

ANNEX 11 BACK DATA FOR PUBLIC TRANSPORT

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A11.1 ANALYSIS OF BRT CAPACITY AND OPERATION

A11.1.1 BRT CAPACITY AND FUTURE BRT EXPANSION

Based on present and future travel demand estimated by the BRT study, the present and future total travel time savings by each BRT route have been summarized as shown in Table A11.1.1.

The result shows that the first implementation projects in Jinja Road, Bombo Road and Gayaza Road have the highest effects among nine routes. Gaba Road and Port Bell Road are classified as second priority routes.

Table A11.1.1 Evaluation of Transport Demand and Project Effects

Route	Route Length (L) (km)	Existing Travel Time by Minibus (A*) (min)	Existing Travel Speed by Minibus (C) (Km/hr)	Travel Time by BRT (B) (mini)	Travel Speed by BRT (D) (Km/hr)	Existing Time Saving (A-B) (min)	Existing Time Saving ((A-B)/A) (%)	Existing Speed Improved (D/C) (%)	Future Travel Speed by Minibus except BRT (F)	Future Speed Improved (D/F) (%)	2013 two-way daily demand (E) (000 pass'gers)	Existing Daily Travel Time Saving (A-B)*E (000hr.man/day)	2023 two-way daily demand (G) (000 pass'gers)	2023 Daily Travel Time Saving E*(A-B) (000hr*man/day)
Bombo Rd	11	103	13	54	24	49	48%	191%	6	381%	80.7	65.9	140.0	232.3
Gayaza Rd	9	92	12	45	24	47	51%	204%	6	409%	58.2	45.6	110.0	163.0
Hoima Rd	11	101	13	54	24	47	47%	187%	6	407%	55.4	43.4	110.0	178.4
Kira Rd	7	84	10	40	21	44	52%	210%	6	350%	37.5	27.5	70.0	95.3
Jinja Rd	22	131	20	106	25	25	19%	124%	6	415%	133.3	55.5	330.0	680.2
Entebbe Rd	14	86	20	69	24	17	20%	125%	6	406%	105.5	29.9	230.0	311.8
Masaka Rd	19	106	22	93	25	13	12%	114%	9	272%	82.6	17.9	150.0	254.4
Gaba Rd	11	70	19	58	23	12	17%	121%	9	241%	33.1	6.6	60.0	67.7
Port Bell Rd	11	69	19	60	22	9	13%	115%	9	244%	19.8	3.0	30.0	33.3

Source: BRT Pre-feasibility study report

*: Existing two-way travel times

Source: JICA Study Team

The table also shows that the highest daily demand on Jinja Route will become 330,000 passengers for both directions in 2023. Peak hour traffic in one direction will be about 10-20% of half of the daily demand. Therefore, peak hour demand will reach 16,500-33,000 passengers per hour per direction in 2023.

Table A11.1.2 shows the comparison of BRT operations in the world. The highest capacity of BRT is in Bogota with more than 40,000 passengers per hour per direction. Second is in Guanzhou City with 25,000 passengers per hour per direction. Meanwhile, most BRT in other cities show less than 10,000 passengers per hour per direction. The main reasons for capacity limit are the following:

- Percentage of stations having overtaking lanes,
- Percentage of high capacity bus, and
- Number of buses going to the city center per hour per direction.

Table A11.1.2 Comparison of Bus Rapid Transit (BRT) in the World

Comparison of Bus Rapid Transit (BRT) in the World

Item	Netherlands Amsterdam	Australia Brisbane	Egypt Cairo	India Delhi	Thailand Bangkok	Indonesia Jakarta	Colombia Bogota	Mexico Mexico City	Ecuador Quito	Beijing Beijing	Chongqing Chongqing	Dalian Dalian	Guangzhou Guangzhou	Hangzhou Hangzhou	Hefei Hefei	Jinan Jinan	Kunming Kunming	Xiamen Xiamen	Zhengzhou Zhengzhou	Nigeria Lagos	Uganda Kampala	
Population (Metropolitan Area)	2.2 M (2000)	1.8 M (2000)	10.0 M (2000)	10.0 M (2000)	10.0 M (2000)	24.0 M (2000)	7.0 M (2000)	20.0 M (2000)	2.1 M (2000)	16.0 M (2000)	4.0 M (2000)	6.1 M (2000)	10.0 M (2000)	8.0 M (2000)	4.3 M (2000)	5.7 M (2000)	6.0 M (2000)	2.4 M (2000)	7.0 M (2000)	16 M (2000)	2.5 M (2000)	
1. Commencement of Service	2001	2001	Oct 2009	Jul 2004	May 2010	2004	2000	2005	2003	2004	Jan 2008	Jan 2008	Feb 2010	2006	2010	Apr 2008	2008	Sep 2008	May 2008	Mar 2008	2012	
2. System passenger-LTR per day	100,000	6,800	35,000	1,000	1,000	230,000	1,450,000	260,000	120,000	4,100	6,200	5,700	25,000	800,000	3,150	3,600	8,600	3,600	4,200	-	10,000	
3. Peak ridership	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	No	No	No	No	No	No	Yes/No	No	
4. Actual peak ridership over 10,000 passengers per hour per direction	Yes/No (some yes)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes/No (Conn 1)	Yes	Yes	Yes	Yes	Yes	Yes/No (Conn 1)	Yes	Yes	Yes/No (Conn 1)	Yes/No (Conn 1)	Yes	
5. Passenger volume greater than a mixed traffic lane (6,300 implied)	2 (more)	5	1	1	1	8 (more)	6	1	3	1	1	1	1	1	1	4	5	2	1	1	1	3
6. Number of trunk corridors	2	-	-	1	1	-	84	1	-	4	-	1	No (D)	No (D)	No (D)	-	-	-	-	-	-	-
7. More than one BRT operator	No (D)	No (D)	Yes	No (D)	No (D)	Yes	Yes	No (D)	Mostly Center	Mostly Center	Mostly Center	Mostly Center	Mostly Center	Mostly Center	Mostly Center	Mostly Center	Mostly Center	Mostly Center	Mostly Center	Mostly Center	Mostly Center	Mostly Center
9. Location of busway lanes	Dedicated Roadway	Dedicated Roadway	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center	Center
10. Segregated busways or bus-only lanes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes/No (Conn 1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11. Total length of dedicated busway (km)	38.8 incl 14 busway lane	19.3	43.0	12.5	11.9	124.0	84.0	28.5	-	34.5	41.0	9.0	22.5	17.4	7.7	34.4	46.7	38.2	26.6	87%	26.6	
12. Length including raised traffic corridors (km)	44.0	19.3	44.4	12.5	15.3	125.0	86.5	28.5	-	54.0	44.9	13.7	22.5	44.0	7.7	34.4	46.7	40.2	30.5	22.0	30.5	
14. Overlapping lanes > more than half of all stations	No	Yes	No (not functioning)	No	No	No	Yes	No	No	No	No	No	Yes	No	Yes/No	No	No	No	No	No	No	
15. Percentage of stations having boarding lanes	0%	76%	-	0%	0%	-	100%	0%	-	12%	11%	8%	100%	0%	100%	4%	6%	7%	26%	-	26%	
16. Includes BRT-only tunnels or bridges	Yes	Yes	Yes	Yes/No (over)	No	No	Yes	No	Yes	No	No	No	No	No	No	No	No	No	No	Yes/No	No	
17. Majority of bus passenger demand in the corridor met by BRT buses	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
18. Bicycles stored for bus passengers	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
19. High peak period operational speed (km/hr)	35	Up to 29	12-14	22	-	-	18-28	-	-	21	17-19	31	23-25	18	15-17	11-13	11-14	29	70	40-50	70	
20. City center peak hour speed	10	17%	700	12	-	-	310	60	60	55	70	75	304	65	60	40	140	50	40-50	-	40-50	
21. Balance of station environment (more than just a bus stop)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
22. Station size based on passenger	No	No	No	No	No	No	Yes	No	Yes	No	No	No	Yes	No	Yes/No	No	No	No	No	No	Yes	
23. Number of stations	30	17	73	70	12	145	115	45	-	60	51	13	26	17	9	46	63	30	38	30	38	
24. Average distance between stations	1,500	1,500	600	550	1,000	790	635	635	-	940	900	1,440	880	1,250	870	760	500	1,300	800	1,300	800	
25. Number of stations with boarding	0	13	-	0	0	-	115	0	14 (Conn 2)	7	0	1	26	0	9	2	4	2	10	10	10	
26. Stations away from interchanges	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
27. Bicycle parking at BRT stations	Yes (foot all)	Yes	Yes	Yes	Yes	No	Yes (some)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
28. Dedicative BRT buses	No	No	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
29. High capacity BRT buses	No (90% special 12m)	No	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
30. Capacity of Bus Passengers	37	12 m/2 doors	10-11 m/2 doors	12 m	12 m	12 m (some 18m)	14.5 m/4 doors	16 m/4 doors	upto 17 m	15.5 m/3 doors	17.7 m	17 m	17 m	18.5 m (also 11m)	12 m	18.5 m	18.5 m	18.5 m	18.5 m	18.5 m	18 m	
31. BRT vehicle height and No. of Doors	18 m/3 doors	12 m	12 m	12 m	12 m	12 m (some 18m)	18.5 m/4 doors	16 m/4 doors	upto 17 m	15.5 m/3 doors	17.7 m	17 m	17 m	18.5 m (also 11m)	12 m	18.5 m	18.5 m	18.5 m	18.5 m	18.5 m	18 m	
32. At level boarding and alighting lanes gap (level bus sometimes)	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
33. BRT buses paid for by operators rather than government budget	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	
34. No operational subsidy from government needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	
35. Dedicative BRT buses	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	Subsidy needed	

Note: *Lines 1 and 2 under massive new elevated roads
Source: BRT Information and Maps, China Bus Rapid Transit, ** Lagos BRT from LAMATA, Nigeria

In Bogota's case, a high capacity of 45,000 passengers per hour per direction is enabled by the complete overtaking lanes and high percentage of high capacity buses. And if BRT has less than 100% of overtaking lanes and less than 100% of high capacity buses, peak hour passengers will decrease to less than 10,000.

It is clear that if road space is sufficient for the installation of BRT overtaking lanes and if high capacity buses are provided, the BRT's capacity reaches maximum. In the Pre-Feasibility Study of BRT, 12.0 m rigid buses with maximum capacity of 105 passengers were proposed and also overtaking lanes were not installed at every station. The expected capacity of BRT will be less than 10,000 passengers per hour per direction. The calculation is shown in the following table.

Table A11.1.3 Assumptions of Capacity Calculation of BRT

BRT Capacity (Route Operation with Fare collection)		6,000pass/way/hour										10,000pass/way/hour										20,000pass/way/hour										30,000pass/way/hour									
Bus type	vehicle length (m)	Crush capacity (passengers)	33%1.5-50%Alight/Boarding times (sec)	Boarding times *1.5 (sec)	Numbers of Vehicle required	Arrival Frequency (minutes)	Boarding time (minutes)	Vehicles on Stop	Length of station (m)	length of station less than 80m	numbers of BRT lane at station	Numbers of Vehicle required	Arrival Frequency (minutes)	Boarding time (minutes)	Vehicles on Stop	Length of station (m)	length of station less than 80m	numbers of BRT lane at station	Numbers of Vehicle required	Arrival Frequency (minutes)	Boarding time (minutes)	Vehicles on Stop	Length of station (m)	length of station less than 80m	numbers of BRT lane at station	Numbers of Vehicle required	Arrival Frequency (minutes)	Boarding time (minutes)	Vehicles on Stop	Length of station (m)	length of station less than 80m	numbers of BRT lane at station									
minibus	5	14	7	35	428	0.1	0.6	6	62	O	3/4	714	0.1	0.6	9	89	x	3/4	1429	0.0	0.6	15	134	x	3/4	2143	0.0	0.6	22	197	x	3/4									
corch	7	25	12.5	50	240	0.3	0.8	4	61	O	3/4	400	0.2	0.8	7	92	x	3/4	800	0.1	0.8	12	133	x	3/4	1200	0.1	0.8	18	194	x	3/4									
standard	10	60	30	90	100	0.6	1.5	4	70	O	3/4	167	0.4	1.5	5	103	x	3/4	333	0.2	1.5	9	131	x	3/4	500	0.1	1.5	14	189	x	3/4									
2door bus	12	100	50	75	60	1.0	1.3	2	54	O	3/4	100	0.6	1.3	3	74	O	3/4	200	0.3	1.3	5	83	x	3/4	300	0.2	1.3	7	116	x	3/4									

Strengthened BRT Capacity (Area Operation and Closed)		6,000pass/way/hour										10,000pass/way/hour										20,000pass/way/hour										30,000pass/way/hour									
Bus type	vehicle length (m)	Crush capacity (passengers)	50%Alight/Boarding times (sec)	Boarding times *1.5 (sec)	Numbers of Vehicle required	Arrival Frequency (minutes)	Boarding time (minutes)	Vehicles on Stop	Length of station (m)	length of station less than 100m	numbers of BRT lane at station	Numbers of Vehicle required	Arrival Frequency (minutes)	Boarding time (minutes)	Vehicles on Stop	Length of station (m)	length of station less than 100m	numbers of BRT lane at station	Numbers of Vehicle required	Arrival Frequency (minutes)	Boarding time (minutes)	Vehicles on Stop	Length of station (m)	length of station less than 100m	numbers of BRT lane at station	Numbers of Vehicle required	Arrival Frequency (minutes)	Boarding time (minutes)	Vehicles on Stop	Length of station (m)	length of station less than 100m	numbers of BRT lane at station									
2door bus	12	100	50	25	60	1.0	0.4	1	24	O	2	100	0.6	0.4	2	48	O	3/4	200	0.3	0.4	2	32	O	3/4	300	0.2	0.4	3	48	O	3/4									
Articulate 2-3door bus	18	150	75	25	40	1.5	0.4	1	36	O	2	67	0.9	0.4	1	36	O	2	133	0.5	0.4	2	44	O	3/4	200	0.3	0.4	2	44	O	3/4									
Articulate d LRT	24	200	100	25	30	2.0	0.4	1	48	O	2	50	1.2	0.4	1	48	O	2	100	0.6	0.4	2	56	O	3/4	150	0.4	0.4	2	56	O	3/4									
Articulate d LRT	36	300	150	25	20	3.0	0.4	1	72	O	2	33	1.8	0.4	1	72	O	2	67	0.9	0.4	1	40	O	2	100	0.6	0.4	2	80	O	3/4									
Articulate d LRT	48	400	200	25	15	4.0	0.4	1	96	O	2	25	2.4	0.4	1	96	O	2	50	1.2	0.4	1	52	O	2	75	0.8	0.4	2	100	O	3/4									

Source: JICA Study Team

Source: JICA Study Team

The calculation is based on the assumption that the arriving period of BRT is less than 30 seconds and the number of stopping buses is over four at the same time. In this case, the necessary length of the station is 80 m. Also, it is difficult for the aged or young passengers to ride the buses promptly. Therefore, the capacity of BRT decreases due to delay of bus departure or reduction of bus frequency.

Table A11.1.3 also shows that if the bus for BRT is changed to 18.0 m articulated buses with maximum capacity of 195 passengers (which the BRT report recommends), then the capacity of BRT will increase to about 20,000 passengers per hour per direction. Change of the operation system for closed routes and closed stations are also necessary. Based on the proposed network of BRT, all routes are concentrated in the city center and take the same track to the three roads (Kampala Road, Entebbe Road and Ben Kiwanuka Street). Therefore, the limitation of BRT system's capacity will be at those roads. Moreover, if passenger demand will exceed the capacity of those roads, the recommended system above shall be considered for the future.

A11.1.2 BRT OPERATION

Based on passenger demand, priority routes, and the proposed BRT system in the Draft Final Report of the BRT Project, the operational plan of each priority route has been assumed as shown in Table A11.1.4.

Table A11.1.4 Assumption of BRT Operational Plan

Item	Year	Route No.	Route Name	Route length (km)	Future/plan				2018 BRT Operational Plan						2023 BRT Operational Plan						
					Future Minibus Travel Speed	Future BRT Travel Speed 1	Future BRT Travel Speed 2 (express bus included)	BRT Bus Passenger Capacity 1	BRT Bus Passenger Capacity 2	2018 two-way daily demand (000 men)	2018 Peak Demand (000 men/hr /direc)	2018 Peak hour Bus Head (min) (bus1)	2018 Peak hour Bus Head (min) (bus2)	2018 Number of BRT Bus required (bus1)	2018 Number of BRT Bus required (bus2)	2023 two-way daily demand (000 men)	2023 Peak Demand (000 men/hr /direc)	2023 Peak hour Bus Head (min) (bus1)	2023 Peak hour Bus Head (min) (bus2)	2023 Number of BRT Bus required (bus1)	2023 Number of BRT Bus required (bus2)
Basic Data	A2	Gayaza	8.8	6	24	40	100	200	82	4.1	1.5	2.9	25	12	110	5.5	1.1	2.2	27	13	
	A1	Jinja	21.9	6	25	40	100	200	220.3	11.0	0.5	1.1	163	82	330	16.5	0.4	0.7	199	99	
	B4	Port Bell	11.1	9	22	100	200	200	26.3	1.3	4.6	9.1	15	7	30	1.5	4.0	8.0	17	8	
	B3	Gaba	11.2	9	23	100	200	200	45.7	2.3	2.6	5.3	24	12	60	3	2.0	4.0	32	16	
	B1	Entebbe	14.1	6	20	40	100	200	160.4	8.0	0.7	1.5	83	41	230	11.5	0.5	1.0	89	45	
	B2	Masaka	19.1	9	22	100	200	200	114.2	5.7	1.1	2.1	109	55	150	7.5	0.8	1.6	143	72	
	A4	Hoima	10.7	6	24	100	200	200	79.6	4.0	1.5	3.0	39	20	110	5.5	1.1	2.2	54	27	
	A1	Bombo	10.9	6	24	40	100	200	110.1	5.5	1.1	2.2	41	21	140	7	0.9	1.7	42	21	
	A3	Kira	7.4	6	21	40	100	200	51.9	2.6	2.3	4.6	14	7	70	3.5	1.7	3.4	14	7	
			Total	115.2									312	158					371	183	
BRT Operatin Plan	2018	A1+A2	Jinja-Bombo-Gayaza	41.6	6	25	40	100	200	192.1	9.6	0.6	1.2								
		A1+B	Jinja-Entebbe	36	6	23	40	100	200	160.4	8.0	0.7	1.5								
		Total		77.6	6	24	40	100	200	352.5	17.6										
	2023	A1+A2	Jinja-Bombo-gayaza	41.6	6	25	40	100	200							250	12.5	0.5	1.0		143
		A1+B	Jinja-Entebbe	36	6	23	40	100	200							230	11.5	0.5	1.0		114
		A3	Kira	7.4	6	21	40	100	200							70	3.5	1.7	3.4		14
	Total		85	6	23	40	100	200							236					14	257
Alternative Operation Plan	2018	A1+B	Jinja-Entebe	36	6	23	40	100	200	160.4	8.0	0.7	1.5								
		A1	Jinja-Bombo	32.8	6	25	40	100	200	110.1	5.5	1.1	2.2	122							
		A2	Gayaza	8.8	6	24	40	100	200	82	4.1	1.5	2.9	25							
		Total		68.8	6	24	40	100	200	270.5	13.5			122							
	2023	A1+B	Jinja-Entebe	36	6	23	40	100	200							230	11.5	0.5	1.0		114
		A1	Jinja-Bombo	32.8	6	25	40	100	200							140	7.0	0.9	1.7		126
A2		Gayaza	8.8	6	24	40	100	200							110	5.5	1.1	2.2		27	
	A3	Kira	7.4	6	21	40	100	200							70	3.5	1.7	3.4		14	
	Total		85												550	27.5				167	114

Source: BRT Draft Final Report

The points of the operation plan are as follows:

- What type of vehicle to be used?
- How many vehicles required for the operation of each route?
- How frequently the buses operate (vehicle head)?
- How many bus routes are in operation?

(1) Type of Vehicles

In order to minimize the initial investment cost, buses with 12 m length are supposed to operate for the pilot route. But due to rapid increase of passenger demand which the BRT Pre-Feasibility Study estimated, bus operation frequency will become 30 seconds on Jinja Route and 42 seconds on Entebbe Route in 2018. The frequency will become higher in 2023. This frequency will exceed the capacity of the operation of 12 m length buses as shown in the previous section. Therefore, articulated buses with 18 m length will be necessary soon after the operation of the pilot route has commenced, as shown in Table A11.1.4.

(2) Route, Frequency and Number of Vehicles Required for Each Route

The column on basic data in Table A11.1.4 shows the information of each bus route including the necessary number of buses. The total number of BRT buses in the column of basic data is the sum of each bus route. Space available in the city center is insufficient for the increasing number of buses coming into the center. This will bring the same situation as that of the existing traffic congestion in the center.

- Original Operation Plan

The pilot route in the BRT Pre-FS plan consists of Jinja Route, Bombo Route and Gayaza Route, and Entebbe Route in the next stage. Comparing the required numbers of Jinja, Bombo and Gayaza Routes, the demand of Jinja Route is much higher than the other two (Bombo and Gayaza Routes). Therefore it will be better to pass from Jinja Route to Entebbe Route because

demand in Entebbe Route is in equilibrium with Jinja Route. Based on the results of analysis on the bus operation plan of each route, the required number of articulated buses will become more than 200 in 2018. Also, the required number of articulated buses will become more than 250 in 2023.

- Proposed Alternative Operation

Observing passenger demand in the network of BRT in 2018, the highest passenger demand is estimated to be at the Jinja and Entebbe routes. Therefore, the route from Jinja to Entebbe will provide consistent service level for both routes. Moreover, the route from Jinja to Bombo will be evaluated by passenger demand on both routes. Gayaza Route will be evaluated further. From the results of trial calculation of the bus operation plan, the required number of buses is about 120 of 12 m length and 100 articulated. In 2023, the required number of 12 m length buses and articulated buses is about 170 and 110, respectively. The capacity will almost be the same as 200 articulated buses, and the total cost will be cheaper than the BRT Pre-FS plan.

The trial calculation and its results are one of the proposals for the feasibility study and detailed design of BRT. What is pointed out here is that even if BRT is introduced, traffic concentration to the city center is still a crucial issue in GKMA.

A11.2 BREAKDOWN OF FINANCIAL ANALYSIS

(1) Income

- Fare: Considering the result of the traffic survey, large bus fare per kilometer is presumed at UShs 120 and the base fare is presumed at UShs 500. The fare to the terminal of each large bus route is as follows.

Table A11.2.1 Bus Fare to the Terminal

Route		Bus Fare to the Terminal (UGX)
No.	Name	
D1	Natete Route	1,000
D2	Munyonyo Route (A)	900
D3	Munyonyo Route (B)	1,300
D4	Sentema Route	900
D5	Kiwatule Route	1,400
D6	Kigowa Route	1,300

Source: JICA Study Team

Since not all the passengers go to the terminal, the average fare is the mean value of fares along the route as shown in the next table.

Table A11.2.2 Average Bus Fare

Route		Average Bus Fare (UGX)
No.	Name	
D1	Natete Route	740
D2	Munyonyo Route (A)	680
D3	Munyonyo Route (B)	920
D4	Sentema Route	680
D5	Kiwatule Route	930
D6	Kigowa Route	890

Source: JICA Study Team

- Operation receipts: Annual operation receipts are estimated by the average bus fare, and leakage of 10% is deducted. The following table shows the annual operation receipts.

Table A11.2.3 Annual Operation Receipts

Route		Annual Operation Receipts (USD)
No.	Name	
D1	Natete Route	1,382,600
D2	Munyonyo Route (A)	8,303,100
D3	Munyonyo Route (B)	1,465,500
D4	Sentema Route	390,700
D5	Kiwatule Route	7,288,100
D6	Kigowa Route	5,413,600

Source: JICA Study Team

(2) Expenses

Unit cost of items is acquired from BRT Pre-feasibility study "Operating Cost and Commercial Viability" and from records of bus operating institutions of neighboring Rwanda and Burundi.

1) Variable costs

- Total travel distance: Total annual travel distance of large buses in each route is shown in the next table.

Table A11.2.4 Annual Travel Distance by Route

Route		Year	Annual Travel Distance ('000 km)
No.	Name		
D1	Natete Route	2018	923

D2	Munyonyo Route (A)	2018	5,291
D3	Munyonyo Route (B)	2018	1,080
D4	Sentema Route	2023	249
D5	Kiwatule Route	2023	5,397
D6	Kigowa Route	2023	3,904

Source: JICA Study Team

- Fuel: As the result of calculation of the average fuel consumption per travel of 0.35 l/km and by fuel cost of 1 USD/l, annual fuel cost is shown in the next table.

Table A11.2.5 Annual Fuel Cost

Route		Annual Fuel Cost (USD)
No.	Name	
D1	Natete Route	323,100
D2	Munyonyo Route (A)	1,852,000
D3	Munyonyo Route (B)	378,100
D4	Sentema Route	87,200
D5	Kiwatule Route	1,889,100
D6	Kigowa Route	1,379,100

Source: JICA Study Team

- Tire: Tire cost is calculated by the tyre cost of 0.04 USD/km as the following table.

Table A11.2.6 Annual Tire Cost

Route		Annual Tire Cost (USD)
No.	Name	
D1	Natete Route	36,900
D2	Munyonyo Route (A)	211,700
D3	Munyonyo Route (B)	43,200
D4	Sentema Route	97,000
D5	Kiwatule Route	215,900
D6	Kigowa Route	157,600

Source: JICA Study Team

- Spare parts cost: Spare parts consumption cost is acquired by the unit cost of 0.125 USD/km.

Table A11.2.7 Annual Spare Parts Cost

Route		Annual Spare Parts Cost (USD)
No.	Name	
D1	Natete Route	115,400
D2	Munyonyo Route (A)	661,400
D3	Munyonyo Route (B)	135,000
D4	Sentema Route	31,100
D5	Kiwatule Route	674,700
D6	Kigowa Route	492,500

Source: JICA Study Team

- License and insurance cost: 2,400 USD per year per vehicle including KCC trading license, TLB PSV license and comprehensive insurance.

Table A11.2.8 Annual License and Insurance Cost

Route		Annual License and Insurance Cost (USD)
No.	Name	
D1	Natete Route	31,200
D2	Munyonyo Route (A)	175,200
D3	Munyonyo Route (B)	33,600
D4	Sentema Route	96,000
D5	Kiwatule Route	165,600
D6	Kigowa Route	122,400

Source: JICA Study Team

➤ Total variable costs:

TableA11.2.9 Total Variable Cost

Route		Year	Total Variable Cost (USD)
No.	Name		
D1	Natete Route	2018	506,700
D2	Munyonyo Route (A)	2018	2,900,300
D3	Munyonyo Route (B)	2018	589,900
D4	Sentema Route	2023	137,800
D5	Kiwatule Route	2023	2,945,300
D6	Kigowa Route	2023	2,151,600

Source: JICA Study Team

2) Fixed Costs

➤ Number of staff

- Driver: The operation time of buses is set to be 16 hours from 6:00 to 22:00, and the necessary number of drivers is calculated in consideration of two shifts and change for rests.
- Service staff: Equivalent to the number of drivers.
- Maintenance staff: necessary number is set to be 0.3 persons per vehicle.
- Office staff: Necessary number is set to be 0.6 persons per vehicle including manager.

The total number of staff is shown in the below table.

TableA11.2.10 Number of Staff

Route		Driver	Service staff	Maintenance staff	Office staff	Total
No.	Name					
D1	Natete Route	37	37	4	9	87
D2	Munyonyo Route (A)	214	214	22	45	495
D3	Munyonyo Route (B)	37	37	4	9	87
D4	Sentema Route	10	10	1	3	24
D5	Kiwatule Route	178	178	21	42	419
D6	Kigowa Route	132	132	15	32	311

Source: JICA Study Team

➤ Wage: Monthly salary of bus operating company staff is set as shown in the following table.

Table A11.2.11 Monthly Salary of Staff

Driver	UShs 500,000
Service Staff	UShs 250,000
Maintenance Staff	UShs 400,000
Office Staff	UShs 350,000
Manager	UShs 750,000

Source: JICA Study Team

Based on the table above, the total annual wage is estimated as shown in the following table.

Table A11.2.12 Annual Staff Cost

Route		Annual Staff Cost	
No.	Name	Thousand UShs	USD
D1	Natete Route	394,800	173,700
D2	Munyonyo Route (A)	2,225,400	979,100
D3	Munyonyo Route (B)	394,800	173,700
D4	Sentema Route	112,200	49,400
D5	Kiwatule Route	1,884,000	828,900
D6	Kigowa Route	1,399,200	615,600

Source: JICA Study Team

- Rent for bus depot and office: Necessary area for bus depot is set at 105 m² per bus. The necessary area for office is set to be 10 m² per office staff. The annual rent for bus depot and office is shown in the following table.

Table A11.2.13 Annual Rent for Bus Depot and Office

Route		Bus Depot		Office	
No.	Name	Area (m ²)	Rent USD	Area (m ²)	Rent USD
D1	Natete Route	1,365	1,800	90	21,600
D2	Munyonyo Route (A)	7,665	10,100	450	108,000
D3	Munyonyo Route (B)	1,470	1,900	90	21,600
D4	Sentema Route	420	600	30	7,200
D5	Kiwatule Route	7,245	9,600	420	100,800
D6	Kigowa Route	5,355	7,100	320	76,800

Source: JICA Study Team

- Layout plan for bus depot

Each bus association will prepare bus depots for bus parking out of the road, bus maintenance and inspection for safe daily operation. The size of each bus depot shall be determined by the total number of bus fleet.

Table A11.2.14 shows the number of bus fleet required and the typical size of bus depot for each bus route consisting of 1,600 m² area (type 1) for 10 buses, 2,600 m² area (type 2) for 20 buses, 8,000 m² (type 3) for 60 buses and 10,000 m² area (type 4) for 80 buses. Figure A.11.2.1 shows the typical layout plan for each of the four types of bus depots.

Table A11.2.14 Typical Size of Bus Depots

Route Name	Necessary Fleet at Opening Operation	Typical number of garaged vehicles	Depot Area (m ²)
Natete Route	13	20 (type 2)	2,600
Munyonyo Route A	73	80 (type 4)	10,000
Munyonyo Route B	14	20 (type 2)	2,600
Sentema Route	4	10 (type 1)	1,600
Kiwatre Route	69	80 (type 4)	10,000
Kigowa Route	51	60 (type 3)	8,000

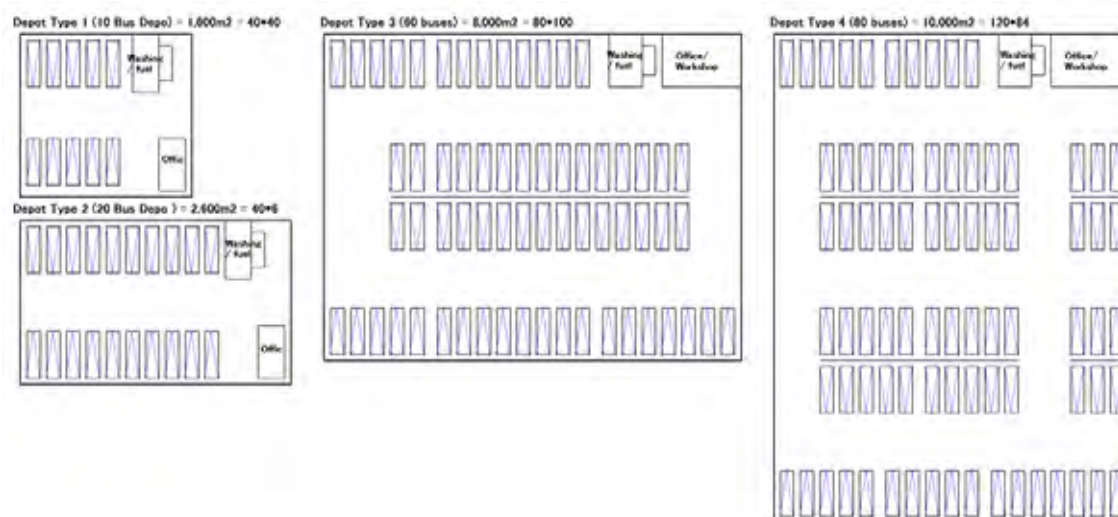


Figure A11.2.1 Typical Layout Plan of Bus Depot

3) Administrative Cost

Through the analysis of bus institutions of neighboring countries, administrative cost is

considered to be equivalent to the total cost of fixed cost.

4) Refund

➤ Refund of bus body:

Import Tax: Common external tariff, EAC, 2007.

Import Duty – 25%

COMESA Duty – 6%

VAT – 18%

Lending interest rate: Commercial bank rates for January 2010: 21.90%, Bank of Uganda

TableA11.2.14 Refund of Large Bus

Item	Price	
Vehicle body	USD 66,000	55 seats diesel bus, 2009 Model
Transport	USD 1,700	Mombasa – Kampala
Import Tax	USD 32,340	49%
Vehicle cost total	100,040	
Lending interest rate	22%	Commercial bank rates for January 2010: 21.90%
Operation life	8 years	
Annual refund	27,641	

Source: JICA Study Team

Total refund for each bus route is as follows:

Table A11.2.15 Annual Refund of Bus Body

Route		Annual refund (USD)
No.	Name	
D1	Natete Route	359,300
D2	Munyonyo Route (A)	2,017,800
D3	Munyonyo Route (B)	387,000
D4	Sentema Route	110,600
D5	Kiwatule Route	1,907,200
D6	Kigowa Route	1,409,700

Source: JICA Study Team

(3) Tax: 30%, Income Tax Guide – Uganda, Based on the Income Tax Act, July 1, 1997.

Interest paid on money borrowed and utilized wholly, and exclusively for the purpose of business is excluded as allowable expenses.

ANNEX 12 CONDITIONS OF EXISTING TRAFFIC SIGNALS

ANNEX 12 CONDITIONS OF EXISTING TRAFFIC SIGNALS

A12.1 LOCATION AND OUTLINE OF SUBLECTED TRAFFIC SIGNALS

The location of subjected traffic signals is as follows. These traffic signals were installed by the grant aid of EOJ.

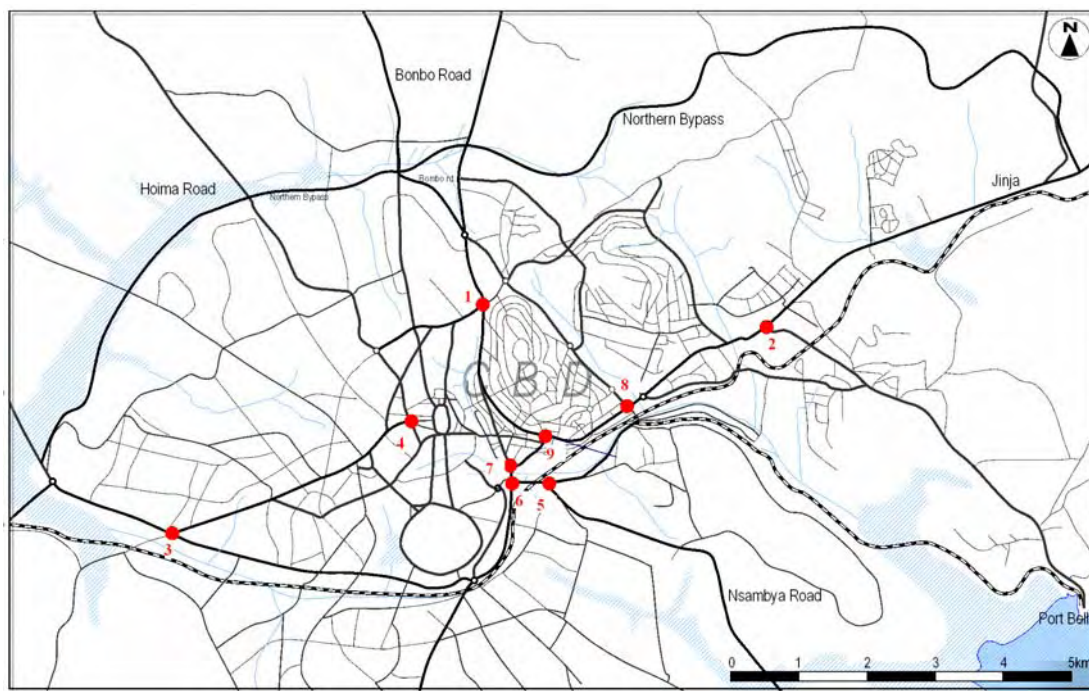


Figure A12.1.1 Location Map of Traffic Signals by Japanese Grant Aid Projects

Table A12.1.1 Outline of Existing Conditions of Traffic Signals

No.	Jct. Name	Year	Operation	Lamp	Power Voltage	UPS
1	Wandegeya	1998	Operating	Bulb	AC240V	No
2	Port Bell	1998	Operating	Bulb	AC240V	No
3	Natete	1998	Resumed	Bulb	AC240V	No
4	Bakuli	2002	Operating	LED	AC100V	No
5	Kibuli	2002	Nonoperating	LED	AC100V	No
6	Clock Tower	2005	Operating	LED	AC100V	Yes
7	Shoprite	2005	Operating	LED	AC100V	Yes
8	Jinja	2005	Operating	LED	AC100V	Yes
9	Kampala/Entebbe	2005	Operating	LED	AC100V	Yes

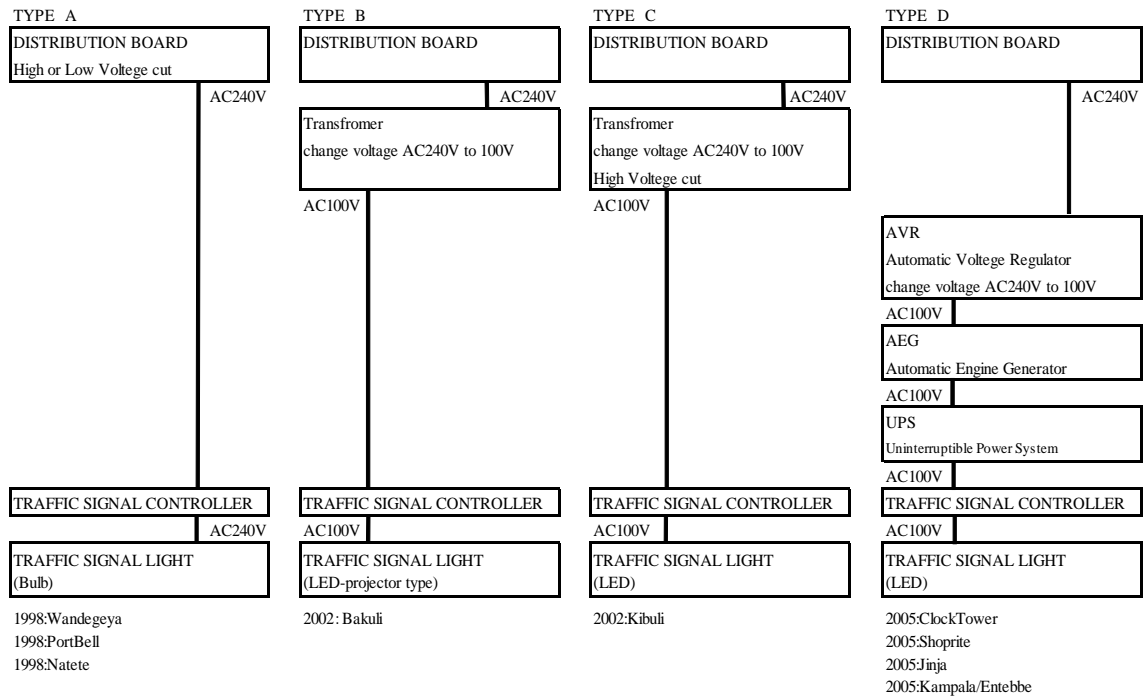


Figure A12.1.2 Type of System Component

A12.2 EXISTING CONDITION OF TRAFFIC SIGNALS

(1) Wandegeya Jct.

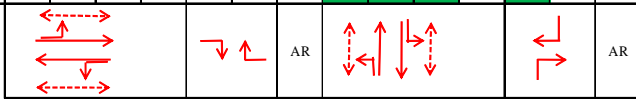
Wandegeya JCT

Multi-plan Operation Time Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Cycle
P1	22	10	6	4	20	4	3	13	8	4	4	15	4	3											120
P2	27	10	6	4	25	4	3	20	8	4	4	18	4	3											140
P3	15	10	6	4	15	4	3	10	8	4	4	10	4	3											100

Phase Data

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1P	-	W	-	-	-	-	-	-	-	-	-	-	-	-										
1V	-	-	-	W	-	W	-	-	-	-	-	-	-	-										
1A	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
2P	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
2V	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
2A	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
3P																								
3V																								
3A																								
4P																								
4V																								
4A																								



 Vehicle or Pedestrian Green-light
W Vehicle Yellow-light
 Vehicle or Pedestrian Red-light
 Vehicle Arrow-light
 Pedestrian Green-light winking

Pattern Changing Time Table

No.	Hour	Minute	Pattern
1	7	0	P2
2	9	0	P1
3	17	0	P2
4	21	0	P1
5			
6			
7			
8			
9			
10			

*Phasing data was derived from document prepared by KCC.
 *Controller made in Uganda is using.

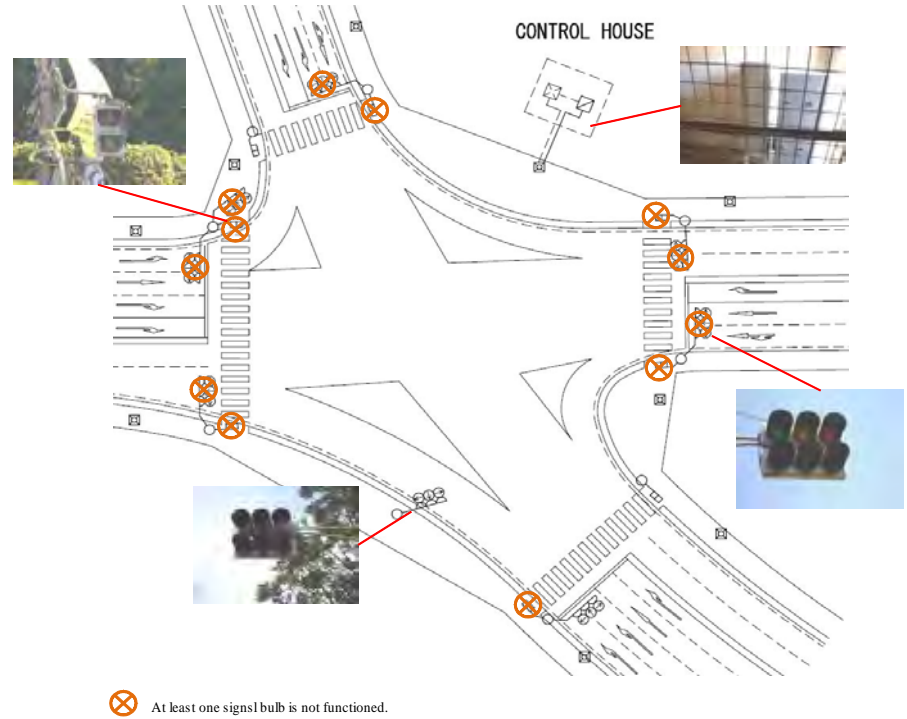


Figure A12.2.1 Survey Results of Wandegeya Jct.

(2) Port Bell Jct.

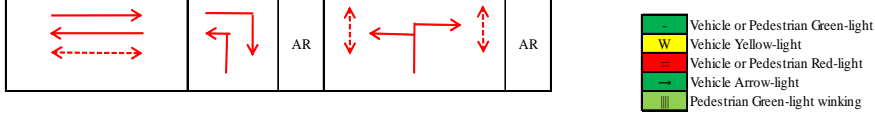
Port Bell JCT

Multi-plan Operation Time Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Cycle
P1	40	5	4	4	25	5	3	25	5	3	4	3													126
P2	35	5	4	4	15	5	3	15	5	3	4	3													101
P3	49	5	4	4	8	5	3	8	5	3	4	3													101

Phase Data

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1P	-		=	=	=	=	=	=	=	=	=	=													
1V	-	-	-	W	=	W	=	=	=	=	=	=													
1A					→																				
2P																									
2V	-	-	-	W	=	=	=	=	=	=	=	=													
2A					→																				
3P	=	=	=	=	=	=	=	=	=		=	=													
3V	=	=	=	=	=	W	=	=	=		=	W	=												
3A																									
4P																									
4V																									
4A																									

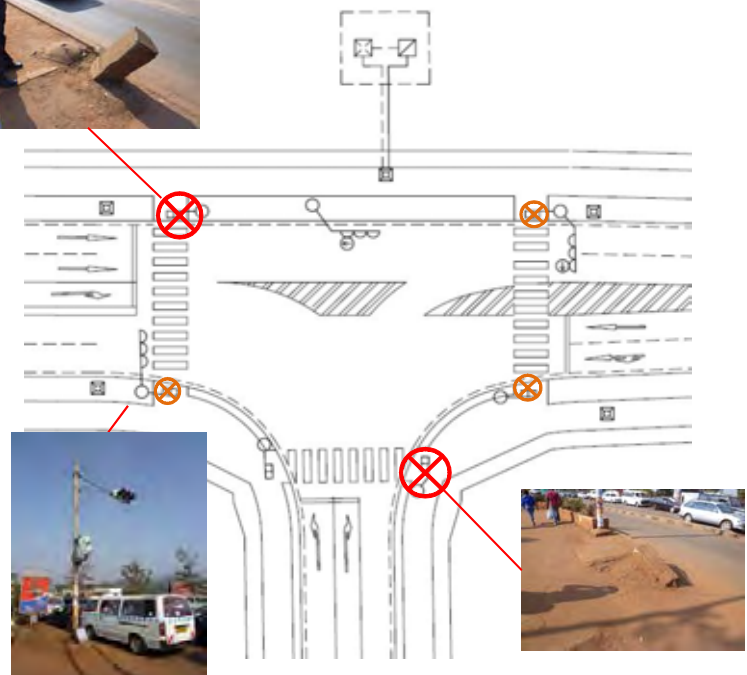


Pattern Changing Time Table

No.	Hour	Minute	Pattern
1	6	0	P1
2	7	30	P2
3	9	30	P1
4	16	30	P2
5	18	30	P1
6	21	0	P3
7			
8			
9			
10			



CONTROL HOUSE



- Signal for pedestrian was disappeared due to the accident.
- At least one signal bulb is not functioning.

Figure A12.2.2 Survey Results of Port Bell Jct.

(3) Natete Jct.

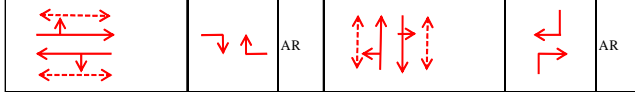
Natete JCT

Multi-plan Operation Time Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Cycle
P1	15	5	4	4	8	4	3	29	5	4	4	8	4	3											100
P2	25	5	4	4	11	4	3	42	5	8	4	8	4	3											130
P3	10	5	4	4	6	4	3	11	5	4	4	8	4	3											75

Phase Data

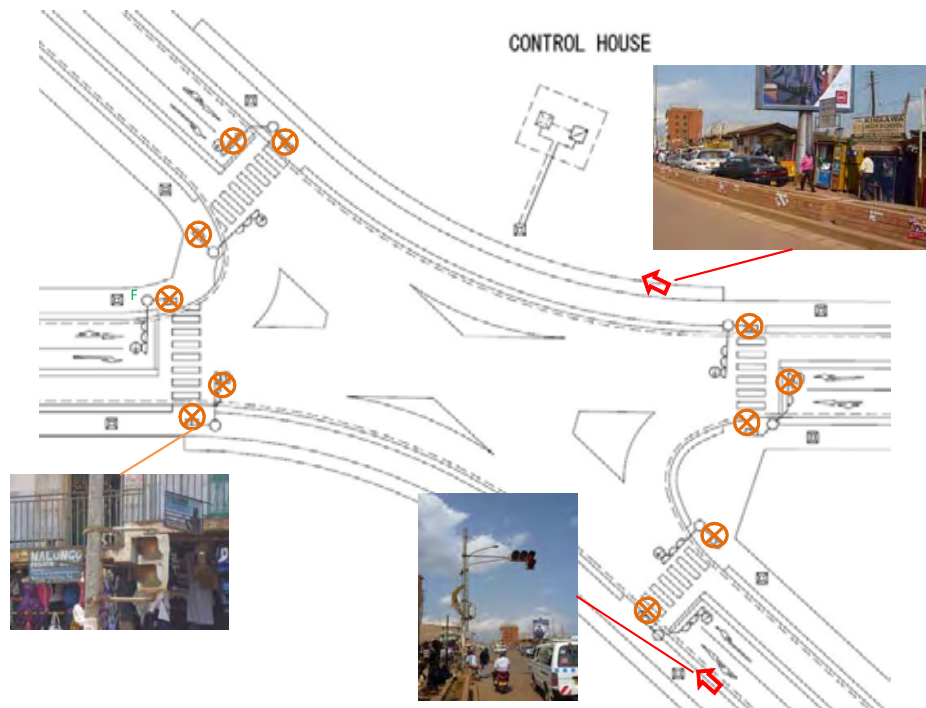
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1P	-		=	=	=	=	=	=	=	=	=	=	=	=											
1V	-	-	-	W	=	W	=	=	=	=	=	=	=	=											
1A																									
2P	=	=	=	=	=	=	=	=		=	=	=	=	=											
2V	=	=	=	=	=	=	=	=	=	=	W	=	W	=											
2A																									
3P																									
3V																									
3A																									
4P																									
4V																									
4A																									



- █ Vehicle or Pedestrian Green-light
- █ W Vehicle Yellow-light
- █ Vehicle or Pedestrian Red-light
- Vehicle Arrow-light
- || Pedestrian Green-light winking

Pattern Changing Time Table

No.	Hour	Minute	Pattern
1	6	0	P1
2	7	30	P2
3	9	30	P1
4	16	30	P2
5	18	30	P1
6	21	0	P3
7			
8			
9			
10			



⊗ At least one signal bulb is not functioning.

Figure A12.2.3 Survey Results of Natete Jct.

(4) Bakuli Jct.

Bakuli JCT

Multi-plan Operation Time Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Cycle
P1	30	9	3	4	25	3	3	26	7	3	3	20	3	3											142
P2	28	9	3	4	20	3	3	28	7	3	3	15	3	3											132
P3	32	9	3	4	12	3	3	32	7	3	3	10	3	3											127

Phase Data

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1P	-		=	=	=	=	=	=	=	=	=	=	=	=											
1V	-	-	-	W	=	W	=	=	=	=	=	=	=	=											
1A																									
2P	=	=	=	=	=	=	=	=		=	=	=	=	=											
2V	=	=	=	=	=	=	=	=	-	-	W	=	W	=											
2A																									
3P																									
3V																									
3A																									
4P																									
4V																									
4A																									



- █ Vehicle or Pedestrian Green-light
- W Vehicle Yellow-light
- █ Vehicle or Pedestrian Red-light
- Vehicle Arrow-light
- ||| Pedestrian Green-light winking

Pattern Changing Time Table

No.	Hour	Minute	Pattern
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

*Controller was not operated.

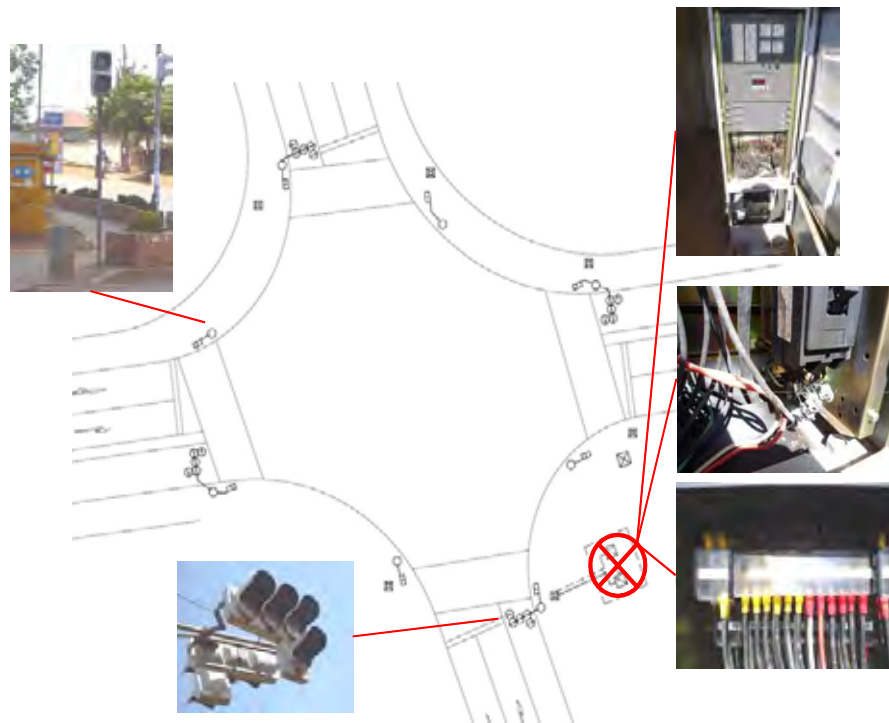


Figure A12.2.4 Survey Results of Wandegya Jct.

(5) Kibuli Jct.

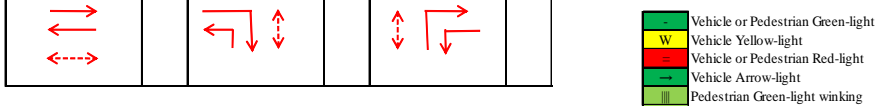
Kibuli JCT

Multi-plan Operation Time Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Cycle
P0	18	4	4	2	28	4	4	2	11	4	4	2													87
P1	11	4	4	2	28	4	4	2	11	4	4	2													80
P2	18	4	4	2	29	4	4	2	15	4	4	2													92
P3	29	4	4	2	49	4	4	2	12	4	4	2													120
P4																									0
P5																									0
P6																									0
P7																									0
P8																									0
P9																									0
P10																									0

Phase Data

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1P	-		=	=	=	=	=	=	=	=	=	=												
1V	-	-	W	=	=	=	W	=	=	=	=	=												
1A																								
2P	=	=	=	=	=	=	=	=	=	=	=	=												
2V	-	-	W	=	=	=	=	=	=	=	W	=												
2A																								
3P	=	=	=	=	=	=	=	=	=	=	=	=												
3V	=	=	=	=	=	=	W	=	=	=	W	=												
3A																								
4P																								
4V																								
4A																								



Pattern Changing Time Table

Weekday			
No.	Hour	Minute	Pattern
1	0	0	P1
2	7	0	P3
3	9	0	P2
4	17	0	P3
5	19	30	P1
6			
7			
8			
9			
10			

Saturday			
No.	Hour	Minute	Pattern
1	0	0	P1
2	8	0	P2
3	19	0	P1
4			
5			
6			
7			
8			
9			
10			

Sunday, Holiday			
No.	Hour	Minute	Pattern
1	0	0	P1
2	8	0	P2
3	19	0	P1
4			
5			
6			
7			
8			
9			
10			



Figure A12.2.5 Survey Results of Kibuli Jct.

(6) Clock Tower Jct.

ClockTower JCT

Multi-plan Operation Time Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Cycle
P0	22	4	4	2	10	4	4	2	18	4	4	2													80
P1	25	3	3	5	56	3	3	5	66	3	3	5													180
P2	20	3	3	5	52	3	3	5	75	3	3	5													180
P3	25	3	3	5	72	3	3	5	50	3	3	5													180
P4	25	3	3	5	70	3	3	5	45	3	3	5													173
P5	25	3	3	5	50	3	3	5	50	3	3	5													158
P6	20	3	3	5	45	3	3	5	35	3	3	5													133
P7	25	3	3	5	75	3	3	5	47	3	3	5													180
P8	25	3	3	5	80	3	3	5	42	3	3	5													180
P9	20	3	3	5	75	3	3	5	45	3	3	5													173
P10	15	3	3	2	15	3	3	2	15	3	3	2													69

Phase Data

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1P	-	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1V	-	-	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2P	-	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2V	-	-	-	-	-	-	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3V	-	-	-	-	-	-	-	-	-	-	-	W	-	-	-	-	-	-	-	-	-	-	-	-
3A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



- █ Vehicle or Pedestrian Green-light
- █ Vehicle Yellow-light
- █ Vehicle or Pedestrian Red-light
- Vehicle Arrow-light
- █ Pedestrian Green-light winking

Pattern Changing Time Table

Weekday

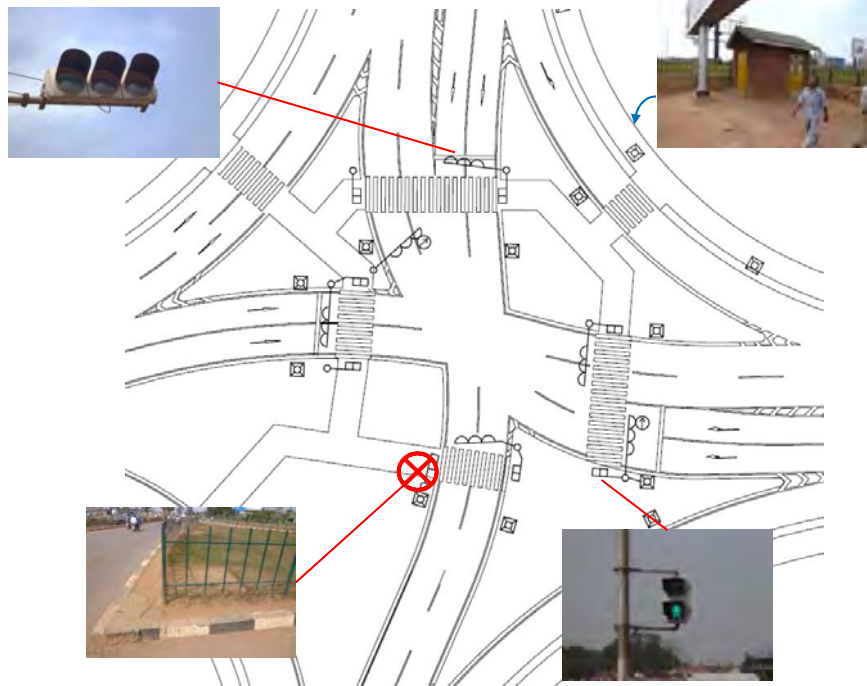
No.	Hour	Minute	Pattern
1	16	0	P7
2	8	0	P2
3	9	0	P3
4	11	0	P4
5	14	0	P5
6	15	0	P6
7	16	0	P7
8	17	0	P8
9	19	0	P9
10	21	0	P10

Saturday

No.	Hour	Minute	Pattern
1	6	0	P1
2	9	0	P3
3	12	0	P5
4	15	0	P8
5	18	0	P7
6	21	0	P1
7			
8			
9			
10			

Sunday, Holiday

No.	Hour	Minute	Pattern
1	6	0	P1
2	12	0	P6
3	17	0	P5
4	5	0	P4
5			
6			
7			
8			
9			
10			



Signal for pedestrian was disappeared due to the accident.

Figure A12.2.6 Survey Results of Clock Tower Jct.

(7) Shoprite Jct.

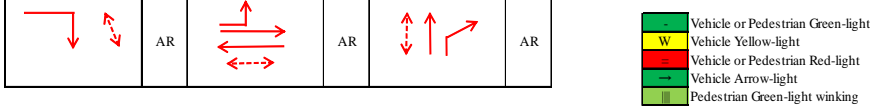
Shoprite JCT

Multi-plan Operation Time Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Cycle
P0	22	4	4	2	10	4	4	2	18	4	4	2													80
P1	25	3	3	5	56	3	3	5	66	3	3	5													180
P2	20	3	3	5	52	3	3	5	75	3	3	5													180
P3	25	3	3	5	72	3	3	5	50	3	3	5													180
P4	25	3	3	5	70	3	3	5	45	3	3	5													173
P5	25	3	3	5	50	3	3	5	50	3	3	5													158
P6	20	3	3	5	45	3	3	5	35	3	3	5													133
P7	25	3	3	5	75	3	3	5	47	3	3	5													180
P8	25	3	3	5	80	3	3	5	42	3	3	5													180
P9	20	3	3	5	75	3	3	5	45	3	3	5													173
P10	15	3	3	2	15	3	3	2	15	3	3	2													69

Phase Data

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1P	→	→	→	→	→	→	→	→	→	→	→	→													
1V	→	→	→	→	→	→	→	→	→	→	→	→													
1A	→	→	→	→	→	→	→	→	→	→	→	→													
2P	→	→	→	→	→	→	→	→	→	→	→	→													
2V	→	→	→	→	→	→	→	→	→	→	→	→													
2A	→	→	→	→	→	→	→	→	→	→	→	→													
3P	→	→	→	→	→	→	→	→	→	→	→	→													
3V	→	→	→	→	→	→	→	→	→	→	→	→													
3A	→	→	→	→	→	→	→	→	→	→	→	→													
4P																									
4V																									
4A																									



Pattern Changing Time Table

Weekday

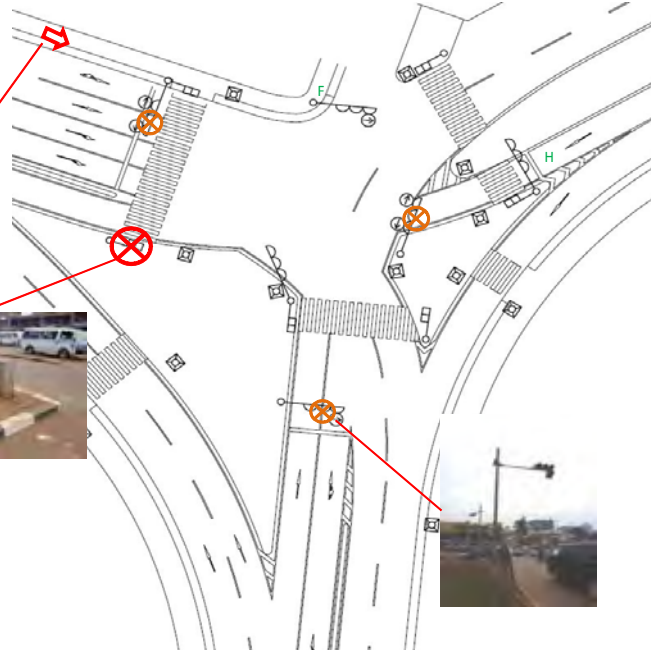
No.	Hour	Minute	Pattern
1	6	0	P2
2	8	0	P2
3	9	0	P3
4	11	0	P4
5	14	0	P5
6	15	0	P6
7	16	0	P7
8	17	0	P8
9	19	0	P9
10	21	0	P10

Saturday

No.	Hour	Minute	Pattern
1	6	0	P1
2	9	0	P3
3	12	0	P5
4	15	0	P8
5	18	0	P7
6	21	0	P1
7			
8			
9			
10			

Sunday, Holiday

No.	Hour	Minute	Pattern
1	6	0	P1
2	12	0	P6
3	17	0	P5
4	5	0	P4
5			
6			
7			
8			
9			
10			



- Signal for pedestrian was disappeared due to the accident.
- At least one signal bulb is not functioning.

Figure A12.2.7 Survey Results of Shoprite Jct.

(8) Jinja Jct.

Jinja JCT

Multi-plan Operation Time Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Cycle
P0	20	3	3	2	2	6	2	2	16	7	3	2	2	6	2	2									80
P1	60	6	4	3	2	37	3	4	30	6	4	3	2	45	3	4									216
P2	63	6	4	3	2	42	3	4	35	6	4	3	2	50	3	4									234
P3	37	6	4	3	2	30	3	4	20	6	4	3	2	30	3	4									161
P4	74	6	4	3	2	50	3	4	38	6	4	3	2	43	3	4									249
P5	53	6	4	3	2	37	3	4	28	6	4	3	2	42	3	4									204
P6	51	6	4	4	2	34	4	4	33	6	4	4	2	73	4	4									239
P7	47	3	2	3	2	27	3	2	27	3	2	3	2	30	3	2									161
P8	56	6	4	4	2	38	4	4	33	6	4	4	2	56	4	4									231
P9	35	2	2	3	2	25	3	2	23	2	2	3	2	25	3	2									136
P10	67	6	4	4	2	45	4	4	31	6	4	4	2	51	4	4									242

Phase Data

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1P	-	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→								
1V	-	-	-	W	-	-	W	-	-	-	-	-	-	-	-	-								
1A	-	-	-	→	-	-	→	-	-	-	-	-	-	-	-	-								
2P	-	-	-	-	-	-	-	-	-	→	→	-	-	-	-	-								
2V	-	-	-	-	-	-	-	-	-	-	-	W	-	-	W	-								
2A	-	-	-	-	-	-	-	-	-	-	-	-	-	→	-	-								
3P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
3A	→	→	→	-	-	-	-	-	-	-	-	-	-	-	-	-								
4P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
4V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
4A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								

- Vehicle or Pedestrian Green-light
- Vehicle Yellow-light
- Vehicle or Pedestrian Red-light
- Vehicle Arrow-light
- Pedestrian Green-light winking

Pattern Changing Time Table

Weekday			
No.	Hour	Minute	Pattern
1	5	0	P3
2	6	0	P5
3	7	0	P4
4	10	0	P1
5	13	0	P2
6	16	10	P8
7	17	12	P6
8	18	26	P2
9	20	0	P5
10	22	0	P9

Saturday			
No.	Hour	Minute	Pattern
1	5	0	P9
2	6	0	P7
3	7	0	P5
4	9	0	P1
5	14	0	P2
6	18	0	P1
7	20	0	P7
8	22	0	P9
9			
10			

Sunday, Holiday			
No.	Hour	Minute	Pattern
1	5	0	9
2	10	0	3
3	15	0	5
4	18	0	7
5	20	0	9
6			
7			
8			
9			
10			

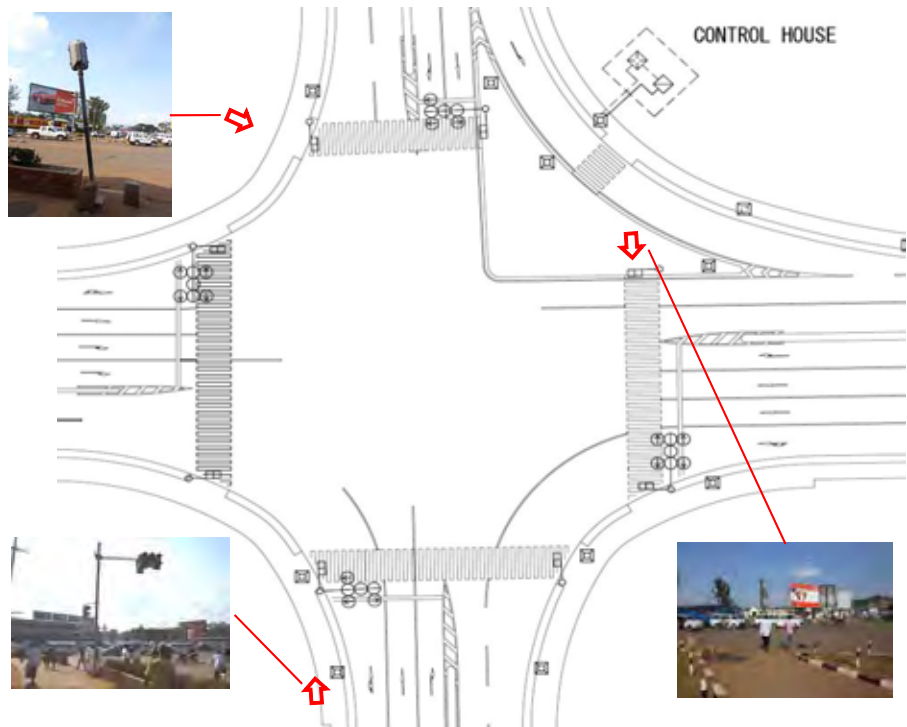


Figure A12.28 Survey Results of Jinja Jct.

(9) Kampala/Entebbe Jct.

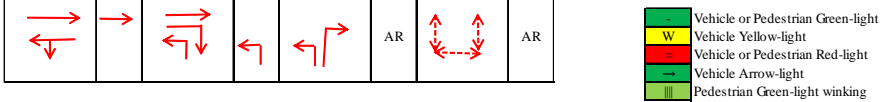
Kampala/Entebbe JCT

Multi-plan Operation Time Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Cycle
P0	15	4	2	5	4	2	20	4	2	16	4	2													80
P1	30	5	2	40	5	2	35	5	2	15	10	2													153
P2	45	5	2	30	5	2	35	5	2	11	6	2													150
P3	40	5	2	25	5	2	40	5	2	10	6	2													144
P4	50	5	2	30	5	2	35	5	2	10	10	2													158
P5																									0
P6																									0
P7																									0
P8																									0
P9																									0
P10																									0

Phase Data

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1P	=	=	=	=	=	=	=	=	=	=	=	=												
1V	=	=	=	=	W	=	=	=	=	=	=	=												
1A	=	=	=	=	=	=	=	=	=	=	=	=												
2P	=	=	=	=	=	=	=	=	=	=	=	=												
2V	=	W	=	=	=	=	=	=	=	=	=	=												
2A	=	=	=	=	=	=	=	=	=	=	=	=												
3P	=	=	=	=	=	=	=	=	=	=	=	=												
3V	=	=	=	=	=	=	=	W	=	=	=	=												
3A	=	=	=	=	=	=	=	=	=	=	=	=												
4P																								
4V																								
4A																								



Pattern Changing Time Table

Weekday

No.	Hour	Minute	Pattern
1	5	0	P1
2	7	0	P3
3	9	0	P4
4	17	0	P2
5	19	30	P1
6			
7			
8			
9			
10			

Saturday

No.	Hour	Minute	Pattern
1	9	0	P2
2	8	0	P2
3	19	0	P1
4			
5			
6			
7			
8			
9			
10			

Sunday, Holiday

No.	Hour	Minute	Pattern
1	14	0	P3
2	8	0	P2
3	19	0	P1
4			
5			
6			
7			
8			
9			
10			

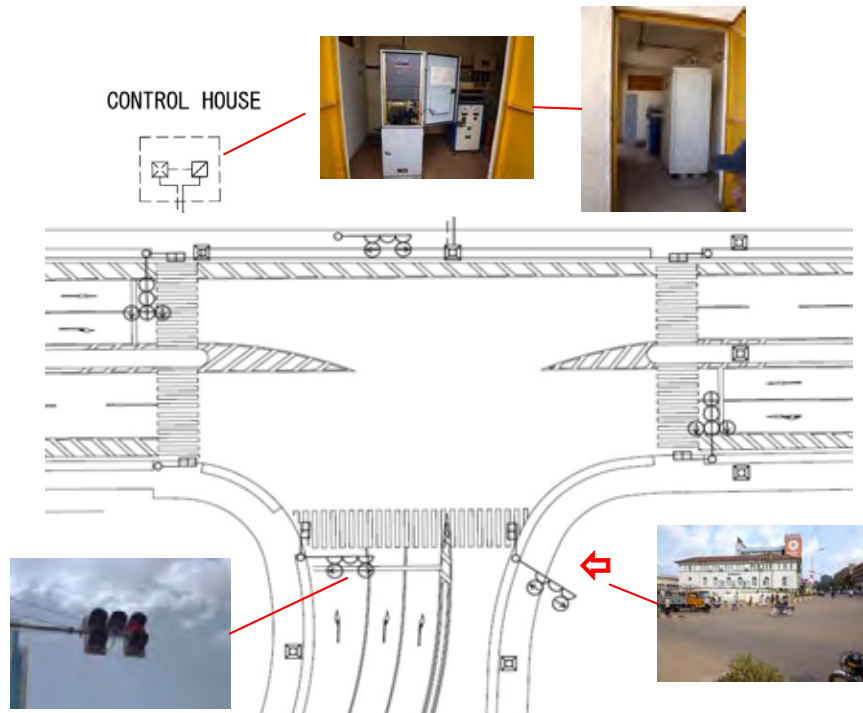


Figure A12.2.9 Survey Results of Kampala/Entebbe Jct.

ANNEX 13 PARTICIPANTS AND SCHEDULE OF THE STUDY TOUR IN JAPAN ON TRAFFIC SAFETY

ANNEX 13 PARTICIPANTS AND SCHEDULE OF THE STUDY TOUR IN JAPAN ON TRAFFIC SAFETY

Participants

1	Mr.Rwego Francis Xavier	Assistant Inspector General of Police, Director, Interpol & Peace Support Operations
2	Mr.Mugabi Micheal	Commander Integrated Highway Police
3	Mr.Mugisha Bazil	Commissioner Traffic & Road Safety

Schedule


No	Date					Contents	Lecturer	Venue
1	23-Oct-10	Sat				Entebbe-Dubai		—
2	24-Oct-10	Sun				Dubai-Narita		—
3	25-Oct-10	Mon	AM			JICA Briefing		JICA
			14:00	~	15:00	Program Orientation		JICA
4	26-Oct-10	Tue	9:30	~	12:30	Outline of Traffic Safety Measures in Japan (Objectives, Organization, Institution, Finance, etc.)	Mr. Sato, Former Counsellor, Metropolitan Police Department	Japan Traffic Safety Education Association
			13:30	~	15:30	1) Practical Situation of Traffic Management in Japan	Mr. Akiyama, Former Officer, Metropolitan Police Department	Japan Traffic Safety Education Association
			15:30	~	17:30	2) Practical Situation of Traffic Safety Education in Japan	Mr. Hoshi, President, Institute of Traffic Safety Education	Japan Traffic Safety Education Association
5	27-Oct-10	Wed	9:30	~	12:30	Drivers Education and Lisencing System	Manager, Ogu Driving School	Ogu Driving School
			14:00	~	17:00	Site Survey for Practice of Traffic Management	Mr. Akiyama, Former Officer, Metropolitan Police Department	Japan Traffic Safety Education Association
6	28-Oct-10	Thu	10:00	~	12:00	Outline of Metropolitan Expressway, Visit to Traffic Management Center, Exchange of Opinions	Metropolitan Expressway Co., Ltd.	Metropolitan Expressway Co., Ltd.
			14:00	~	16:00	Practical Situation of Traffic Safety Activities for Citizens, Exchange of Opinions	Mr. Nishi, Director, Japan Traffic Safety Education Association	Japan Traffic Safety Education Association
7	29-Oct-10	Fri	10:00	~	13:00	Site Survey for Traffic Management and Monitoring Facilities	Mr. Akiyama, Sato, Nishi and Hoshi	Institute of Traffic Operation LLP.
			PM	~		Evaluation Meeting		JICA
8	30-Oct-10	Sat				Narita-Dubai		—
9	31-Oct-10	Sun				Dubai-Entebbe		—

ANNEX 14 TERMS OF REFERENCE FOR THE STUDY

ANNEX 14 TERMS OF REFERENCE FOR THE STUDY

SCOPE OF WORK
FOR
THE STUDY
ON
GREATER KAMPALA ROAD NETWORK AND TRANSPORT IMPROVEMENT
IN
THE REPUBLIC OF UGANDA
AGREED UPON
BETWEEN
MINISTRY OF WORKS AND TRANSPORT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

KAMPALA, 1st March, 2007



Charles Muganzi Amooti
Permanent Secretary
Ministry of Works and Transport
The Republic of Uganda



Hozumi Katsuta
Leader of Preparatory Study Team
Japan International Cooperation Agency
Japan





I. INTRODUCTION

In response to the official request of the Government of Republic of Uganda (hereinafter referred to as "GOU"), the Government of Japan (hereinafter referred to as "GOJ") decided to conduct The Study on Greater Kampala Road Network and Transport Improvement (hereinafter referred to as "the Study") within the framework of the Agreement on Technical Cooperation between the Government of Japan and the Government of Uganda signed on 12th December, 2005 (hereinafter referred to as "the Agreement").

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of GOJ, will jointly undertake the Study with the concerned authorities of GOU.

The present document sets forth the Scope of Work with regard to the Study and will be valid after notification of approval by JICA Headquarters to the Ugandan side through JICA Uganda office.

II. OBJECTIVES OF THE STUDY

The objectives of the Study are:

1. to conduct a pre-feasibility study of prioritized projects;
2. to formulate a public transport plan;
3. to formulate a road safety improvement plan; and
4. to transfer relevant skills and technologies to personnel concerned with the Study.

III. STUDY AREA

The Study shall cover the Greater Kampala Metropolitan Area shown in APPENDIX 1.

IV. SCOPE OF THE STUDY

In order to achieve the objectives mentioned above, the Study shall cover the following items:

1. Collection and analysis of existing data (Previous investigation, Socio-economic condition, Natural condition, Related development plan, Related study report etc.)
2. Reviewing the GOU Position Paper on the study report of The National Transport Master Plan (NTMP) and the Master Plan for Greater Kampala Metropolitan Area (MP_GKMA).
3. Selection of the projects for pre-Feasibility Study related to the road traffic improvement plan
 - (1) Studying some projects listed in the GOU Position Paper



1

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- (2) Analyzing aspects of road improvement
- (3) Analyzing aspects of traffic management
- (4) Selecting projects for Pre-Feasibility Study
4. Undertaking Pre-Feasibility Study for the selected projects
 - (1) Supplementary surveys
 - (2) Traffic demand consideration
 - (3) Outline design of the facilities
 - (4) Construction planning
 - (5) Estimation of the project costs and maintenance costs
 - (6) Economic analysis
 - (7) Initial Environmental Examination (IEE)/Environmental Impact Assessment (EIA)
5. Formulation of a Public Transport Plan
 - (1) Supplementary surveys
 - (2) Establishment of long term strategy
 - (3) Improvement of the Regulatory and Institutional framework
 - (4) Public transport network planning
 - (5) Operation planning
6. Formulation of the road safety improvement plan
 - (1) Analysis of the current condition and problem
 - (2) Development of an improvement strategy
 - (3) Formulation of an action plan

V. STUDY SCHEDULE

The Study will be carried out within eleven (11) months period in accordance with the attached tentative schedule as shown in APPENDIX 2.

VI. REPORTS

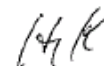
JICA shall prepare and submit the following reports in English to GOU.

1. Inception Report:
Thirty (30) copies will be submitted at the commencement of the Study. This report will contain the schedule and methodology of the Study as well.
2. Interim Report I:
Thirty (30) copies will be submitted within four (4) months after the commencement of the Study. The report will indicate the progress of the Study.
3. Interim Report II



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Thirty (30) copies will be submitted within seven (7) months after the commencement of the Study. The report will contain outline results of the pre-Feasibility Study.

4. Draft Final Report:

Thirty (30) copies will be submitted within nine (9) months after the commencement of the Study. The written comments on the Draft Final Report from GOU shall be delivered to JICA within one (1) month after the receipt of the Draft Final Report.

5. Final Report:

Fifty (50) copies will be submitted within one (1) month after the receipt of the comments on the Draft Final Report.

VII. UNDERTAKINGS OF THE GOVERNMENT OF UGANDA

1. To facilitate the smooth conduct of the Study, GOU shall take necessary measures:
 - (1) to permit the members of the Japanese Study Team (hereinafter referred to as “the Team”) to enter, leave and sojourn in the Republic of Uganda for the duration of their assignments therein, offer them the convenience for procedures of alien registration requirement and exempt them from consular fees;
 - (2) to exempt the members of the Team from taxes, duties and any other charges on equipment, machinery and other material brought into the Republic of Uganda for the implementation of the Study;
 - (3) to exempt the members of the Team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study; and
 - (4) to provide necessary facilities to the Team for the remittance as well as utilization of the funds introduced into the Republic of Uganda from Japan in connection with the implementation of the study.
2. GOU shall bear claims, if any arise, against the members of the Team resulting from, occurring in the course of, or otherwise connected with, the performance of their duties, except when the two Governments agree that such claims arise from gross negligence or willful misconduct on the part of the Team.
3. Ministry of Works and Transport shall, in cooperation with other organizations concerned, at its own expense, where necessary, provide the Team with the following:
 - (1) Security and safety of the Team and the relevant information;
 - (2) Information as well as assistance in obtaining medical service;
 - (3) Available data (including maps and photographs) and information related to the Study;
 - (4) Counterpart personnel;



- (5) Suitable office space with furniture and telephone facilities; and
- (6) Credentials or identification cards.

VIII. UNDERTAKINGS OF JICA

For the implementation of the Study, JICA shall take the following measures:

1. To dispatch, at its own expense, the Team to the Republic of Uganda; and
2. To pursue technology and skills transfer to the Ugandan counterpart personnel in the course of the study.

IX. CONSULTATION

JICA and the Ministry of Works and Transport shall consult with each other in respect of any matter that may arise from or in connection with the Study.

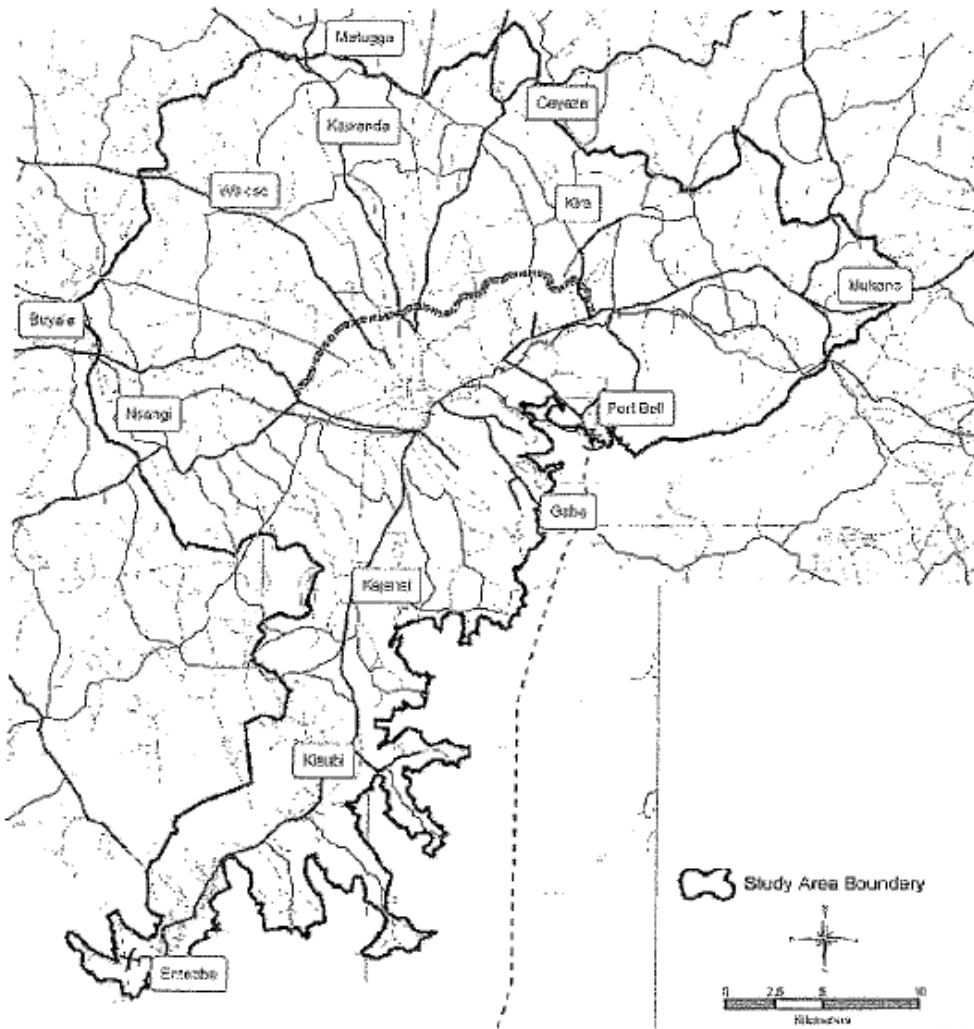


4



APPENDIX 1

STUDY AREA



5

APPENDIX 2


TENTATIVE SCHEDULE

Month	1	2	3	4	5	6	7	8	9	10	11
Work in Uganda											
Work in Japan											
Report	△ IC/R			△ IT/R I			△ IT/R II		△ DF/R		△ F/R

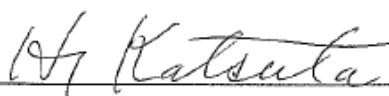
6

MINUTES OF MEETING
ON
SCOPE OF WORK
FOR
THE STUDY
ON
GREATER KAMPALA ROAD NETWORK AND TRANSPORT IMPROVEMENT
IN
THE REPUBLIC OF UGANDA
AGREED UPON
BETWEEN
MINISTRY OF WORKS AND TRANSPORT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

KAMPALA, 1st March, 2007




Charles Muganzi Amooti
*Permanent Secretary
Ministry of Works and Transport
The Republic of Uganda*



Hozumi Katsuta
*Leader of Preparatory Study Team
Japan International Cooperation Agency
Japan*





In response to the official request of the Government of Republic of Uganda (herein after referred to as "GOU"), the Government of Japan (herein after referred to as "GOJ") dispatched the preparatory study team headed by Mr. Hozumi KATSUTA (hereinafter referred to as "the Team") from 20th February to 10th March, 2007, through the Japan International Cooperation Agency (hereinafter referred to as "JICA"), to discuss the scope of work for The Study on Greater Kampala Road Network and Transport Improvement (hereinafter referred to as "the Study").

During the stay of the Team in Uganda, a series of meetings were held with Ministry of Works and Transport, Kampala City Council and other organizations related to the Study. The list of participants of the meetings is shown in Appendix 1.

This document summarizes major items discussed between both sides and is intended to supplement the Scope of Work for smooth conduct of the Study.

1. Study Title

Both parties agreed the title of the Study is "The Study on Greater Kampala Road Network and Transport Improvement".

2. Basic stance of the Study



Both parties agreed that the Study will be done in principle within, ~~but not limited to~~, the GOU Position Paper on The National Transport Master Plan (NTMP) and the Master Plan for Greater Kampala Metropolitan Area (MP_GKMA). *HK*

3. Utilization of the data

The data of the traffic surveys and transport demand forecast contained in the study report of The National Transport Master Plan (NTMP) and the Master Plan for Greater Kampala Metropolitan Area (MP_GKMA) will be used to the extent possible, although supplementary traffic surveys will be carried out during the Study to incorporate any recent changes. Ministry of Works and Transport agreed to make its best efforts to provide those data to the Study Team.

4. Steering Committee



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Both parties agreed that a Steering Committee (hereinafter referred to as “the Committee”) will be set up for effective and efficient implementation of the Study under the chair of the MOWT. The Committee will decide on important matters to promote the output of the Study. The Committee will comprise representatives from the following ministries and organizations.

- (1) Ministry of Works and Transport
- (2) Road Agency Formation Unit
- (3) Kampala City Council
- (4) Wakiso District Council
- (5) Mukono District Council
- (6) Entebbe Municipal Council
- (7) Uganda Police Force
- (8) Uganda Taxi Operators and Drivers Association
- (9) Uganda Bus Operators Association
- (10) National Environment Management Authority
- (11) Ministry of Finance, Planning and Economic Development
- (12) Ministry of Local Government
- (13) JICA Study Team
- (14) JICA Uganda Office

MOWT shall inform JICA Uganda Office of the members of the Committee before the commencement of the Study.

5. Transfer of technology

The study team will make an effort to transfer skills and technology through On-the-Job Training. Ministry of Works and Transport requested for counterpart training in Japan as part of technology know-how transfer activity. The team promised to convey it to JICA Headquarter.

6. Counterpart Personnel

Both parties agreed that the Study should be conducted in close collaboration between the Ugandan side and the Japanese side. In this context, Ministry of Works and Transport agreed to assign an appropriate number of counterpart personnel.

7. Seminars



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Both parties agreed that two seminars will be held after presentation of the Interim Report II and the Draft Final Report.

8. Environmental and Social Considerations

The Team explained the basic concept of environmental and social considerations based on JICA's guidelines, and emphasized on the responsibility of Ugandan side in conducting the environmental and social consideration while ensuring information disclosure and participation of stakeholders from the early stages of the Study. Both parties agreed to use JICA and NEMA EIA guidelines during the Study.



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The List of Participants in the Meeting

UGANDAN SIDE

Ministry of Works and Transport (MOWT)

S. Bagonza, Director of Engineering/Engineer-in-Chief
A. O. Mugisa, Commissioner for Roads
Ssebugga Kimeze, Commissioner for Quality Management
Were Higenyi, Ag. Assistant Commissioner for Quality Assurance
Karuma Kagyina, Assistant Commissioner for District and Urban Roads
Katushabe Winstone, Acting Secretary Transport Licensing Board
Alex Onen, Principal Engineer
Edward Mubiru, Senior Engineer
Magala Godfrey, Japan's Desk (Projects)
Nelson Rwenaga, Statistician
Muhammad Lubega Kagere, Coordinator Community Participation in Road Maintenance

Ministry of Finance, Planning and Economic Development (MOFPED)

Joe Witty Haguma, Principal Finance Officer, Aid Liaison Department
Joyce K. Ruhweeza, Senior Economist

Kampala City Council (KCC)

Kinyera Stephen, Director of Works and Urban Planning
Waiswa Naluwaiho, Principal Electrical Engineer
Bonnie K. Nsambu, Department of Works

Wakiso District

C. Sebwato, District Engineer

Entebbe Municipal Council

J. Mukiibi, Municipal Engineer

Kira Town Council

S. Mwesigwa, Town Engineer

Road Agency Formation Unit (RAFU)

Francis Mugambe Byaruhanga, Acting Director



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Jeremy Bassy Aguma, Transport Economist
David Ssali Luyimbazi, Senior Project Engineer
Fasita, Engineering Division

Uganda Police Force (UPF)

Kassima M Steven, Acting Commissioner/Traffic & Road Safety
Emodingo Anthony, Acting Assistant Commissioner/Traffic & Road Safety

JAPANESE SIDE

The preparatory Study Team, JICA

Hozumi KATSUTA, Leader
Jin HIROSAWA, Member
Koichi ISHII, Member

JICA Uganda Office

Hitoshi FUJIE, Assistant Resident Representative
Hiromichi KANO, Assistant Resident Representative



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