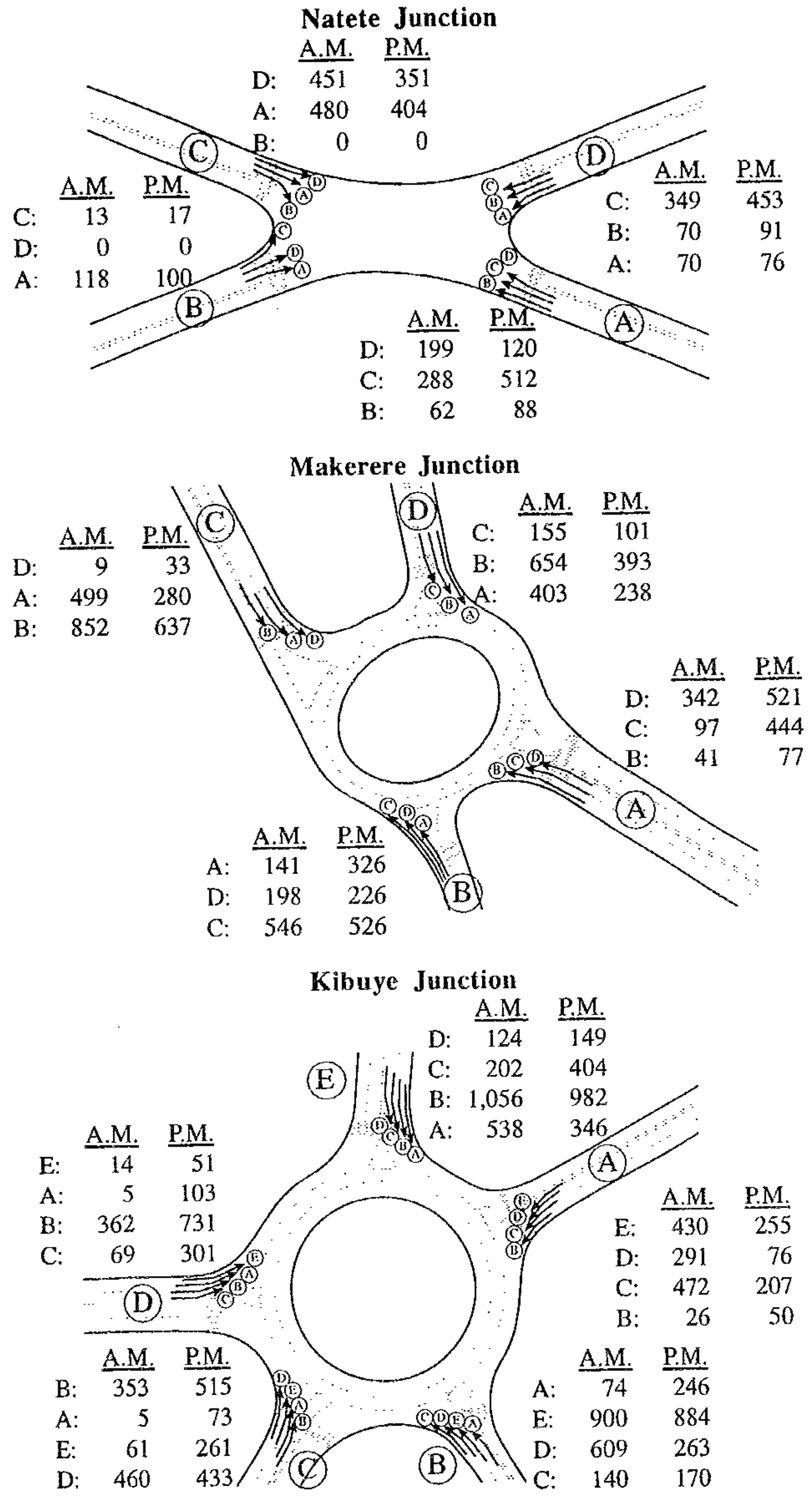


Figure 11.1 Observed Turning Movement in 1997 - 1

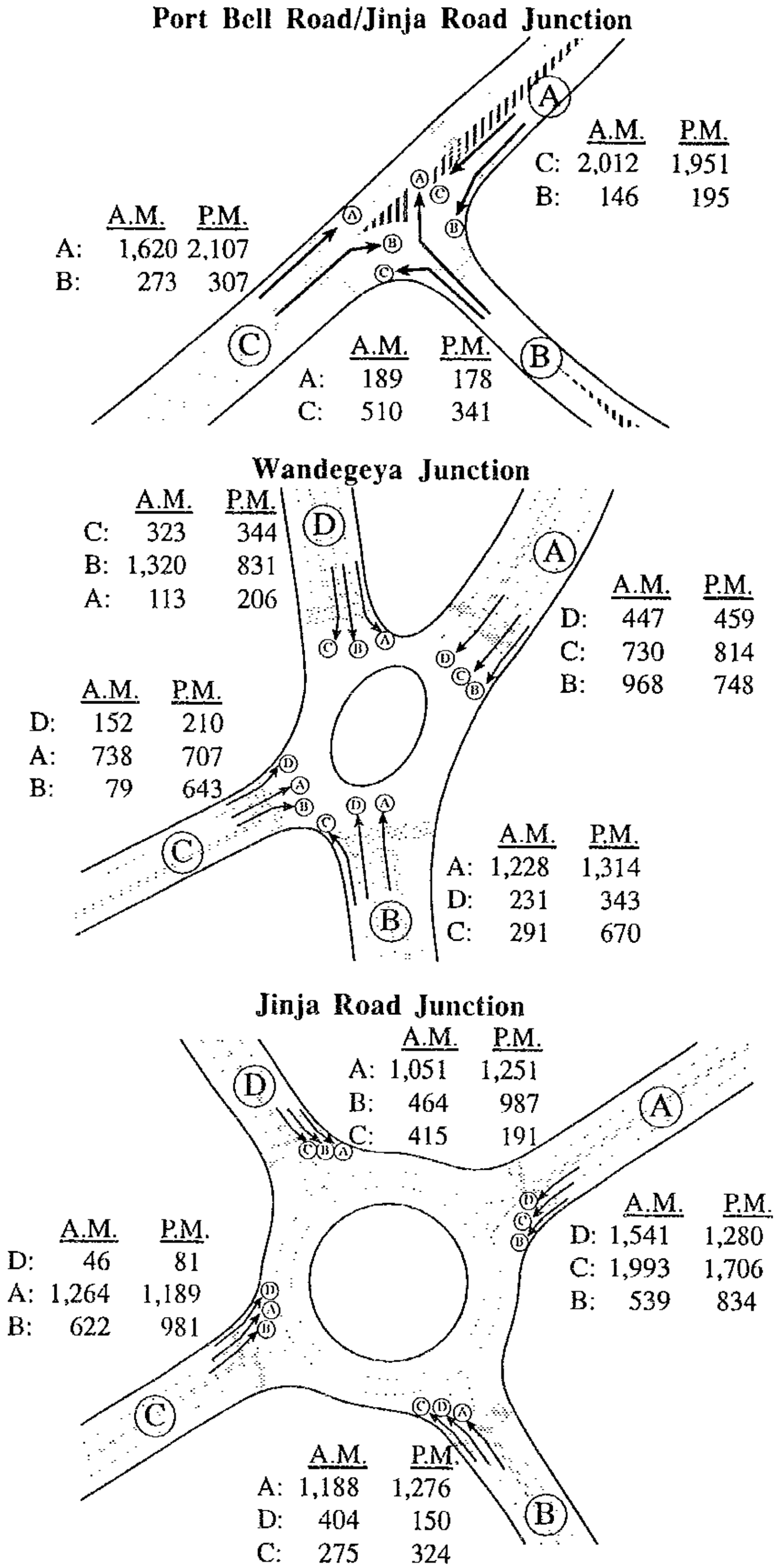
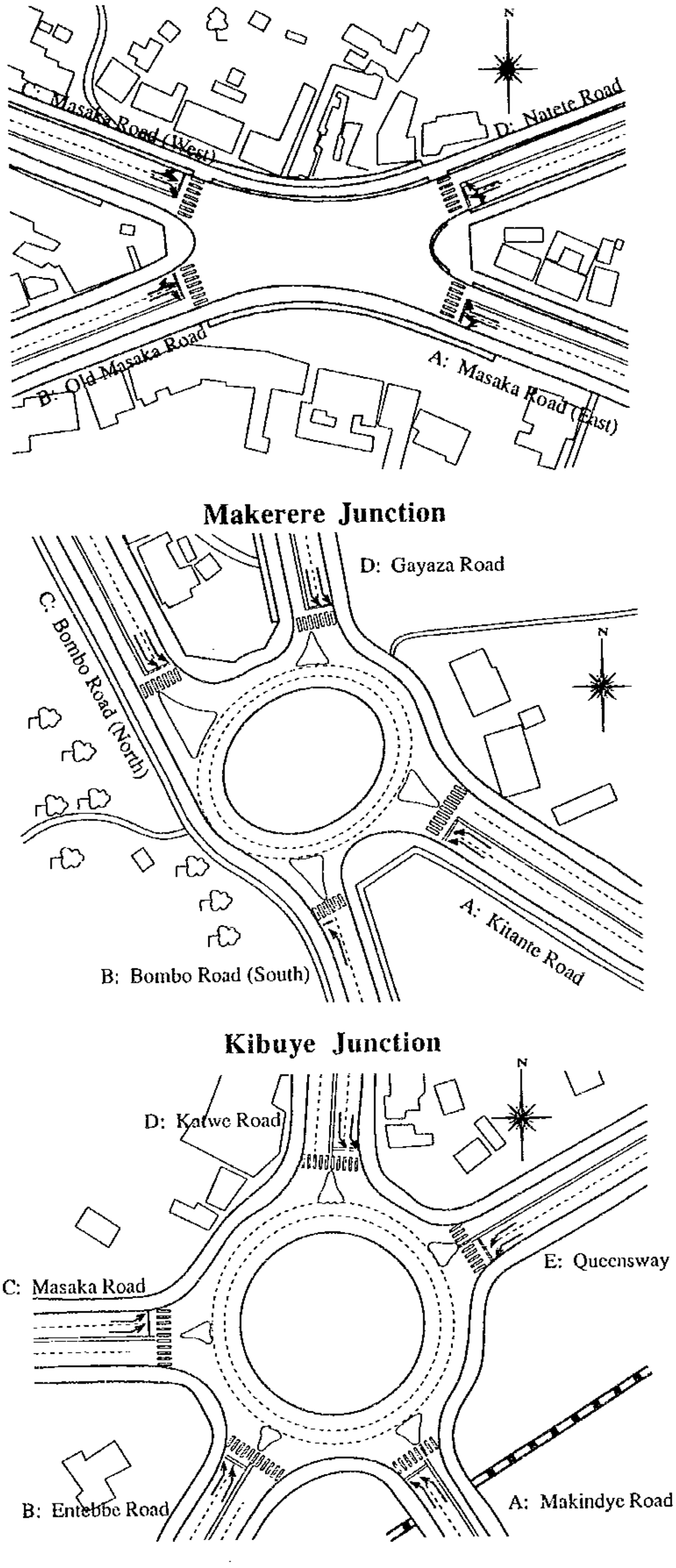


Figure 11.1 Observed Turning Movement in 1997 (AM) - 2

Natete Junction

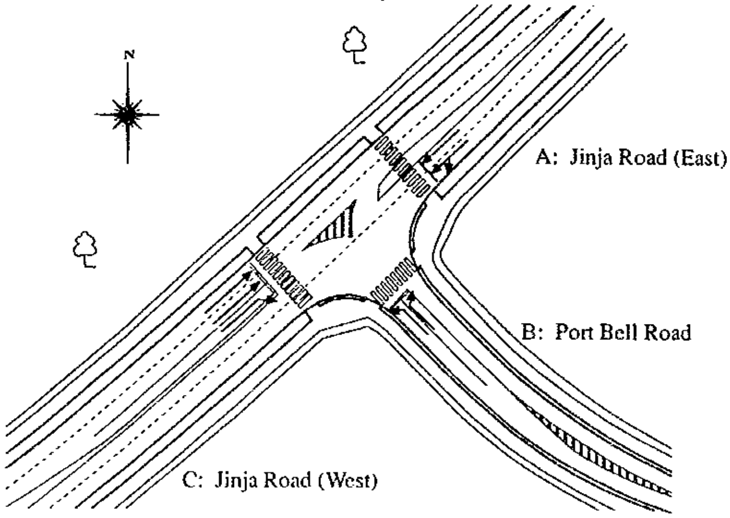


Makerere Junction

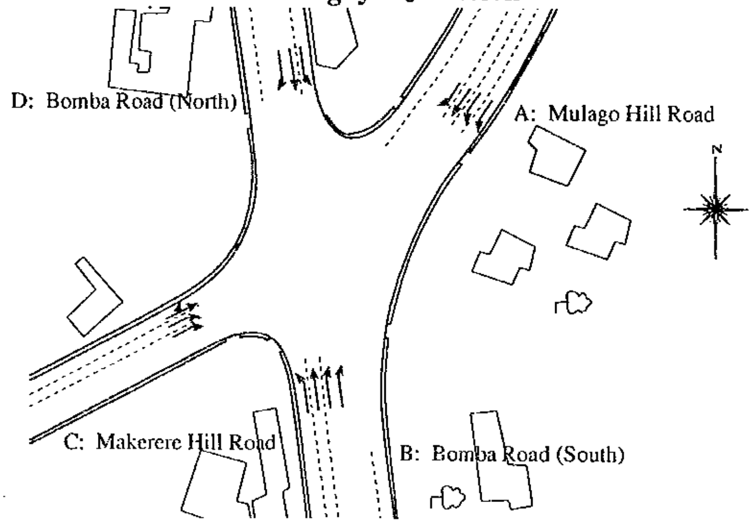
Kibuye Junction

Figure 11.2 (1) Intersection Design

Port Bell Road/Jinja Road Junction



Wandegeya Junction



Jinja Road Junction

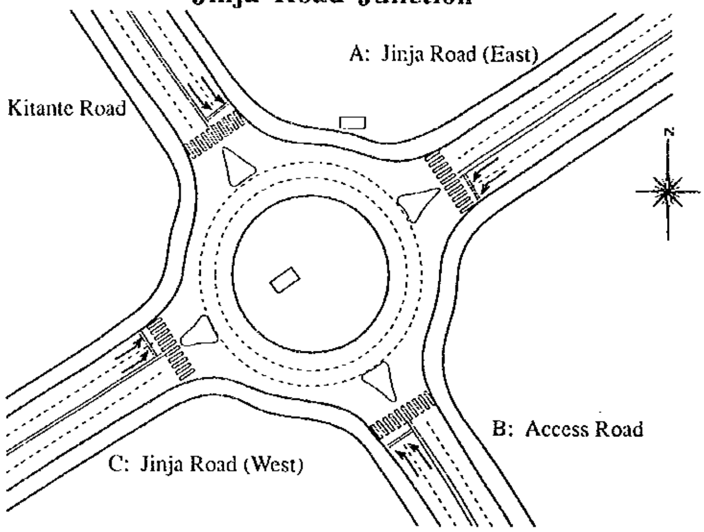


Figure 11.2 (2) Intersection Design

11.4 Drainage Design

Culverts:

- The minimum dimension for pipe culverts shall be 600 mm for ease of maintenance.
- Pipe culverts shall be designed using concrete head walls, wing walls, protective aprons and toes.

Ditches:

- Roadside ditches should be covered with grouted rip-rap to prevent erosion of road structures and cut slopes.
- The minimum dimension of roadside ditches should be 2.5 m x 1.0 m (upper width x height).

11.5 Pavement Design

(1) Thickness Design

The preliminary thickness design of flexible pavement was carried out in accordance with the "Manual for Asphalt Pavement, 1996" published by the Japan Road Association.

Classification of Roads in terms of Traffic
The one way daily traffic volume of heavy vehicles in the 10th year after opening the road to public was forecast to classify the road characteristics in accordance with Asphalt Pavement Manual by Japan Road Association as shown in Table 11.5.

Table 11.5 Traffic Classification for Pavement Design

Road Classification	Traffic Volume of Heavy Vehicles (One way)
L	Less than 100
A	100 to 250
B	250 to 1,000
C	1,000 to 3,000
D	more than 3,000

Source: Asphalt Pavement Manual, Japan Road Association

The summary of estimated traffic volume by road section and corresponding traffic classification are presented in Table 11.6.

Table 11.6 Forecast Traffic Volume and Traffic Classification

Road Section	Traffic Volume of Heavy Vehicles in 2010 (One way)	Corresponding Road Classification
Natete Road	380	B
Gaba Road	480	B
Port Bell Road	240	A
Gayaza	510	B
Hoima Road	220	A

Heavy vehicles refers to buses, trucks and special vehicles.

Design CBR Value

The design CBR values are shown in Table 11.7.

Table 11.7 Design CBR of Project Roads

Proposed Roads	Station	CBR of Subgrade
Natete Road	No. 0+000 ~ No. 3+700	12.0%
	No. 3+700 ~ No. 4+000	4.0%
Gaba Road	No. 0+000 ~ No. 1+700	12.0%
	No. 1+700 ~ No. 2+700	6.0%
	No. 2+700 ~ No. 11+000	20.0%
Port Bell Road	No. 0+000 ~ No. 1+750	12.0%
	No. 1+750 ~ No. 2+700	6.0%
	No. 2+700 ~ No. 3+500	20.0%
	No. 3+500 ~ No. 4+000	6.0%
	No. 4+000 ~ No. 5+000	20.0%
	No. 5+000 ~ No. 6+500	4.0%
Gayaza/Bombo Road	No. 0+000 ~ No. 1+800	2.0%
	No. 1+800 ~ No. 4+300	6.0%
	No. 4+300 ~ No. 5+300	20.0%
	No. 5+300 ~ No. 5+900	8.0%
Hoima Road	No. 0+000 ~ No. 0+700	6.0%
	No. 0+700 ~ No. 5+300	12.0%
	No. 5+300 ~ No. 8+500	20.0%
Natete junction		4.0%
Makerere Junction		2.0%
Kibuye Junction		4.0%
Port Bell/Jinja Road Junction		12.0%
Wandegeya Junction		2.0%
Jinja Road Junction		4.0%

Pavement Thickness Design

The target values of thickness design were determined according to a formula developed by the Japan Road Development Association in June 1996 as shown in Table 11.8.

Table 11.8 Target Values of T_A

	T_A Values by traffic Classification				
Design CBR	Class L	Class A	Class B	Class C	Class D
2%	17	21	29	39	51
3%	15	19	26	35	45
4%	14	18	24	32	41
6%	12	16	21	28	37
8%	11	14	19	26	34
12%	11	13	17	23	30
20% or more	11	13	17	20	26

Note: T_A represents the pavement thickness which would be required if the entire depth of the pavement were to be constructed of hot-mixed asphalt concrete for binder and surface courses.

Thickness Design of Pavement Structure

Prototypes of pavement structures for the project roads were designed as shown in Fig. 11.3 and Table 11.9.

Table 11.9 Pavement Design for Project Roads

Proposed Roads	Road Classification	Station	CBR of Subgrade	TA	Pavement Type
Natete Road	B	No. 0+000 ~ No. 3+700	12.0%	17 cm	Re-8
	B	No. 3+700 ~ No. 4+000	4.0%	24 cm	Re-5
Gaba Road	B	No. 0+000 ~ No. 1+700	12.0%	17 cm	Re-8
	B	No. 1+700 ~ No. 2+700	6.0%	21 cm	Re-6
	B	No. 2+700 ~ No. 11+000	20.0%	17 cm	Re-8
Port Bell Road	A	No. 0+000 ~ No. 1+750	12.0%	13 cm	Re-3
	A	No. 1+750 ~ No. 2+700	6.0%	16 cm	Re-2
	A	No. 2+700 ~ No. 3+500	20.0%	13 cm	Re-3
	A	No. 3+500 ~ No. 4+000	6.0%	16 cm	Re-2
	A	No. 4+000 ~ No. 5+000	20.0%	13 cm	Re-3
	A	No. 5+000 ~ No. 6+500	4.0%	18 cm	Re-1
Gayaza/Bombo Road	B	No. 0+000 ~ No. 1+800	2.0%	29 cm	Re-4
	B	No. 1+800 ~ No. 4+300	6.0%	21 cm	Re-6
	B	No. 4+300 ~ No. 5+300	20.0%	17 cm	Re-8
	B	No. 5+300 ~ No. 5+900	8.0%	19 cm	Re-7
Hoima Road	A	No. 0+000 ~ No. 0+700	6.0%	16 cm	Re-2
	A	No. 0+700 ~ No. 5+300	12.0%	13 cm	Re-3
	A	No. 5+300 ~ No. 8+500	20.0%	13 cm	Re-3
Natete junction			4.0%	24 cm	Re-5
Makerere Junction			2.0%	29 cm	Re-4
Kibuye Junction			4.0%	24 cm	Re-5
Port Bell/Jinja Road Junction			12.0%	13 cm	Re-3
Wandegeya Junction			2.0%	29 cm	Re-4
Jinja Road Junction			4.0%	24 cm	Re-5

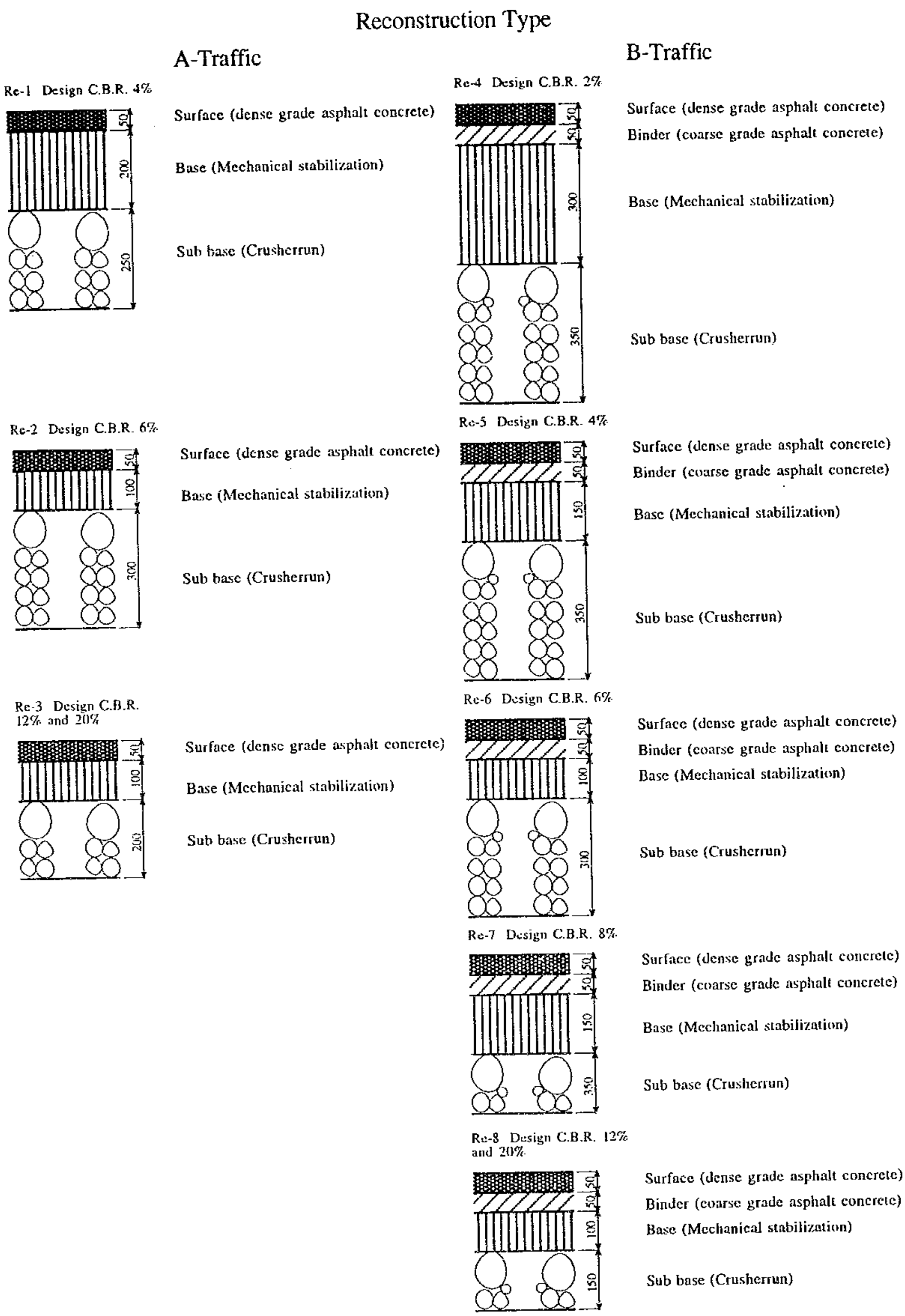


Figure 11.3 Type of Pavement (1)

11.6 Road Facility Design

Utilities Space for Public Services

Public service utilities, either underground or overhead are proposed to be set aside under the side walks.

- Water mains and distribution pipes
- Electric power ducts
- Telecommunication lines

Bus Bays

Bus bays consist of a stopping bay tapered at both ends. A stopping bay 15.0 m long and 3.0 m wide was proposed so as to accommodate a large bus. A 20 m long taper would reduce the mixture of traffic on the through lanes.

Pedestrian Crossing

Pedestrian crossings are recommended to be provided at appropriate intervals so as to reduce traffic accidents during the crossing of roads by pedestrians and to streamline the traffic flow.

Guard Rails

Guard rails are proposed to be installed at busy intersections

Traffic Signal

Traffic signals were proposed to be installed at some of the intersections. Detailed elements considered in the study of traffic signals are as follows:

- Signal type,
- Signal equipment, and
- Signal control system.

A traffic signal should be installed on overhanging, tapered poles with an arm at a height of 6 m so as to be clearly seen from far away.

Flower Bed

It is recommended to introduce flower beds at the boundary of the carriage way and the pedestrian way . These flower beds would not only reduce project costs, but would enhance the aesthetic value of the road environment.

12. CONSTRUCTION PLAN AND COST ESTIMATE

12.1 Basic Stance for Construction Plan

Basic stance for construction plan was set up in following points:

- Cooperation with Ugandan side.
- Maximum utilization of local materials and equipment.

12.2 Site Condition

(1) Availability of Natural Materials Sources

As a result of the field survey, the following material sources were identified available for producing concrete and pavement aggregate:

Materials	Material Sources (Borrow Pits and Quarry Sites)
Soil	Mutundwe, Lubuya (Natete Road)
	Mbuya (Port Bell Road)
	Lubuya (Hoima Road)
	Kikaya, Kawempe, Jinja (Gayaza Road)
Crushed Stone	Kiwatu
Sand	Butto, Kitubulu (Kampala City) Kisambi (Entebbe City)

(2) Availability of Local Plant and Equipment

Most of the construction equipment is available on a rental basis in Kampala. Major equipment available in Kampala is as follows:

- Dump Truck (2 - 11 ton)
- Bulldozer (15 - 32 ton)
- Macadam Roller (10 ton)
- Tyre Roller (8 ton)
- Motor Grader (3.1 m)
- Asphalt Plant (30 t/hr, 110 kW)
- Concrete Plant (0.5 m^3/h, 7.5 kW)

(3) Possibility of Land Acquisition and Demolition/Relocation of Buildings

There is no problem of additional land acquisition and demolition of buildings/housings for the following two (2) reasons: For one thing, the right-of-ways in the project site are fully provided, and secondly, the designing of the project facilities was carried out taking into account the site condition constraints as discussed in Chapter 11.

12.3 Prerequisite of Project Cost Estimate

(1) Components of the Project Cost

- Construction cost,
- Engineering cost including detailed design and construction supervision,
- Physical contingency,
- Relocation costs for existing utility, and
- Government administration expenses.

(2) Component of the Construction Cost

- Direct construction cost,
- Direct cost for temporary works,
- General cost for temporary works,
- Transportation cost and packaging cost, and
- Site operation and administration cost.

(3) Pre-requisite of Project Cost Estimate

- Imported equipment and materials except for fuel were assumed to be exempt from tax and duties by the Ugandan Government. Fuel, including tax and duties, was estimated in the local currency.

- 20% overhead including profit was included in the unit costs.

- The fee for engineering services was assumed to be 10% of the total construction cost.

- The unit prices of labour, materials and equipment were determined based on the economic condition and market prices of Uganda as of July 1997.

- The exchange rate for the United States Dollar (US$), Japanese Yen and Ugandan Shilling were determined as follows:

  US$1 = ¥120.88 = UShs. 1,042.52
  (UShs. 1.0 = ¥0.1159)
  (Adopted average exchange rates during February 1997 and July 1997)

- The unit prices were divided into a foreign currency portions and a local currency portions as shown below :

  Foreign Currency Components:

  - Imported equipment, materials and supplies,
  - Imported materials in the local market,
  - Wages of expatriate personnel, and
  - Overhead and profit of the foreign contractor and consultant.

  Local Currency Components:

  - Domestic materials and supplies,
  - Wages of local personnel,
  - Indirect local costs including temporary facilities, and
  - Duties and tax.

12.4 Unit Rates

(1) Unit Prices of Materials, Labour and Equipment

Materials

Construction materials to be imported are as follows:

- Materials to be imported from Japan, include traffic signals and street lights.
- The unit price is estimated in terms of CIF at Mombasa Port, Kenya.

The unit prices of the materials estimated are shown in Table 12.1 (a).

Labour

The daily wages include an allowance for overtime. The average daily wages by labour classification are shown in Table 12.1 (b).

Equipment

Some contractors in Uganda have an enough capability for execution of the works and hold minimum level equipment. The unit prices of equipment by specification were estimated as shown in Table 12.1. (c).

(2) Unit Cost of Major Work Items

The unit costs of equipment, materials and labour were estimated as shown in Table 12.2 by work item on the basis of the construction schedule and method, availability of local reports, combination and workability of equipment, and quantities of equipment, materials and labour to be adopted.

12.5 Work Quantities

Work quantities were estimated on the basis of the basic design. A list of major work quantities is shown in Table 12.3.

12.6 Estimated Project Costs

Project costs were estimated as the product of unit cost and work quantities shown in Table 12.3 as shown in Table 12.4, 5. A summary of the project cost by currency component is shown in Table 12.6.

12.7 Maintenance Cost

(1) Routine Maintenance Cost

Taking the present size of expense on road maintenance by Kampala City Council, into consideration, the total routine maintenance cost for the above is estimated at around Ush. 6 million considering inflation until the start year of the project.

(2) Periodic Maintenance Cost

Periodic maintenance work was assumed to be executed throughout the project life with a large scale overlay at a 10 year interval. The cost of periodic maintenance work was estimated at around Ushs. 80 million per km.

12.8 Proposal for Strengthening of Road Maintenance Capability

In parallel with the preparation of road maintenance program on the Project, it is strongly proposed that MOWTC should strengthen , its capability in the following filed of maintenance works:

Technical Aspect

- Special Care for Roadside Drainage Structure
- Improvement of Storm Drainage System

- Planning Function
- Training Facilities
- Training Programmes

Institutional Aspect

- Road administration and financing
- Institutional Strengthening of MOWTC
- Updating/development of MOWTC's management and operating policies, standards and procedures ensuring a commercial approach
- Development of the local construction industry
- Strengthening of the functions of the central materials laboratory

12.9 Traffic Signal System

To maintain the signal system at the improved junctions, the following operational and maintenance work are proposed:

- From the power source (high voltage line) directly supply junctions via a step down facility (low voltage electricity). In the event of an area power outage, junction power supply will be uninterrupted.

- In the event of power outage, install battery back-up system at junction.

- Special equipment such as lift cars for maintenance works at high places should be provided.

- Maintenance crew which consists of mechanical engineers and electric engineers should be organized along with the provision of minimum level of equipment for daily maintenance work.

Table 12.1 (a) Unit Cost of Construction Materials

No.	Material	Unit	¥	US$	Ushs.
1	Aggregate up to 20 mm	ton			19,658
2	Aggregate up to 30 mm	ton			17,094
3	Crusher-run for road sub-base	ton			10,256
4	Crusher-run for coarse aggregate	ton			17,094
5	Selected stones up to 250 mm	ton			12,821
6	Murram or crusher feed	ton			10,000
7	Sand for Base course	ton			15,000
8	Sand for fine aggregate	ton			11,966
9	Deformed bars D = 12mm	kg			532
10	Deformed bars D = 16mm	kg			606
11	Deformed bars D = 20mm	kg			606
12	Round bars D = 10mm	kg			680
13	Cement ordinary	ton			240,000
14	Fuel	Liter			1,050
15	Diesel	Liter			910
16	Asphalt emulsion, MC30 for Prime Coat	Liter			731
17	Straight asphalt, MC80/100	kg			450
18	Timber (Hardwood)	m3			300,000
19	Plywood, t = 12 mm	m2			8,850
20	Pipe Culvert, D = 1000 mm	m			119,658
21	Pipe Culvert, D = 600 mm	m			65,000
22	Pipe Culvert, D = 1200 mm	m			153,846
23	Nail	kg			889
24	Admixture	kg	295		
25	Barbed Wire	kg	142		
26	Form Oil	kg	243		
27	Grating	set	8,230		
28	Beads	kg	283		
29	H-Beam	ton	35,100		
30	Highway Lighting	set	797,250		
31	Signal Installation	set	13,548,193		
32	Epoxy Resin	Liter	1,107		
33	Coating Plywood	m2	858		60,000
34	Traffic sign plate	set			192,600
35	Traffic Informatory signs	set			253,100
36	Grass	m2			333
37	Chatter-bar (Jiggle bars)	nos.	8,470		
38	Heavy oil, grude petroleum	Liter			2,612
39	Brick (Selected Bricks)	nos.			85
40	Fence	nos.			178,752
41	Shrub, Scrub (up to 400 mm)	each			1,000
42	Tree (Up to 3000 mm)	each			5,000
43	Guardrail	set	6,600		
44	Cut-back asphalt for Prime coat	m3			427,350
45	Cut-back asphalt for Tack coat	m3			427,350
46	Paint for Road marking	kg	162		

Table 12.1 (b) Unit Cost of Labour (Wage Rate)

Unit: Ushs.

No.	Material	Unit	Wage Rate
1	Foreman	Man-Day	13,287
2	Mechanic	Man-Day	7,853
3	Electrician	Man-Day	7,461
4	Operator	Man-Day	11,391
5	Assistant operator	Man-Day	7,724
6	Assistant operator	Man-Day	5,876
7	Driver	Man-Day	5,969
8	Mason	Man-Day	5,766
9	Rigger	Man-Day	8,500
10	Welder	Man-Day	7,539
11	Pipe Fitter	Man-Day	8,500
12	Pavement worker	Man-Day	7,500
13	Steel worker	Man-Day	6,099
14	concrete worker	Man-Day	7,500
15	Carpenter	Man-Day	6,099
16	Semi-skilled labour	Man-Day	3,935
17	Common labour	Man-Day	4,167

Table12.1(c) Unit Cost of Majour Equipment

Unit : Ushs.

No.	Particular	Specification	Unit	¥	Ushs.	***
1	Bulldozer	15t	hr		112,465	
2	Back hoe	0.6m3	hr		58,287	
3	Back hoe	0.35m3	hr		31,561	
4	Tractor shovel	1.0m3	hr		65,008	
5	Dunp Truck	11t	hr		38,521	
6	Dunp Truck	2t	hr		14,373	
7	Track with Crane	4.0t、2.9t	hr		19,622	
8	Track	4t	hr		19,433	
9	Track	2t	hr		14,959	
10	Trailer	20t	hr		52,330	
11	Track crane	4.8-4.9t	hr		27,087	
12	Track crane	15-16t	hr		58,854	
13	Track crane	25t	hr		66,565	
14	Motor grader	3.1m	hr		93,076	
15	Road roller	10-12t	hr		48,122	
16	Tire roller	8-20t	hr		65,595	
17	Vibrating rubber tired roller	3-4t	hr		28,052	
18	Asphalt finisher	2.4-5.0m	hr		98,629	
19	Road sprinkler	5.5-6.5kltr	hr		39,011	
20	Mobile hydraulic platform	12-13m	hr		74,901	
21	Concrete mixer	1.6-1.7m3	hr		23,144	
22	Breaker	1,300kg	hr		58,287	
23	Concrete cutter	30cm	day		16,560	
24	Tampa/Ranma	60-100kg	day		20,027	
25	Asphalt sprayer	200ltr	day		84,999	
26	Line marker	80-120kg	hr		34,091	
27	Concrete plant	0.5m3	hr		24,892	
28	Asphalt plant	50t/hr	hr		132,819	
29	Micro-bas	26 persons	hr		73,875	
30	Four-wheel drive	5 persons	hr		33,646	
31	Air Compressor	3.5-3.7m3/min	day		74,713	
32	Air Compressor	17m3/min	day		225,561	
33	Concrete breaker	20kg	day		8,000	
34	Bulldozer	32t	hr		140,442	
35	Back hoe	1.0m3	hr		83,557	
36	Tractor shovel	3.2m3	hr		105,963	
37	Tractor shovel	2.1m3	hr		75,611	
38	Track	11t	hr		31,476	
39	Track crane	20t	hr		63,561	
40	Tire roller	8t	hr		46,151	
41	Vibrating rubber tired roller	0.5t	hr		14,216	

Table12.2 Unit Cost for Major Work Items

Unit:Ushs.

No.	Description	Unit	Unit Price		Total
			Foreign Currency	Local Current	
1	Removable of existing pavement material	m2		510	510
2	Excavation(common)-A	m3		7,359	7,359
3	Excavation(common)-B	m3		5,599	5,599
4	Embankment	m3		18,383	18,383
5	Sodding	m2		1,664	1,664
6	Planting-A	Each		8,956	8,956
7	Planting-B	Each		2,904	2,904
8	Box culvert(2.25x1.5x4)	Each	2,728,163	72,764,870	75,493,033
9	Box culvert(1.8x1.5x3)	Each	1,979,356	48,861,543	50,840,899
10	Box culvert(2.2x1.2)	Each	915,129	22,371,775	23,286,904
11	Pipe culvert D600 (Type-A)	m	793	181,887	182,680
12	Pipe culvert D600 (Type-B)	m	3,096	252,545	255,641
13	L-side ditch	m	1,527	39,873	41,400
14	U-shaped drain ditch	m	4,683	96,230	100,913
15	Catch pit Type-A (400x700x1000)	Each	11,677	443,347	455,024
16	Catch pit Type-B (1000x1000x1000)	Each	155,645	277,499	433,144
17	Open Drain Type-A(2.5x1.0x0.5m)	m	9,970	160,690	170,660
18	Open Drain Type-B(3.5x1.0x0.5m)	m	12,894	203,912	216,806
19	Cleaning for existing Open Drain	m		7,729	7,729
20	Cleaning for existing Pipe Culvert	m		3,910	3,910
21	Cleaning for existing Box Culvert	m		19,948	19,948
22	Cleaning for existing Catch pit	Each		598	598
23	In-Outlet	Each	2,846	68,925	71,771
24	Head Wall(3300x500x1500)	Each	18,241	319,153	337,394
25	Median Kerb	m	1,587	30,419	32,006
26	Kerb stone	m	1,018	16,690	17,708
27	Flush Kerb	m	535	8,895	9,430
28	Flower Bed	m	931	29,210	30,141
29	Reinforced Concrete Slab	Each	11,117	414,445	425,562
30	Preparation of Subbase Course	m2		575	575
31	Subbase Course(t=15cm,1layer)	m2		4,787	4,787
32	Subbase Course(t=20cm,1layer)	m2		6,117	6,117
33	Subbase Course(t=25cm,2layers)	m2		8,244	8,244
34	Subbase Course(t=30cm,2layers)	m2		9,574	9,574
35	Subbase Course(t=35cm,2layers)	m2		10,904	10,904
36	Base Course(t=10cm,1layer)	m2		5,956	5,956
37	Base Course(t=15cm,1layer)	m2		8,485	8,485
38	Base Course(t=20cm,2layers)	m2		11,912	11,912
39	Base Course(t=30cm,2layers)	m2		16,970	16,970
40	Preparation for Overlay	m2	526	2,120	2,646
41	Asphalt Surface Course t=5cm	m2		9,963	9,963
42	Asphalt Binder Course t=5cm	m2		9,742	9,742
43	Tack Coat	m2		326	326
44	Prime Coat	m2		947	947
45	Side Walk	m2		5,964	5,964
46	Road Marking	m2	5,908	1,971	7,879
47	Traffic Signal	Set	116,845,319		116,845,319
48	Street Light	Each	6,398,889		6,398,889
49	Guardrail	m	173,518	1,050	174,568
50	Fence	m	664	63,842	64,506
51	Chatter-bar	Each	193,057	2,231	195,288
52	Guard Block	Each	2,104	55,246	57,350
53	Staircase of Embankment	Each	16,628	887,946	904,574
54	Excavating for Side Walk	m3	345	3,175	3,520
55	Access Road	Each		1,413,480	1,413,480
56	Road Sign	Each		194,831	194,831

Table12.3 Summary of Work Quantities

No.	Description	Unit	Package 1					Package 2		Package 3	Package 4	Package 5	
			Natete Jct	Wandegeya Jct	Kibuye Jct	Port Bell Jct	Makerere Jct	Natete Road	Gaba Road	Port Bell Road	Gayaza Road	Hoima Road	Jinja Jct
1	Removable of existing pavement material	m2	200	700				900	1,200	2,300	1,100	2,000	
2	Excavation(common)-A	m3						7,000	9,000	6,000	8,000	8,000	
3	Excavation(common)-B	m3						3,000	4,000	5,000	3,000	4,000	
4	Embankment	m3						20,000	30,000	25,000	16,000	30,000	
5	Sodding	m2	1,000	1,300	2,000	720	1,300						2,000
6	Planting-A	Each			130	100	130						130
7	Planting-B	Each			4,900		5,200	37,000	59,400	28,000	19,000	65,000	4,900
8	Box culvert(2.25x1.5x4)	Each										1	
9	Box culvert(1.8x1.5x3)	Each							1				
10	Box culvert(2.2x1.2)	Each						2					
11	Pipe culvert D600 (Type-A)	m						1,070	2,120	780	830	1,830	
12	Pipe culvert D601 (Type-B)	m				50		22			14	14	
13	L-side ditch	m						1,790	3,560	1,320	1,370	3,050	
14	U-shaped drain ditch	m	1,500	1,400	1,000	750	1,000	7,540	11,000	1,970	1,850	12,600	1,200
15	Catch pit Type-A (400x700x1000)	Each	16	16	20	8	16						16
16	Catch pit Type-B (1000x1000x1000)	Each				4		142	282	104	112	246	
17	Open Drain Type-A(2.5x1.0x0.5m)	m				700	550	3,750	5,900			6,750	
18	Open Drain Type-B(3.5x1.0x0.5m)	m							4,420	8,550	7,360	6,900	
19	Cleaning for existing Open Drain	m	50	50	50	50	100	100	100	100	100	100	50
20	Cleaning for existing Pipe Culvert	m	30	30	30	30	30	30	50	110	180	70	30
21	Cleaning for existing Box Culvert	m						10	60	20	30	40	
22	Cleaning for existing Catch pit	Each	20	20	20	20	20	6	10	22	36	14	20
23	In-Outlet	Each						6	10	22	36	14	
24	Head Wall(3300x500x1500)	Each				1		10	38	14	26	46	
25	Median Kerb	m	250	250	400	100	300						980
26	Kerb stone	m					150	7,540	11,000	1,970	1,850	12,600	150
27	Flush Kerb	m	1,500	1,300	1,200	750	1,000	7,540	11,000	1,970	1,850	12,600	1,300
28	Flower Bed	m	1,000	1,300	900	250	950	6,910	11,000	1,970	1,850	12,600	900
29	Reinforced Concrete Slab	Each						30	46	35	14	45	
30	Preparation of Subbase Course	m2	6,800	5,100	1,200	3,100	1,600	7,960	29,000	19,840	22,750	23,600	1,200
31	Subbase Course(t=15cm,1layer)	m2						7,820	27,000		9,000		
32	Subbase Course(t=20cm,1layer)	m2				3,100				9,000		22,200	
33	Subbase Course(t=25cm,2layers)	m2								5,240			
34	Subbase Course(t=30cm,2layers)	m2							2,000	5,600	13,700	1,400	
35	Subbase Course(t=35cm,2layers)	m2	6,800	5,100	1,200		1,500	140			1,050		1,200
36	Base Course(t=10cm,1layer)	m2	2,200		7,000	3,100		8,230	29,000	23,300	22,300	23,600	8,800
37	Base Course(t=15cm,1layer)	m2	6,800	7,900			4,700	140			6,150		1,200
38	Base Course(t=20cm,2layers)	m2								5,240			
39	Base Course(t=30cm,2layers)	m2		5,100	1,200		1,600				1,050		
40	Preparation for Overlay	m2	2,200	7,900	7,000	2,700	4,700	22,800	54,600	28,920	27,600	51,000	8,800
41	Asphalt Surface Course t=5cm	m2	9,000	13,000	8,200	5,800	6,300	30,570	72,800	38,560	39,400	68,000	10,000
42	Asphalt Binder Course t=5cm	m2	9,000	13,000	8,200		6,300	8,370	73,400		50,500		10,000
43	Tack Coat	m2	9,000	13,000	8,200		6,300	30,570	117,200	20,220	60,400	51,000	10,000
44	Prime Coat	m2	9,000	13,000	1,200	5,800	6,300	8,370	29,000	18,340	29,500	17,000	10,000
45	Side Walk	m2	4,370	4,200	3,000	2,140	3,000	22,610	54,600	28,920	27,750	51,000	3,600
46	Road Marking	m2	460	560	160	320	120	470	1,050	710	740	910	280
47	Traffic Signal	Set	1	1		1							
48	Street Light	Each	22	39	30	17	23						34
49	Guardrail	m											
50	Fence	m		100					800	740		3,650	
51	Chatter-bar	Each	20	20	20	20	20						20
52	Guard Block	Each	22	39	30	17	23						34
53	Staircase of Embankment	Each		3				6	10	4	6	10	
54	Excavating for Side Walk	m3	500	1,000	1,300	500	2,300						1,300
55	Access Road	Each						71	141	62	61	121	
56	Road Sign	Each	12	12	15	9	12	20	45	30	30	35	12

Table12.5 Summary of Project Cost by Construction Package

No.	Description	Unit	Unit Rate (Ushs.)	Package1 Quantity	Package1 Amount(Ushs.)	Package2 Quantity	Package2 Amount(Ushs.)	Package3 Quantity	Package3 Amount(Ushs.)	Package4 Quantity	Package4 Amount(Ushs.)	Package5 Quantity	Package5 Amount(Ushs.)	Total Quantity	Total Amount(Ushs.)
A. Construction Cost															
1	Removable of existing pavement material	m2	510	900	459,000	2,100	1,071,000	2,300	1,173,000	1,100	561,000	2,000	1,020,000	8,400	4,284,000
2	Excavation(common)-A	m3	7,359			16,000	117,744,000	6,000	44,154,000	8,000	58,872,000	8,000	58,872,000	38,000	279,642,000
3	Excavation(common)-B	m3	5,599			7,000	39,193,000	5,000	27,995,000	3,000	16,797,000	4,000	22,396,000	19,000	106,381,000
4	Embankment	m3	18,383			50,000	919,150,000	25,000	459,575,000	15,000	275,745,000	30,000	551,490,000	120,000	2,205,960,000
5	Sodding	m2	1,664	6,320	10,516,480							2,000	3,328,000	8,320	13,844,480
6	Planting-A	Each	8,956	360	3,224,160							130	1,164,280	490	4,388,440
7	Planting-B	Each	2,904	10,100	29,330,400	96,400	279,945,600	28,000	81,312,000	19,000	55,176,000	69,900	202,989,600	223,400	648,753,600
8	Box culvert(2.25x1.5x4)	Each	75,493,033									1	75,493,033	1	75,493,033
9	Box culvert(1.8x1.5x3)	Each	50,840,899			1	50,840,899							1	50,840,899
10	Box culvert(2.2x1.2)	Each	23,286,904			2	46,573,807							2	46,573,807
11	Pipe culvert D600 (Type-A)	m	182,680			3,190	582,750,625	780	142,490,748	830	151,624,771	1,830	334,305,218	6,630	1,211,171,362
12	Pipe culvert D601 (Type-B)	m	255,641	50	12,782,058	22	5,624,106			14	3,578,976	14	3,578,976	100	25,564,117
13	L-side ditch	m	41,400			5,350	221,487,445	1,320	54,647,370	1,370	56,717,346	3,050	126,268,544	11,090	459,120,705
14	U-shaped drain ditch	m	100,913	5,650	570,158,792	18,540	1,870,928,143	1,970	198,798,729	1,850	186,689,162	13,800	1,392,600,236	41,810	4,219,175,062
15	Catch pit Type-A (400x700x1000)	Each	455,024	76	34,581,859							16	7,280,391	92	41,862,251
16	Catch pit Type-B (1000x1000x1000)	Each	433,144	4	1,732,576	424	183,653,024	104	45,046,968	112	48,512,120	246	106,553,405	890	385,498,093
17	Open Drain Type-A(2.5x1.0x0.5m)	m	170,660	1,250	213,324,788	9,650	1,646,867,365					6,750	1,151,953,856	17,650	3,012,146,010
18	Open Drain Type-B(3.5x1.0x0.5m)	m	216,806			4,420	958,280,351	8,550	1,853,687,104	7,360	1,595,688,548	6,900	1,495,958,014	27,230	5,903,614,017
19	Cleaning for existing Open Drain	m	7,729	300	2,318,700	200	1,545,800	100	772,900	100	772,900	150	1,159,350	850	6,569,650
20	Cleaning for existing Pipe Culvert	m	3,910	150	586,500	80	312,800	110	430,100	180	703,800	100	391,000	620	2,424,200
21	Cleaning for existing Box Culvert	m	19,948			70	1,396,360	20	398,960	30	598,440	40	797,920	160	3,191,680
22	Cleaning for existing Catch pit	Each	598	100	59,800	16	9,568	22	13,156	36	21,528	34	20,332	208	124,384
23	In-Outlet	Each	71,771			16	1,148,337	22	1,578,963	36	2,583,758	14	1,004,795	88	6,315,853
24	Head Wall(3300x500x1500)	Each	337,394	1	337,394	48	16,194,895	14	4,723,511	26	8,772,235	46	15,520,108	135	45,548,143
25	Median Kerb	m	32,006	1,300	41,607,661							980	31,365,776	2,280	72,973,437
26	Kerb stone	m	17,708	150	2,656,152	18,540	328,300,418	1,970	34,884,133	1,850	32,759,211	12,750	225,772,941	35,260	624,372,856
27	Flush Kerb	m	9,430	5,750	54,220,856	18,540	174,826,899	1,970	18,576,537	1,850	17,444,971	13,900	131,073,026	42,010	396,142,289
28	Flower Bed	m	30,141	4,400	132,622,325	17,910	539,833,145	1,970	59,378,632	1,850	55,761,659	13,500	406,909,406	39,630	1,194,505,166
29	Reinforced Concrete Slab	Each	425,562			76	32,342,703	35	14,894,666	14	5,957,865	45	19,150,285	170	72,345,519
30	Preparation of Subbase Course	m2	575	17,800	10,235,000	36,960	21,252,000	19,840	11,408,000	22,750	13,081,250	24,800	14,260,000	122,150	70,236,250
31	Subbase Course(t=15cm,1layer)	m2	4,787			34,820	166,683,340			8,000	38,296,000			42,820	204,979,340
32	Subbase Course(t=20cm,1layer)	m2	6,117	3,100	18,962,700			9,000	55,053,000			22,200	135,797,400	34,300	209,813,100
33	Subbase Course(t=25cm,2layers)	m2	8,244					5,240	43,198,560					5,240	43,198,560
34	Subbase Course(t=30cm,2layers)	m2	9,574			2,000	19,148,000	5,600	53,614,400	13,700	131,163,800	1,400	13,403,600	22,700	217,329,800
35	Subbase Course(t=35cm,2layers)	m2	10,904	14,700	160,288,800	140	1,526,560			1,050	11,449,200	1,200	13,084,800	17,090	186,349,360
36	Base Course(t=10cm,1layer)	m2	5,956	12,300	73,258,800	37,230	221,741,880	23,300	138,774,800	22,300	132,818,800	32,400	192,974,400	127,530	759,568,680
37	Base Course(t=15cm,1layer)	m2	8,485	19,400	164,609,000	140	1,187,900			6,150	52,182,750	1,200	10,182,000	26,890	228,161,650
38	Base Course(t=20cm,2layers)	m2	11,912					5,240	62,418,880					5,240	62,418,880
39	Base Course(t=30cm,2layers)	m2	16,970	7,900	134,063,000					1,050	17,818,500			8,950	151,881,500
40	Preparation for Overlay	m2	2,646	24,500	64,829,197	77,400	204,807,341	28,920	76,524,913	27,600	73,032,075	59,800	158,236,163	218,220	577,429,689
41	Asphalt Surface Course t=5cm	m2	9,963	42,300	421,434,900	103,370	1,029,875,310	38,560	384,173,280	39,400	392,542,200	78,000	777,114,000	301,630	3,005,139,690
42	Asphalt Binder Course t=5cm	m2	9,742	36,500	355,583,000	81,770	796,603,340			50,500	491,971,000	10,000	97,420,000	178,770	1,741,577,340
43	Tack Coat	m2	326	36,500	11,899,000	147,770	48,173,020	20,220	6,591,720	60,400	19,690,400	61,000	19,886,000	325,890	106,240,140
44	Prime Coat	m2	947	35,300	33,429,100	37,370	35,389,390	18,340	17,367,980	29,500	27,936,500	27,000	25,569,000	147,510	139,691,970
45	Side Walk	m2	5,964	16,710	99,658,440	77,210	460,480,440	28,920	172,478,880	27,750	165,501,000	54,600	325,634,400	205,190	1,223,753,160
46	Road Marking	m2	7,879	1,620	12,763,540	1,520	11,975,667	710	5,593,697	740	5,830,259	1,190	9,375,687	5,780	45,539,050
47	Traffic Signal	Set	116,845,319	3	350,535,957									3	350,535,957
48	Street Light	Each	6,398,889	131	838,254,472							34	217,562,229	165	1,055,816,701
49	Guardrail	m	174,568												
50	Fence	m	64,506	100	6,450,608	800	51,604,864	740	47,734,500			3,650	235,447,193	5,290	341,237,165
51	Chatter-bar	Each	195,288	100	19,528,832							20	3,905,766	120	23,434,598
52	Guard Block	Each	57,350	131	7,512,897							34	1,949,912	165	9,462,809
53	Staircase of Embankment	Each	904,574	3	2,713,722	16	14,473,182	4	3,618,296	6	5,427,443	10	9,045,739	39	35,278,381
54	Excavating for Side Walk	m3	3,520	5,600	19,711,870							1,300	4,575,970	6,900	24,287,840
55	Access Road	Each	1,413,450			212	299,657,760	62	87,635,760	61	86,222,280	121	171,031,080	456	644,546,880
56	Road Sign	Each	194,831	60	11,689,860	65	12,664,015	30	5,844,930	30	5,844,930	47	9,157,057	232	45,200,792
		Total(A)			3,927,932,197		11,417,264,300		4,216,563,273		4,246,146,679		8,814,028,987		32,621,935,336
B. Contractor Overhead															
	(20% of the construction cost)				785,586,439		2,283,452,860		843,312,655		849,229,336		1,762,805,777		6,524,387,067
C. Consultancy Service															
	Detail Design (4% of the construction cost)				157,117,288		456,690,572		168,662,531		169,845,867		352,561,155		1,304,877,413
	Supervison (6% of the construction cost)				235,675,932		685,035,858		252,993,796		254,768,801		528,841,733		1,957,316,120
		Total(C)			392,793,220		1,141,726,430		421,656,327		424,614,668		881,402,889		3,262,193,534
	Total of the Project Cost (A+B+C)				5,106,311,855		14,842,443,590		5,481,532,255		5,519,990,682		11,458,237,554		42,408,515,937
D. Administration Cost of Uganda Government															
	Operation Cost of Government Project Office (1% of the construction cost)				26,450,593		109,989,472		40,527,100		40,980,423		82,468,456		300,416,043
		Total(D)			26,450,592		109,989,472		40,527,100		40,980,423		82,468,456		300,416,043
	Grand Total (A+B+C+D)				5,132,762,448		14,952,433,062		5,522,059,355		5,560,971,106		11,540,706,009		42,708,931,980

US$=1.0=¥120.88=Ushs.1042.52

Table 12.6 Summary of Project Cost by Currency Portion

Unit : Ushs.

No. Description	Amount		
	Foreign Portion	Local Portion	Total
A. Construction Cost			
(Package-1)			
Natete Jct	274,917,424	578,356,756	853,274,180
Makerere rdbt	167,460,598	515,914,762	683,375,360
Kibya rdbt	207,998,602	456,485,855	664,484,457
Port Bell Jct	245,179,567	347,812,976	592,992,543
Wandegeya Jct	387,316,760	746,488,896	1,133,805,656
Total (1)	1,282,872,952	2,645,059,245	3,927,932,197
(Package-2)			
Natete Road	133,824,087	3,431,053,682	3,564,877,769
Gaba Road	284,493,031	7,567,893,500	7,852,386,531
Total (2)	418,317,118	10,998,947,182	11,417,264,300
(Package-3)			
Port Bell Road	163,853,260	4,052,710,013	4,216,563,273
Total (3)	163,853,260	4,052,710,013	4,216,563,273
(Package-4)			
Gayaza Road	148,104,369	4,098,042,310	4,246,146,679
Total (4)	148,104,369	4,098,042,310	4,246,146,679
(Package-5)			
Hoima Road	329,908,447	7,699,655,454	8,029,563,901
Jinja rdbt	237,274,889	547,190,098	784,464,987
Total (5)	567,183,335	8,246,845,552	8,814,028,887
Total (1)+(2)+(3)+(4)+(5)	2,580,331,034	30,041,604,302	32,621,935,336
B. Contractor Overhead (20% of Const. cost)	516,066,207	6,008,320,860	6,524,387,067
C. Engineering Cost Detailed Design & Supervision (10% of Const. cost)	258,033,103	3,004,160,430	3,262,193,534
D. Government Administration Cost (1% of Const. cost)		300,416,043	300,416,043
Grand Total (A)+(B)+(C)+(D)	3,354,430,344	39,354,501,636	42,708,931,980

US$=1.0=¥120.88=Ushs.1042.52

13. ENVIRONMENTAL IMPACT ASSESSMENT

13.1 Introduction

The majour subjects of environmental analysis carried out in the study are as follows:

- Possibility of Demolition, Relocation and Resettlement
- Noise and Vibration Pollution
- Air Pollution
- Flood-Prone Areas, Siltation of Water Courses and Erosion

Present environmental issues and environmental concern about the proposed high-priority projects (6 junctions and 5 roads) are analysed as shown in Table 13.1.

13.2 Environmental Study

1) Demolition, Relocation and Resettlement

The present situation of building/housing location was investigated and described by project and this information was used as a prerequisite for junction/road design. As a consequence, it was proved that the projects involve no demolition and relocation of building/housing with the adoption of junction and road designs which aim at minimization of environmental damage.

One of the over riding principles behind the highway engineering design was that the minimum of demolition should be planned. Instead, the road design or width was frequently changed along the length of the road in order to accommodate buildings and trees, in particular well established buildings and indigenous trees. In extreme instances this resulted in a narrow to non-existent pedestrian/cycle way or buffer zone.

2) Noise and Vibration Pollution

In order to identify the level of noise pollution, the following types of survey were carried out:

- A noise source survey
- A road traffic survey of noise 1 m from the edge of the road and at a building fronting the road.
- A road traffic vibration survey 1 m from the edge of the road
- A construction machinery noise survey
- A construction machinery vibration survey

Table 13.1 Environmental Description of High Priority Projects

Junction or Road	Social and Economic Environment	Physical and Natural Environment	Environmental Concern
Natete Junction	- next to one of the 3 busiest markets in Kampala. - area of intense commercial activity. - encroachment of businesses onto roadside taxi park	- drainage channel passes underneath the road. - roundabout at base of slope. - disintegrated road - no greenery	- pedestrian-cycle-vehicle conflict - chronic congestion. - dust, air & noise pollution - blocked drains
Makerere Junction	- area of commercial activity (timber sale, furniture sale, car washing & shops)	- Mulago Green Park next to Bombo road - no flora in roundabout centre, but a number of trees in area - drainage underneath road	- blocked drains - exacerbated by car washing (associated hydrocarbon pollution) - dust & air pollution
Kibuye Junction	- area of commercial activity - railway crossing with two bridge (Makindye & Entebbe road) crossings	- trees and shrub beds in roundabout centre. - flora along railway embankment and ball field	- dust, air and odour (from rubbish) pollution
Port Bell/Jinja Road Junction	- area of less intense commercial activity (abuts onto Nakawa University, Nakasero market and a fuel station)	- area rich in flora with trees, bananas, crops (maize, cassava, potatoes) and mixed grasses	- dust & air pollution from Nakasero market - blocked drains with associated odour
Wandegeya Junction	- area of intense commercial activity. - focal point for Makerere University students - taxi park - police flats	- religious/cultural site of Wandegeya Mosque - landscaped area surrounding mosque and some other large trees	- noise, dust & air pollution affecting mosque - building encroachment onto road reserve
Jinja Junction	- industrial & commercial area	- next to Centenary Green Park through which Kitante channel passes	- flooding - dust, air & noise pollution
Natete Road	- commercial at both ends of the road with a residential zone in the middle and many schools	- highly disintegrated road. - topographically many lows and highs - wetland zone	- poor drainage - dust & air pollution
Gaba Road	port access route commercial & residential area	- crosses Kansanga wetland	- poor drainage - dust, air & noise pollution
Port Bell Road	- port access route with mixed residential, commercial & institutional area. - For the last 1.4 km industrial zone	- low lying area, skirts Kansanga wetland - tree planting along road in places	- poor drainage - water pollution from industrial area into Lake Victoria - dust & air pollution - water hyacinth dumping on road reserve
Gayaza Road	- sparsely commercial & residential (least densely populated road) area	- low lying, intermittent wetland	- poor drainage - some exposed drinking wells along road
Hoima Road	- commercial area at start and low density residential at end	- crosses Lubigi wetland - tree lined road along sections.	- poor drainage

As the results of the survey, the following could be concluded:

- The noise source survey indicates that the larger the vehicle engine the greater the noise level as would be expected. However, the results also indicate that the noise level is not directly proportional to the speed the vehicle is travelling at. From a planning perspective these results support the classification of different areas into zones such as residential zones which do not allow the movement of large vehicles through the area, either at all, or during designated time periods, such as at night. Other recommendations include an information campaign on the insidious nature of noise pollution and ways to prevent it.

- The road traffic noise survey clearly shows that some roads are subject to levels of noise above recommended limits. It is therefore suggested that future construction of residential buildings along all roads in Kampala, but the Jinja and Bombo Roads in particular, should be discouraged within a 20-40m corridor on either side of the road.

- Vibration is not a problem in Kampala. This is supported by the fact that the City mainly rests on Precambrian basement rocks comprised of granitoid gneisses and granites and has extensive wetlands which are likely to absorb most of the vibration.

- Noise levels emanating from construction machinery borders on acceptable recommended limits. The use of construction machinery in general and Wheel Loaders (CAT 950F) in particular is intermittent and usually for short time periods of time during the construction phase. Therefore, recommendations include warning communities prior to their use, particularly if there are likely to be computers and other sensitive equipment in the area. Construction should be prevented at night and periodic tests on construction equipment used by different contractors, should be carried out particularly if there are complaints.

3) Air Pollution Survey

In order to identify the issues of air pollution the following surveys were carried out:

- Automobile Exhaust Gas Survey
- Dust Survey

Air pollution, specifically Carbon monoxide pollution, is a growing problem in Kampala. The junction designs have gone a long way to easing congestion and resulting in time savings, which in turn reduces the amount of air pollution around these heavily developed junctions. A result of a case study about the reduced level of Carbon monoxide pollution through the junction improvement is shown in Table 13.2.

4) Flood-prone Areas, Siltation of Water Courses & Erosion

Present Condition

Kampala is located on the watershed between the Lake Victoria down-warped basin and the more gentle slope to Lake Kyoga in the north. There are very few free flowing water courses or drainage channels in the City. Most water courses and drainage channels are heavily polluted and silted, or blocked, often with refuse. Drainage, or the lack of, is probably the single largest cause of the disintegration of roads in Kampala. All the roads in the study have inadequate drainage. Fig. 13.1 illustrates the major wetlands of Kampala District and the main roads which cross them.

Mitigation Measure

Drainage, or the lack of, is one of the largest environmental problems plaguing the roads in Kampala and a number of solutions are proposed to rectify this problem:

- Existing drainage channels should be un-blocked and cleared of silt/refuse and overgrown vegetation. For example it is noted that the drainage channels running through market areas are often blocked. The reason for this is likely to be a combination of factors that may include an inadequate size of channel, poor refuse collection/disposal and lack of information on the importance of un-blocked drains. Therefore, solving the problem must include a combination of strategies ranging from engineering solutions such as the widening of channels, to encouraging better refuse disposal and simple educational information campaigns.

- Existing drainage channels should be re-examined to assess whether they are of an adequate depth and width, particularly bearing in mind that building activities are likely to continue for the next decade at the current high rate in and around the city. As much of this building activity is not strictly regulated by the authorities, it is likely that the road drainage provided may be the only properly constructed drainage in a given area. Therefore, the capacity of the drains should be re-examined with this factor in mind, particularly in low income residential and commercial areas such as Kitintale on the Port Bell Road and Bwaise on the Bombo Road.

- There should be adequate drainage channels on either side of the road sections leading up to the wetlands and adequate culverts allowing for cross flow in the road sections that actually cross the wetlands, for example Gaba Road.

- There are a number of stretches on existing roads, for example parts of Natete Road that clearly require the installation of new drainage channels. In the past drainage channels may not have been necessary due to the high proportion of vegetation cover. However, over the last decade construction activities have increased dramatically and the vegetation cover has diminished substantially leading to increased run-off and soil erosion.

- Where necessary lined drainage channels should be installed, such as along parts of Natete Road.

- Earth roads feeding into the main paved roads cause erosion (Refer Fig. 13.2). The inclination of these earth roads should be assessed and changed if possible for some distance prior to joining the main road and consideration should be given to paving these earth roads at the junctions. In addition the drainage channels of these earth roads should also be assessed for some distance prior to joining the main road.

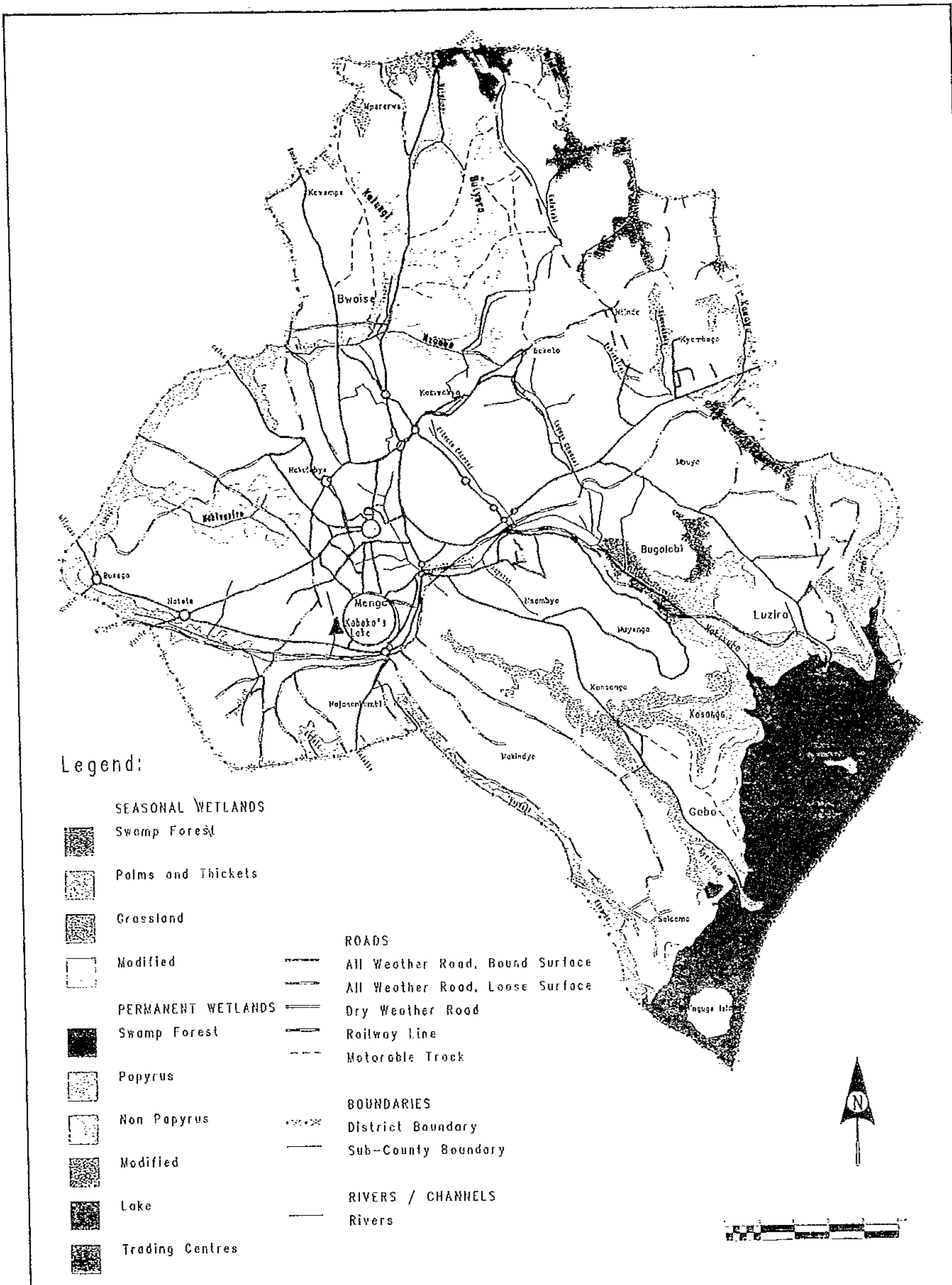
- Provision of adequate drainage channels combined with the correct camber of road and shoulder protection of the roads is inevitable.

- Exposed slopes on either side of the road should be vegetated with indigenous grasses.

Table 13.2 The Existing and New Designs for the High Priority Junctions and the Corresponding Time and Carbon Monoxide Savings.

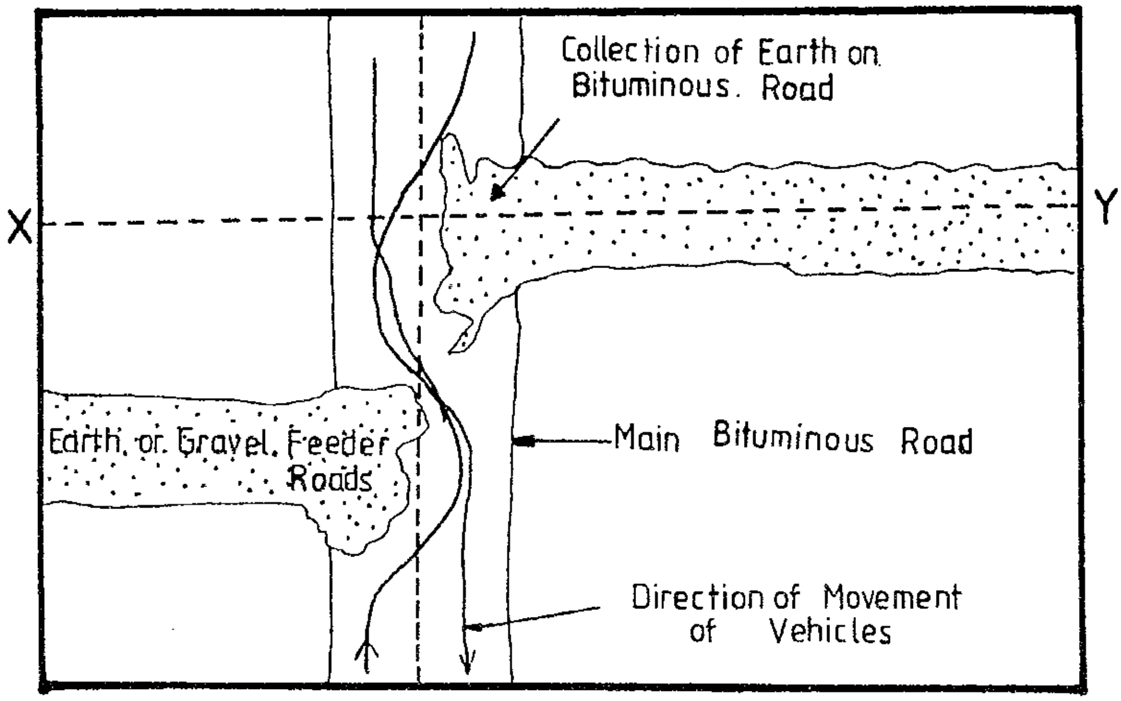
Junction Name	Average Concentration of Carbon monoxide (g/m3) *	Existing Design Queue Delay (min)	New Design Queue Delay (min)	Time savings per hour (min)	Concentration (g/m3) x Time Savings per hour
Natete					
(am)	1800	9871	4346	5525	6.0×10^{8}
(pm)		5200	2253	2947	3.2×10^{8}
Makerere					
(am)	1800	171550	28015	143535	2.6×10^{8}
(pm)		60735	13755	46980	8.5×10^{7}
Kibuye					
(am)	1800	521983	75314	446669	4.8×10^{10}
(pm)		658637	133217	525420	5.7×10^{10}
Port Bell					
(am)	1800	231360	27983	203377	2.2×10^{10}
(pm)		196320	14197	182123	2.0×10^{10}
Wandegeya					
(am)	1800	800925	306244	494681	5.3×10^{10}
(pm)		495120	296344	198776	2.1×10^{10}
Jinja					
(am)	1800	1268658	688795	579861	6.3×10^{10}
(pm)		1299087	534145	764922	8.3×10^{10}

* the average concentration of Carbon monoxide pollution was calculated by assuming a ratio of 66% petrol vehicles to 33% diesel vehicles and averaging the results from the emission survey during idling.

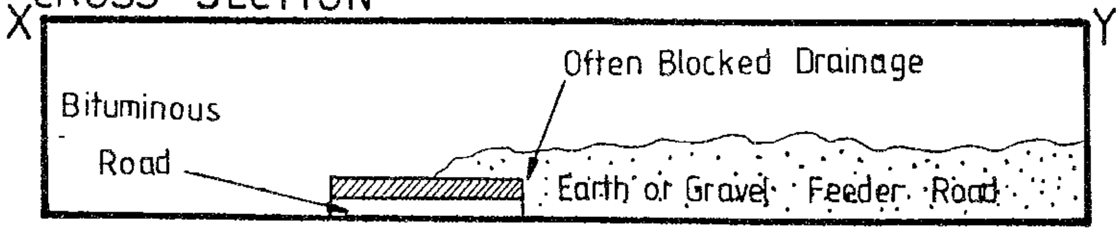


THE FEASIBILITY STUDY OF
IMPROVEMENT OF TRUNK ROAD
AT KAMPALA URBAN INTERFACE

Figure 13.1 Kampala District Wetlands



CROSS SECTION



THE FEASIBILITY STUDY OF IMPROVEMENT OF TRUNK ROAD AT KAMPALA URBAN INTERFACE	
Figure 13.2 Erosion of Main Roads Caused by Earth Feeder Roads	

14. IMPLEMENTATION PLAN

14.1 Executing Agency

The Development Department, Ministry of works, Transport and Communications (MOWTC) is the government agency responsible for the execution of the Project.

14.2 Project Components and Construction Package

The high priority projects selected in the Master Plan Study consist of two (2) categories of projects; namely, (1) Improvement of bottleneck junctions and (2) Improvement of road sections. These projects have been classified into construction packages as shown below (Ref. 12.1.2 (3)):

Package-I	:	Mainly consists of bottleneck junction improvement projects. Junctions included in this package are Natete, Makerere, Kibuye, Port Bell/Jinja Road, and Wandegeya.
Package-II	:	The simultaneous improvement of two road sections, i.e. Natete Road and Gaba Road. Combination of two contrasted road sections; Natete Road, an urban short cut route with a short length of 3.8 km, and Gaba Road, a radiating trunk road with a length of 9.1 km. Both need urgent improvement works.
Package-III	:	Improvement of Port Bell Road, a typical intra-regional trunk road in the area, within an industrial zone with a length of 4.8 km.
Package-IV	:	Improvement of Gayaza Road. A section of the national trunk road connecting to the northern part of the nation with a length of 4.6 km.
Package-V	:	Improvement of Hoima Road and Jinja Junction. A combination section of national trunk road with a length of 8.5 km located in the urban periphery and a junction located in the city centre.

14.3 Description of Projects

Description of projects by construction package is shown in Table 14.1.

Table 14.1 Project Description

Package	Project Components	Present Issues	Content of Improvement Work	Traffic (1997) (A.M. Peak Hour)	Area of the Project Site (sq. m)
I	Natete Junction	- Queuing - Intrusion of pedestrians	- Signalized junction - Turning lanes - Pedestrian crossing	3,902 (A.M. Peak Hour)	9,000 sq. m
	Makerere Junction	- Queuing - Traffic accident	- Signalized junction - Turning lanes - Pedestrian crossing	5,565 (A.M. Peak Hour)	6,300 sq. m
	Kibuye Junction	- Queuing - Pavement deterioration	- Improvement of geometry - Safety facilities	5,618 (A.M. Peak Hour)	8,200 sq. m
	Port Bell/ Jinja Road Junction	- Queuing - Traffic accident	- Improvement of geometry - Safety facilities - Pedestrian crossing	7,793 (A.M. Peak Hour)	5,800 sq. m
	Wandegeya Junction	- Queuing - Traffic accident - Instruction of pedestrian	- Signalized junction - Turning lanes - Safety facilities - Pedestrian crossing	8,679 (A.M. Peak Hour)	13,000 sq. m
II	Natete Road	- Narrow carriageway - Pavement deterioration - Poor drainage system - Lack of sidewalk	- Improvement of pavement - Widening of carriageway - Raising of carriageway (2 points) - Installation of sidewalks	8,500 ADT	3.8 km
	Gaba Road	- Narrow carriageway - Pavement deterioration - Poor drainage system	- Improvement of pavement - Widening of carriageway - Raising of carriageway (1 point) - Installation of sidewalks	11,600 ADT	9.1 km
III	Port Bell Road	- Pavement deterioration - Poor drainage system - Lack of sidewalk	- Improvement of pavement - Widening of carriageway - Installation of sidewalks	7,800 ADT	4.8 km
IV	Gayaza Road	- Narrow carriageway - Pavement deterioration - Poor drainage system - Lack of sidewalk	- Improvement of pavement - Widening of carriageway - Installation of sidewalks	15,700 ADT	4.6 km
V	Hoima Road	- Narrow carriageway - Pavement deterioration - Poor drainage system - Lack of sidewalk	- Improvement of pavement - Widening of carriageway - Raising of carriageway (1 point) - Installation of sidewalks	9,900 ADT	8.5 km
	Jinja Junction	- Queuing - Pavement deterioration - Traffic accident	- Improvement of geometry - Turning lanes - Safety facilities	9,802 (A.M. Peak Hour)	10,000 sq. m

14.4 Short-term Investment Plan

An investment plan by package of project is shown in Table 14.1, 2 and Fig. 14.1.

Table 14.2 Investment Plan

Unit: Ushs. million
(Unit: Yen million)

Package	Construction Schedule		
Package I	1998 - 1999	5,132.8	(594.9)
Package II	1999 - 2001	14,952.4	(1,733.0)
Package III	2001 - 2002	5,521.2	(640.0)
Package IV	2002 - 2003	5,560.9	(644.5)
Package V	2003 - 2005	11,540.7	(1,337.6)
Total		42,707.9	(5,544.9)

14.5 Long-term Investment Plan

Long-term investment plan during 2005 - 2015 is shown in Table 14.3. Total cost required for the implementation is estimated to be Ushs. 65,153.2 million (7,551.4 million Yen).

Fig. 14.1 Proposed Implementation Schedule by Construction Package

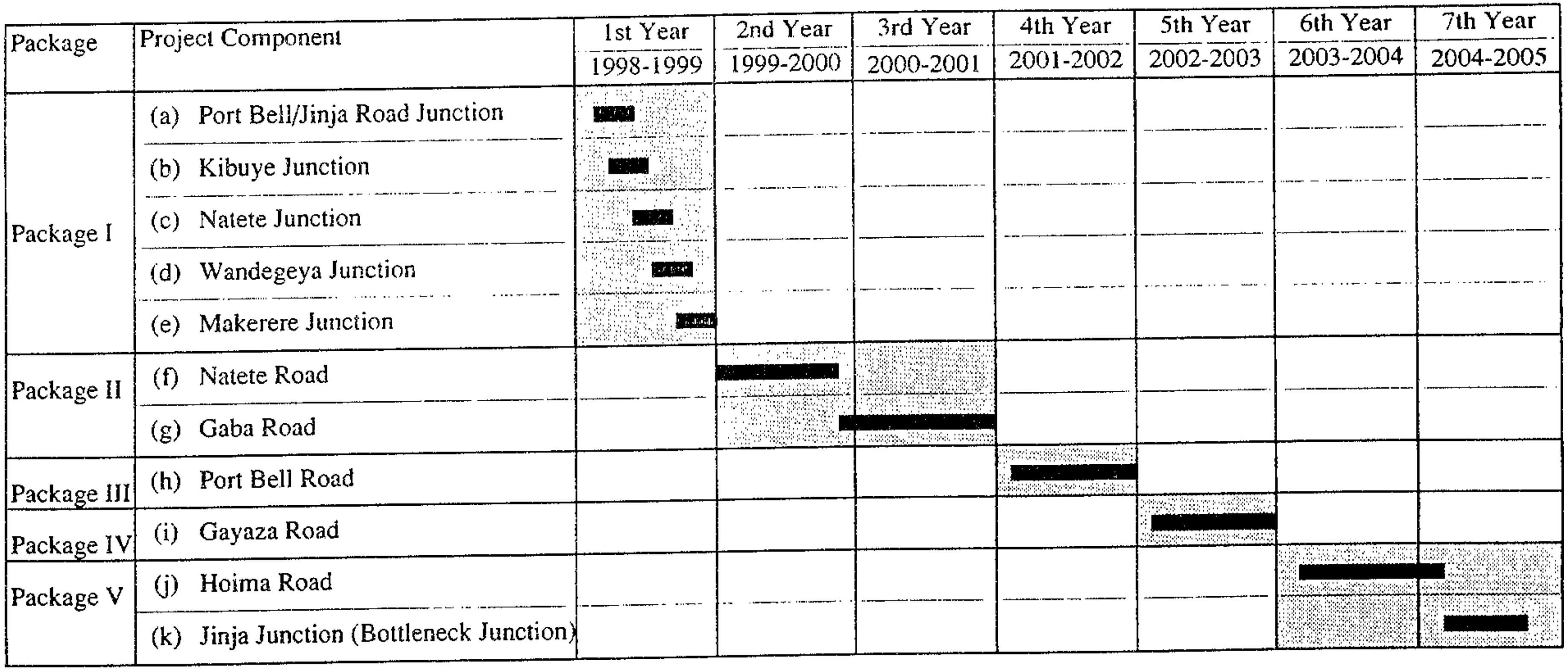


Table 14.3 Proposed Cost Disbursement Schedule by Construction Package

Unit: Ushs. million
(Unit: Yen, million)

Package	Project Component	1st Year 1998-1999	2nd Year 1999-2000	3rd Year 2000-2001	4th Year 2001-2002	5th Year 2002-2003	6th Year 2003-2004	7th Year 2004-2005
Package I	(a) Port Bell/Jinja Road Junction							
	(b) Kibuye Junction							
	(c) Natete Junction	5,132.8 (594.9)						
	(d) Wandegeya Junction							
	(e) Makerere Junction							
Package II	(f) Natete Road		14,952.5 (1,733.0)					
	(g) Gaba Road							
Package III	(h) Port Bell Road				5,522.1 (640.0)			
Package IV	(i) Gayaza Road					5,561.0 (644.5)		
Package V	(j) Hoima Road						11,540.7 (1,337.6)	
	(k) Jinja Junction							

Table 14.4 Proposed Investment Schedule by Road Development (Long-term)

Unit: Ushs. million

Proposed Projects to be Implemented in the Long-term Plan		2005 - 2009		2010 - 2015	
		Investment Schedule			
		Pro. Cost	Land Acq.	Pro. Cost	Land Acq.
[Improvement of Bottleneck]					
Junction	Clock Tower Roundabout	1,107.1			
Flood Area:	Sentema Road Carriageway Raising	(1,141.9)			
	Bomba Road Carriageway Raising	(464.6)			
	Jinja Road (A) Carriageway Raising	(468.9)			
	Jinja Road (B) Carriageway Raising	(433.3)			
[Reinforcement of Linehaul]					
Regional	Sentema Road	4,927.8	(10.0)		
Artery:	Kira Road	10,462.8	(10.0)		
	Jinja-Kampala -Bomba Road	1,878.0			
	Butikiro-Kisenyi Road	1,476.1			
	Musaja-Alumbwa Road	370.1			
	Muwanga Road	444.1			
	Mengo-Kisenyi Road	518.1			
[Reinforcement of Linehaul]					
Inter-regional					
Artery:	Masaka Road	11,502.9			
	Bomba Road	6,637.3			
	Jinja Road	8,085.5			
	Entebbe Road	4,214.8			
[Strengthening of Road Network]					
Circular:	Inner Ring Road	9,111.1	(15.0)		
	Katwe Lubiri Ring Road			2,948.2	(23.0)
	Middle Ring Road (Kampala Bypass)			* –	–
Access:	Katwe Road			803.1	
	Motebi Road			296.1	
	Lubiri Ring-Queens way			222.0	
	Lubiri Ring-Masaka Road			148.0	
	Subtotal	60,735.7	(35.0)	4,417.4	(23.0)
Total		Project Cost 65,153.2		Land Acq. Cost (58.0)	

* Committed by EU

15. PROJECT EVALUATION

15.1 Procedures and Preposition in the Economic Evaluation

The economic evaluation begins with the estimation of yearly economic project costs and benefits. Economic project costs are obtained from the financial project costs by deducting transfer components in the national economy.

Cost/benefit streams over the appraisal period are the source of the evaluation indicator calculation. The cost stream is prepared by allocating the yearly amount of project investment to meet the disbursement schedule in addition to the maintenance cost stream. In calculating the benefit stream, an appropriate annual increase in the rate of benefits shall be settled.

The yearly amount of cost/benefits shall be discounted to the present values of 1997 (as a base year). A discount rate having been applied is 12% per annum, which was confirmed in the discussions with MOWTC to be used for public sector investment appraisal.

The total present values of project costs (C) and the total present values of project benefits (B) are then obtained by the summation. Using B and C, 3 key indicators for evaluation are calculated as follows:

- Benefit-Cost Ratio : B/C
- NPV : B - C
- IRR : Discount rate making B = C,
  or making B/C = 1 or NPV = 0

15.2 Results of Economic Evaluation

(1) Estimated Economic Evaluation

Vehicle Operation Cost (VOC) savings and Time Cost (TC) savings were two of the benefit components considered in the study. The initial year benefits by package of projects were estimated as shown in Table 15.1.

Table 15.1 Economic Benefits in the Year 2005

Unit: Million Ushs.

Description	Package-I	Package-II	Package-III	Package-IV	Package-V
1. VOC savings	-	2,002.8	585.6	667.9	982.6
2. TC Savings	989.3	23.7	4.6	10.9	416.7
Total Benefit	989.3	2,026.5	590.2	678.8	1,399.3

(2) Evaluation Results and the Interpretations

The calculated evaluation indicators are tabulated in Table 15.2 below.

Table 15.2 Summary of Economic Evaluation Results

Evaluation Indicator	Package-I	Package-II	Package-III	Package-IV	Package-V	Whole Project
1. B/C	1.50	1.20	1.02	1.24	1.35	1.26
2. NPV (Million Ushs.)	1,936	1,819	52	633	1,675	6,116
3. IRR (%)	19.6	15.1	12.3	15.8	17.0	16.1

Remarks: B/C and NPV have been calculated at a discount rate of 12%.

In all, B/C is higher than 1, NPV is more than 0, and IRR is higher than 12%. The evaluation results indicate the project, not only the individual components but as a whole, is economically feasible.

Package-I containing 5 junction/roundabout improvements has the highest feasibility, followed by Package-V which is Hoima Road and Jinja Roundabout improvement. Package-II (Natete and Gaba Roads improvement) has the second biggest NPV but, if compared through B/C and IRR values, its feasibility shall be placed 4th next to Package-IV.

Package-III has the values of B/C and IRR just over the evaluation criteria; moreover, the obtained NPV is specifically low-valued. It can be said Package-III is marginally feasible. The reason for this low feasibility is the low level of future traffic forecast against the required costs for improvement.

The whole project implementation will have a favourable feasibility; B/C and IRR come after Package-V and it is obvious that NPV is the biggest because of the total sum of those of all project components. 16.1%, which is the IRR value of the whole project, shall be deemed as a benchmark of feasibility in this project implementation.

15.3 Socio-economic Impact

Besides direct benefits such as VOC savings and TC savings considered in the evaluation, the Projects are expected to produce many other benefits in intangible form. Some of these benefits are explained as follows:

(1) Encouragement or Stimulation of Economic Activity

An efficient urban traffic ensures smooth distribution of goods and easy transportation of people. Agriculture produce can be more easily brought into the city for consumption and for processing. Commuter and shopping movement will become easier. Input (raw materials) - output (processed products) relationships will be vitalized among the different economic sectors, especially industry. Commercial activities and the services sector are other beneficiaries in the effective distribution of goods and people. As a result, the level of economic activities will rise in the different sectors. All types of private business are encouraged through the provision of the improved road infrastructure, even investment.

(2) Promotion of the Planned Urban (or Regional) Development

The Project will provide the basic framework to allow the urban transport network to meet the demands of the structure plan formulated under the "Kampala Urban Study, 1994". Intensified land use will be promoted within the current usage as well as for the planned expansion of the different land use proposals in the future. Inter-area linkage among the strategic population clusters with various land uses is also expected to become closer. Residential areas will be more closely connected to industrial areas, commercial centres and various service facilities. The potential suburban area might be encouraged towards new development associated with the planned location of sub-centres (Nakawa, Bwaise, Natete and Kibuye). Dispersion of city centre functions to these sub-centres and further to suburban areas will be realized by way of the improved corridors. Haphazard urban sprawl might be prevented by the construction of planned facilities with their different functions. The planned regional development will be accelerated in a more streamlined manner.

(3) Enhancement of Access to Essential Government Services

It is foreseen that the accessibility to public service facilities will be improved. These include hospitals (health), schools (education), water/sanitation, police stations (security), and other government offices. Public services will be improved for the potential beneficiaries in Kampala City. The incidence of poverty is highly connected to the lack of these facilities.

(4) Improvement of the Roadside Environment

Effects to the roadside environment will be:

- Decrease of air pollution in proportion to the decrease of travel distance, as traffic efficiency is improved,
- Improvement of road space by the provision of trees, lighting and other ancillary facilities and furnitures,
- Provision of safety measures for motorists, cyclists pedestrians and residents, and
- Alleviation of inundation in the surrounding flood-prone areas by the provision of roadside and/or crossing drainage systems.

(5) Negative Impact

Foreseeable negative socio-economic impacts include:

- Inflation due to the increased inflow of construction workers during the construction period and stimulated economic activities after the opening of project roads,
- Compensation required for the resettlement of the affected people, which arises from the road improvement works,
- Noise and vibration during the construction period,
- Dust caused by abandoned borrow pits and quarries, and
- Soil erosion on the embankment, cuts and slopes.

15.4 Financial Considerations

Financial aspects related to the project implementation have been analyzed, so as to assure the financing possibility as well as fund availability.

Table 15.3 summarizes the required investment amounts and their disbursement, indicated both in Ushs. and US$.

Table 15.3 Project Investment Cost and Disbursement

Year	In Ushs. Million	In US$ Million
1998	5,132.7	4.9
1999	4,668.7	4.5
2000	10,283.8	9.9
2001	5,522.1	5.3
2002	5,561.0	5.3
2003	10,515.4	10.1
2004	1,025.3	1.0
Total	42,709.0	41.0

Remarks: Exchange Rate: US$1 = Ushs. 1,042.52

Table 15.4 shows the MOWTC Budget in Fiscal Year (FY) 1994/95 through FY 1996/97. The Budget comprises Recurrent and Development accounts, of which closely related to the project is the latter; especially, Development Expenditure financed by donor funds.

Table 15.4 MOWTC Budget, 1994/95 to 1996/97

Unit: Ushs. Million

Fiscal Year	Recurrent Expenditure	Development Expenditure		
		Donor	Local	Total
FY 1994/95	10,652.3	46,142.3	11,462.0	57,604.3
FY 1995/96	8,649.7	43,597.3	12,738.9	56,336.2
FY 1996/97	8,272.8	45.8089 *	26,899.7	73,624.8

Remarks: (1) * : In US$ Million

(2) : All figures are the approved amount under MOF authorization

Source: MOWTC Budget Statement, 1994/95 to 1996/97

Table 15.5 gives the cost estimates for the First Road Sector Project that is the first phase of the "10-year Road Sector Development Programme". The MOWTC Budget shall be placed within the framework of the First Road Sector Project. Most important is a category of "Network Improvement" with donor assistance. A provisional financing plan has already been set up, in which donor funds will be disbursed to cover almost 83% of total requirements in the category.

Table 15.5 Estimated Costs for the First Road Sector Project

Unit: US$ Million

Project Category	GOU Fund	Donor Fund	Total
1. Maintenance and Rehabilitation	144.6	86.9	231.5
2. Improvement	34.5	571.8	606.3
3. Administration	3.3	62.8	66.1
Total	182.4	721.5	903.9

Remarks: (1) The First Road Sector Project is the 1st phase of the "10-year Road Sector Development Programme", covering the period July 1996 to June 2001.

(2) A provisional financing plan for the Project has already been established, in which US$776.8 million would be financed out of the total requirements estimated as above.

(3) In the financing plan, donor funds for "Improvement" will be disbursed:

FY 1996/97	:	37.4
FY 1997/98	:	83.9
FY 1998/99	:	107.1
FY 1999/00	:	111.0
FY 2000/01	:	112.8

, by which 83% of total requirements of donor funds in the category would be covered.

Source: "The First Road Sector Project-Progress Report (March 1997)", MOWTC.

If compared to MOWTC Development Expenditure (Donor) in FY 1996/97, the 1st-year (1998) investment cost of the project corresponds to 10.7%. In the next year (1999), the investment amount occupies less than 10% to the same amount in FY 1996/97.

The yearly amount of financial investment costs of the project will not surpass one-tenth of the scheduled disbursement of donor funds in the category of "Network Improvement" for the First Road Sector Project.

From these discussions, the annual amount of project investment cost has proved to correspond to at most 10% of the available or already scheduled fund resources. The financing of the project is therefore well justifiable in connection with the resource use as well as fund availability.

16. CONCLUSION AND RECOMMENDATION

16.1 Conclusion

The feasibility study proved that the high priority projects select in the master plan study are technically, economically and environmentally viable with a high economic internal rate of return.

The projects should be implemented as early as possible according to the implementation schedule proposed in Fig. 14.1. The projects involve no requirements for land/house acquisition, resettlement and compensation for commercial activities.

16.2 Recommendation

In order to materialize the projects, the Study Team recommends MOWTC to take the following actions:

(1) Allocation of a Local Budget for Project Preparation

The project does not involve procedures such as the acquisition of additional land, demolition of housing/building and resettlement of residents, however, it is necessary for MOWTC to prepare local funds for the relocation of electric and telephone poles in limited areas.

Acquisition of local funds for these preparatory works and disbursement of expenses on time are a prerequisite for the smooth implementation of the project.

(2) Strengthening of the Maintenance Capability of MOWTC

For the utilization of materialized traffic facilities by the project, maintenance works have to be provided in an organized manner with strengthening of the MOWTC maintenance unit.

This requires,

- Strengthening and organization of the maintenance unit,
- Education and training of personnel, and
- Installation of maintenance equipment and machinery.

Table 16.1 Priority Order of Short Term Program

Priority	Proposed Project	Expected Effect on Urban Traffic Improvement
First Priority Projects to be executed during (1998 - 2001)	[Package 1] - Improvement of five (5) junctions which are hindering smooth urban traffic flow. Five junctions include, Port Bell/Jinja Road Junction, Kibuye Junction, Natete Junction, Wandegeya Junction Makerere Junctions.	• Reduction of queuing delay • Streamlining of traffic flow on the connected roads • Reduction of traffic accidents at junctions where most of the traffic accidents are taking place at present.
	[Package 2] - Improvement of Natete Road where the road condition is substandard compared with growing traffic demand due to potential accessibility of this road connecting the western part of the city with northern part.	• Reduction of traffic concentration in the city center due to inducement of traffic which bypass the city center.
	- Improvement of Gaba Road, where the pavement has deteriorated the traffic volume is drastically increasing due to rapid residential development in nearby area.	• Easy access between a suburban area and the central business district.
Second Priority Projects to be executed during (2001 - 2005)	[Package 3] - Improvement of Port Bell Road, where the road capacity is expected to be saturated in near future due to the rapid deterioration of road surface as a result of increasing industrial related heavy vehicles.	• Strengthening of function of road radiating to the south east area of the district.
	[Package 4] - Improvement of Gayaza Road, where deterioration of the pavement is progressing with the passage of inter regional heavy vehicles.	• Strengthening of function of radial road connecting northern part of the region with Kampala city.
	[Package 5] - Improvement of Hoima Road	• Strengthening of function of radial road connecting northern eastern region with Kampala city
	- Improvement of Jinja Road Junction, which is one of the bottleneck junctions in urban traffic flow. Coordinated implementation with Nakiuubo Channel Improvement Program to be financed by EU is requested.	• Reduction of queuing delay. • Streamlining of traffic flow on the connected roads. • Reduction of traffic accidents at the junction and in the nearby area.

(3) Reinforcement of Traffic Legislation, Institutional Build-up and Promotion of Traffic Education

It is strongly recommended that in parallel with the physical development of transport infrastructure, support is given to the development of institutions, legislation and education related to traffic affairs.

(4) Coordination with related Ongoing/Proposed Development Scheme

It is also recommended that the Project should be coordinated with the ongoing/proposed development schemes of the city. These include the First Urban Project by Kampala City Council, KCC Car Park Project and Nakivubo Channel Development Project proposed by EU. Special attention should be paid to the water channel development project as it effects the design and engineering work of the project.

(5) Establishment of Comprehensive Legislation for Environmental Protection

It is predicted that the environmental situation will worsen due to an increase in traffic and intensified urban landuse near the project sites. Therefore, it is recommended that the surveillance system for environment protection be strengthened with periodic motor vehicle inspections and the provision of a penalty code in case of violation of the above.

(6) Improvement of Public Transport Services

It is expected that the matatu will remain as the major means of road transport in the city for the foreseeable future. However, at present this public transport is operated in a disorderly manner and service level is substandard. It can be predicted that the improved roads will be used chaotically for this public transport, should strict regulation on those vehicles and/or improvement measures of services not be undertaken.

(7) Establishment of Construction Yard

A construction yard for the purpose of project execution should be established at a suitable location considering all the project sites. The site requires about 10,000 sq. meters for the office, stock yard for construction machinery and equipment. The site which is now used as the construction yard for Entebbe road under the EU project is recommended to be used for the project, with the arrangement of MOWTC. The location of the base camp is shown below.

(8) Implementation of the Project under a Sub-contractor Method

For the purpose of reducing the project cost, it is strongly recommended that the Project should be implemented under a sub-contractor method, utilizing the machinery and equipment held by Ugandan contractors as much as possible. The sub-contractor is to be selected on the basis of their capability in terms of earth work, pavement work, drainage work, and so on.

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