3.4 PLANNING OF BUSWAY SYSTEM ON WEST WING

3.4.1 Route Plans of The West Wing

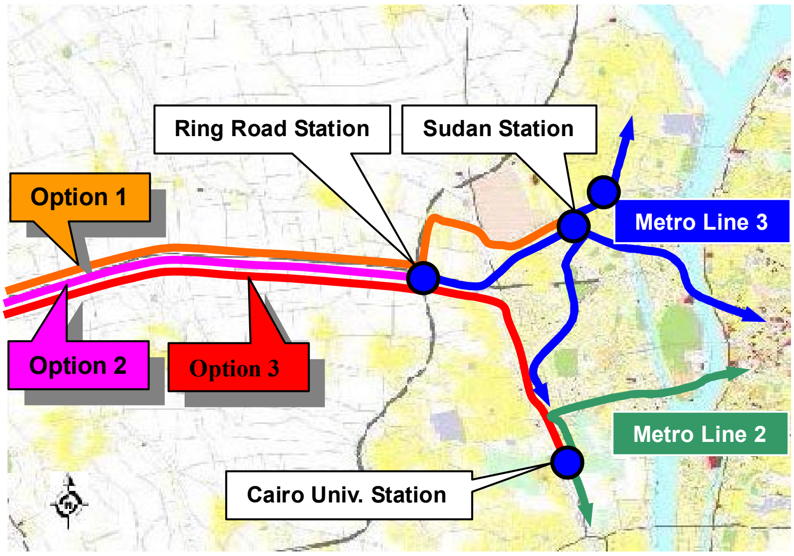
The CREATS Transport Master Plan recommended, for the West Wing, a trunk bus system for the short-term and a dual-truck railway system for the longer term. A busway system will operate articulated buses on an exclusive bus lane. A dual-track railway system will be introduced when traffic demand exceeds the maximum capacity of the busway system. The mass rapid transit will operate on the exclusive bus lane instead of the bus. The entrance of the industrial area in 6th of October City is the start point of the West Wing public transport service. Three Intermodal terminals – Imbaba Airport Redevelopment Area, an Interchange with Ring Road, and Cairo University Station of Metro Line 2 are being studied as terminal for the system. Three different routes for three different destinations were retained after several close site investigations. The options are as follows:

Option 1: 6th of October City ~ an interchange on Alexandria Desert Road ~ an interchange on Ring Road ~ agriculture area along the east side of Ring Road ~ Barageel St. in urban area ~ Tareeq Imbaba St. and Tareeq El Matar St. between Imbaba Airport re-development area and the ENR line ~ a terminal, which will be constructed at Imbaba Airport Redevelopment Area

Option 2: 6th of October City ~ an interchange on Alexandria Desert Road ~ an interchange on Ring Road ~ a terminal constructed near an interchange on Ring Road

Option 3: 6th of October City ~ an interchange on Alexandria Desert Road ~ an interchange on Ring Road ~ a canal and Alamein St. along the ENR line ~ a terminal to be constructed at Cairo University Station on Metro Line 2

Figure 3.4.1 shows the 3 options for the busway system.



Source: JICA Study Team

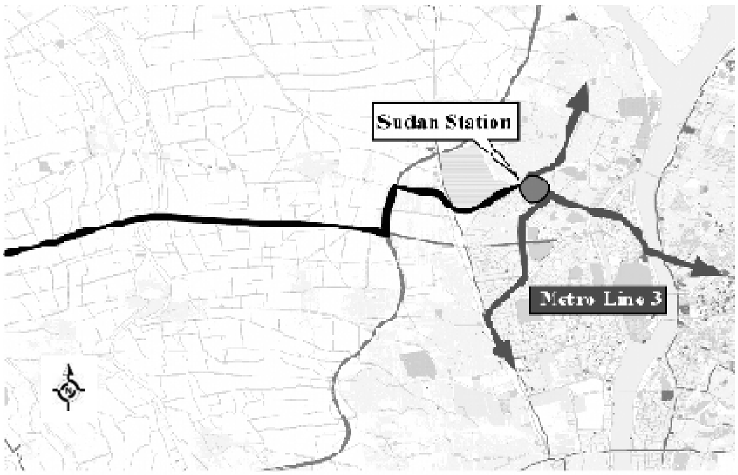
Figure 3.4.1 Three Options of Busway System

(1) Busway Option 1

Total length of Option 1 is 38.1 km (see Figure 3.4.2). Option 1 will start at a bus stop constructed in 6th of October City, on both sides of 26th of July Corridor in the central industrial area. The busway on 26th of July Corridor within 6th of October City has a length of 7.7 km and has two (2) traffic lanes and one frontage road with medians per direction. Trunk buses and other vehicles will run on the same traffic lanes in mixed traffic.

Between the city limits of 6th of October City and the interchange on Ring Road and Alexandria Desert Rd., the system will run on 26th of July Corridor over a total length of 25.4 km. This part consists of 6 traffic lanes, a median and shoulders. Inside lanes will be segregated by curbes or blocks and be used as an exclusive bus lane for trunk buses.

After crossing the interchange by viaduct, the system will turn to the north and run through agricultural area along the Ring Road to reach Barageel St.. From there, the alignment will continue along Barageel St., Tareeq Imbaba St. and Tareeq El Matar St., and finally reach the intermodal terminal at Imbaba Airport redevelopment area. This section will be an elevated 2-lane road for both directions with a total length of 5.0 km. The intermodal terminal should consist of a trunk busway stop and a feeder service stop for ordinary buses and shared-taxi serving Cairo.

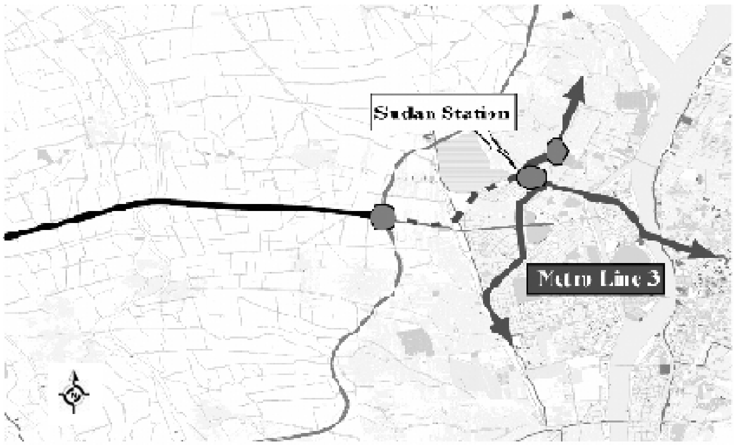


Source: JICA Study Team

Figure 3.4.2 Route Plan of Option 1

(2) Busway Option 2

Option 2 has a total length of 33.1 km (see Figure 3.4.3). The route of Option 2 is completely the same as in Option 1. This option is based on an extension plan for Metro Line 3 between Ring Road station and Sudan station, which was proposed by BOTT. A terminal station such as a bus terminal will be the constructed link to the new station of the extension plan. The terminal should consist of a bus stop and a feeder stop for local buses and shared taxi, similar to the design of the terminal in Option 1. The location of the terminal is in agricultural area, and there is no buildings around the site, which allows construction of the terminal on ground level. However, ramps to and from the terminal might be elevated to secure smooth traffic flows on 26th of July Corridor and Ring Road. Acquisition of agricultural land near the interchange of the Ring Road will be needed for the intermodal terminal.

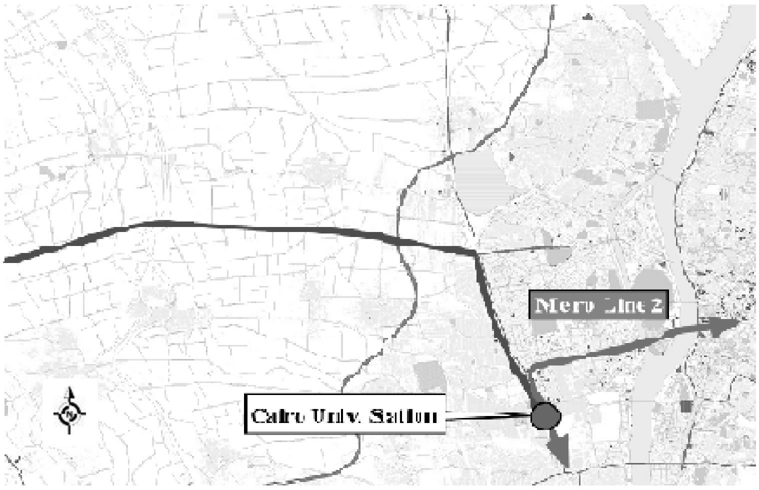


Source: JICA Study Team

Figure 3.4.3 Route Plan of Option 2

(3) Busway Option 3

Option 3 has a total length of 38.0 km (see Figure 3.4.4). The alignment of option 3 is nearly the same as Option 2. The distance from the starting point of the bus terminal (in the central industrial area of 6th of October City) to the entrance of 6th of October City is 7.7 km, and from the city limits to the interchange on Ring Road is 25.4 km. The alignment directly links to the canal from 26th of July Corridor, and runs along the ENR railway line toward a terminal to be constructed at Cairo University Station on Metro Line 2. The total length of this section is 5.4km. The busway will be constructed above the canal, therefore, the route has the advantage of a minimum negative impact on housing and agricultural land. In addition, given the results of the Master Plan, it was proposed that the elevated expressway system should be constructed between 26th of July St. and Cairo University on Metro Line 2 along the canal. In the future, the same alignment of the busway system can be shifted to the elevated expressway system without the need for substantial additional investments. Around the year 2022, when the busway system will upgrade to railway system, the railway will be used under the elevated expressway along the canal. The busway will finally reach the intermodal terminal, which will be constructed near Cairo University Station on Metro Line 2. The proposed terminal is for buses and will be constructed to be elevated above the road and canal.



Source: JICA Study Team

Figure 3.4.4 Route Plan of Option 3.

3.4.2 Bus Stations

Stations for the busway system are foreseen at strategic locations along the alignment and will be served by local feeder transport services such as buses and shared taxi outside the 26th of July Corridor. To optimize the geographic distribution of the local feeder services, and taking into account the convenience of passengers, stations along the alignment will be planned at strategic locations with optimized intervals.

The locations of bus stop stations will be considered to be the important points with the most passengers. In determining the locations for installation of bus stop stations, the following criteria are used, taking into account the analysis of the current situation and the future settlements along the Corridor.

- Transfer points of the busway route;
- Near crossing points of major arterial roads;
- Heavy attraction and generation of passengers by new settlements, and
- Intermodal points between the Metro and the busway.

Six (6) locations are tentatively proposed, namely 6th of October City Industrial, 6th of October City Residential, Sheikh Zayed, West Abu Rawwash, Alexandria Desert Road, and Imbaba Airport (Option 1), Ring Road (option 2), Cairo Univ. (Option 3). The 6th of October City Industrial is a starting point of the West Wing Corridor, the 6th of October City Residential is almost a center of the New City, and EL Sheikh Zayed is the west end of the new community in 6th of October City. The West Abu Rawwash is located in the Abu Rawwash residential area. Alexandria Desert Road is the regional arterial road connecting Cairo and Alexandria. People living and working along Alexandria Desert Road come and go to Cairo through 26th of July Corridor. Therefore, a station will be required near an interchange of those 2 roads for the convenience of those people. The locations and intervals for the 6 stations are shown in Table 3.4.1.

Between Alexandria Desert Road and Ring Road, 26th of July Corridor mainly runs through cultivated area. This section is a 7~8m high-embankment road and cultivated lands cannot be developed for other purposes. No interconnecting roads exist along this section. Therefore, it is not necessary to develop stations between Alexandria Desert Road and its final destination in the intermodal terminal at Giza Governorate in Cairo.

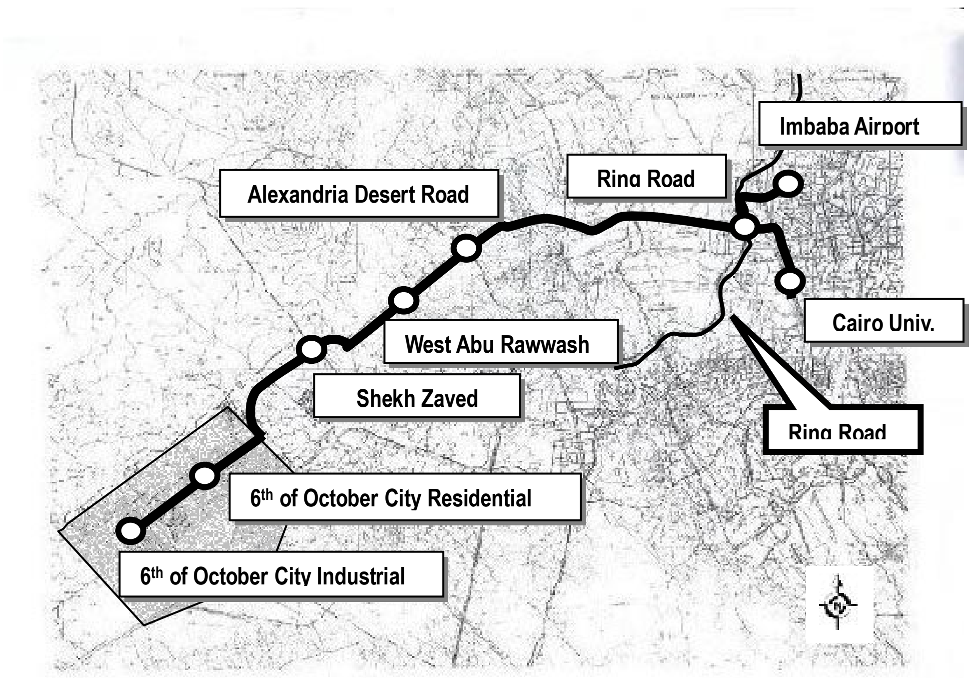
Table 3.4.1 Location of Station and Interval

No.	Name and Location of Station			Interval (km)		
	Option 1	Option 2	Option 3	Option 1	Option 2	Option 3
1	6th of October City Industrial (in front of an industrial park)			5.2		
2	6th of October City Residential (center of residential area)			7.0		
3	Sheikh Zayed			5.0		
4	West Abu Rawwash			3.3		
5	Alexandria Desert Road			17.6	12.6	17.5
6	Imbaba Airport	Ring Road	Cairo Univ.			
Total				38.1	33.1	38.0

Source: JICA Study Team

There are two types of cross section in 6th of October City. The first section between the industrial area and the residential area in 6th of October City, where the right-of-way is 6-lanes per two-directions. Secondly, the 26th of July Corridor section in the residential area of 6th of October City has six (6) traffic lanes with median and two (2) frontage roads with separators per two directions. For both sections, a priority bus lane will be provided on the central lane for each direction. The station for the busway will be provided on the median between the traffic lanes and the frontage road, while the local feeder service buses will stop on the frontage lane at roadsides.

The section on 26th of July Corridor between the city boundary of 6th of October City and the Ring Road consists of 6 traffic lanes, a median and shoulders. The exclusive lane for the busway will be provided on central 2-lanes along a median. Buses will run on the exclusive lanes and will stop on this lane at bus stations on the median. Feeder services for ordinary buses and shared taxies should be operated at station plaza outside 26th of July Corridor. Buildings for passengers will be made available in the stations. A pedestrian bridge will connect to the feeder service stations outside 26thof July Corrido,r with the bus station located on the median. These pedestrian bridges will guarantee the safety and convenience of all bus passengers.



Source: JICA Study Team

Figure 3.4.5 Candidate Location of Bus Station

3.4.3 Transport Demand Forecast

(1) Assumptions of Transport Forecast

Preliminary future transport demand forecasting was carried out to screen the three options. Capacity constraints were not considered in the forecast. Assumptions, common for all options, were made to forecast preliminary demand. The fare level[1] of busway service was assumed to be LE0.63 + LE0.03 /km, LE0.74 + LE0.04 /km, LE1.00 + LE0.05 /km in 2007, 2012 and 2022, respectively (year 2001, constant prices). The frequency of the service was assumed to be every 3 minutes for all cases.

(2) Transport Demand Forecast by Option

Table 3.4.2 shows the results of the transport demand forecast by option and by year. The peak ratio of the demand was assumed as 10%[2] of daily traffic volume, which was derived from peak ratios of the Metro in operation.

According to the results in Table 3.4.2, Option 3 demonstrated the best results in terms of maximum passenger flows in 2012 and 2022. In terms of daily passengers, option 3, attracts more passengers compared to other options.

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1 The fare level of assumption is based on fare level of the Metro Line 2 in Cairo: in 2007, base fare (0.63 L.E) and additional fare per distance (0.03 L.E), in 2012 base fare (0.74 L.E) and additional fare per distance (0.04 L.E), and in 2022 base fare (1.00 L.E) and additional fare per distance (0.05 L.E.).

2 The Study Team assumed this peak ratio to be rational, based on the result of the surveys conducted in the Study of Master Plan (Phase 1). Justification of the peak ratio is explained in item 7) Scheduled Service Frequency of Section 3.4.5 Preliminary Design of Busway System.

Option 2 appeared to attract the least number of passengers. How to predict the progress of new community development is, of course, is of major concern of the CREATS Master Plan. Ministry of Housing, Urban Utilities and New Communities has been investing massive funds to accelerate the development with their targets. The Study Team examined the possible level of the achievement of the targets, using an economic model with factors of: 1) economic growth in terms of GDP; 2) performance trend; 3) private investment on the real estate sector, and 4) projected public investment. As the result, Study Team came up with a scenario that given a moderate economic growth in Egypt, the current targets launched by GOPP will be achieved at a 70% level in 2022. In the case of the Western corridor, 6th October, there is significant development by 2022. The population of 6th October increases from 332,000 in 2007 to 1,165,000 in 2022. Also by 2022 the eastern end of the West Wing is linked to Metro Line 3. This is why there is a significant increase in ridership between 2007 and 2022.

Table 3.4.2 Future Transport Demand by Option

Demand	Year	Option 1	Option 2	Option 3
Maximum Pax. Flow (per hour/direction)	2007	900	1,300	580
	2012	4,800	5,100	5,900
	2022	19,200	18,400	19,200
Number of Pax. per day (x 000)	2007	20	27	12
	2012	100	100	120
	2022	410	380	400

Source: JICA Study Team

3.4.4 Screening for Selection of Optimum Route

Table 3.4.3 summarizes the physical outlines of the three options for the West Wing Busway Project which were preliminary designed to compare them in terms of the route length, the number of station, the length of viaduct structure, all of which affect the investment cost. All options consist of a two-lane segregated busway system. Vehicles for the service will be normal air-conditioned buses in the beginning and will be replaced by articulated buses when the demand exceeds the transport capacity by the normal bus operation.

Table 3.4.3 Comparison of West Wing Public Transport Development Options

Option	1	2	3
Route Plan	Imbaba-6th of October City	Ring Road-6th of October City	Cairo Univ.-6th of October City
Route Distance	38.1 km	33.1 km	38.0km
Number of Stations	7 bus stops	6 bus stops	6 bus stops
Length of Viaduct Structure	5.7 km	0.9 km	5.4 km
Investment Cost (Million L.E.) *	**755**	**440**	**729**

Source: JICA Study Team

As seen in this table, there exists a great difference in the investment cost between Options 1 and 2, or Option 1 is more costly by 72% than Option 2. Such a great difference in the investment cost is caused by the construction cost of the viaduct structure as well as the total length of the bus route. While, looking into the demand side, as shown in Table 3.4.2, the number of daily passengers in 2022 for Options 1 (410,000 pax/day) is greater by only 8% than that in Option 2 (380,000 pax/day). This implies that there will be a remarkable difference in the cost efficiency among options.

In order to examine the comparative cost efficiencies among options, a preliminary economic analysis was carried out in the same manner as the Master Plan. Costs of the options were converted from financial costs to economic costs. Time saving and cost saving benefits were calculated based on the demand forecast outputs. However, additional investment costs were not included in the analyses for a screening purpose.

The analysis aimed at comparing relative priorities among the options, the result of which is summarized in Table 3.4.4. Option 2 indicated 42.1 % of Economic Internal Rate of Return (EIRR), which is the greatest among options. On the other hand, EIRRs of Options 1 and 3 were computed at 30.9 % and 41.5 % respectively. Although Option 2 showed the highest EIRR, the difference between Options 2 and 3 is not significant, or almost the same. For the optimal selection, therefore, other planning factors should be considered.

The most important factor must be the intermodal system formation to network with the available Metro Lines, which allows passengers to conveniently transfer to/from the central areas of Giza and Cairo. Taking into account this planning factor, Option 2 will possibly make a direct connection with the forthcoming Metro Line 3 in the future, while Option 3 can connect directly with Metro Line 2 at Cairo University Station soon after the busway completes. Such a time gap between the completion years of Metro Line 3 and the West Wing Busway may also be a disadvantage to push Option 2.   .

Based on above considerations, the Study Team decided to select Option 3 as the optimal option that shall be discussed further in this feasibility study. Planning works and evaluation tasks are conducted for the selected Option 3, hereafter.

Table 3.4.4 Results of Preliminary Economic Analysis

Unit: Million LE, in 2001 prices

	EIRR	NPV	B/C
Option 1	30.9%	18,724.2	41.7
Option 2	42.1%	20,045.1	75.1
Option 3	41.5%	20,404.4	45.3

Source: JICA Study Team
Note: Social discount rate was assumed as 12 %.

3.4.5 Preliminary Design of Busway System

This section discusses the preliminary design of the busway system. An appropriate, systematic facilities design for the busway is essential for the safe, smooth flow of the bus traffic on the busway. This section deals with the main design of the busway, with a review of the road conditions based on the bus operation system plan. In addition, bus stop station design pertaining to the busway is shown including the station plaza out of 26th of July Corridor. Finally in this section, the design of the bus operation system is covered.

(1) Design Criteria

A dual-track railway system will be operated on the same alignment of the exclusive busway system, as proposed in the CREATS Master Plan. Therefore, the design standards and guidelines related to railways in Egypt should be considered for the design of the West Wing Corridor in terms of horizontal alignment and vertical alignment, cross sectional elements and structures (viaduct, elevated busway and elevated terminal) are to be minimized future investment costs for changing the mode from a busway system to a dual-track railway system. Table 3.4.5 shows the design element of the highway and railway. Egyptian highway design standards should be considered for the design of a terminal at an intermodal point and a bypass road at a bus stop station on the West Wing.

Table 3.4.6 shows the design standard of the bus terminal.

Table 3.4.5 Design Element of Exclusive Busway and Railway

Design Class	Unit	Figure	Remarks
Width of Lane*	m	4.0	Total width of the structure of one and two lanes both direction are 4.0 - 5.5m and 8.0 - 10.0m respectively.
Minimum Radius	m	400	
Maximum Grade	%	4.0	
Vertical Clearance	m	6.0	

Source: Egyptian National Railway (ENR), Egyptian Highway Design Standard

*Note: * On major streets within 6th of October City, the bus priority lane system was proposed during peak periods with no full segregated busway. Thus, buses are to be exclusively operated on the normal lane as a bus priority lane. Therefore, the width of lane shall be kept as it is (3.5m), different from that defined in this table.*

Table 3.4.6 Design Element of Terminal Station (Bus Terminal)

Design Class	Unit	Figure	Remarks
Width of Busway	m	4.0	
Width of Sidewalk	m	3.0-8.0	
Minimum Radius	m	10.0-13.0	

Source: Egyptian Highway Design Standard

The 26th of July Corridor is asphalt-paved. For a bypass road, surface continuity at stations will be constructed in an area apart from 6th of October City, therefore, the design standard is asphalt standard.

(2) Type of Road Structure Adopted

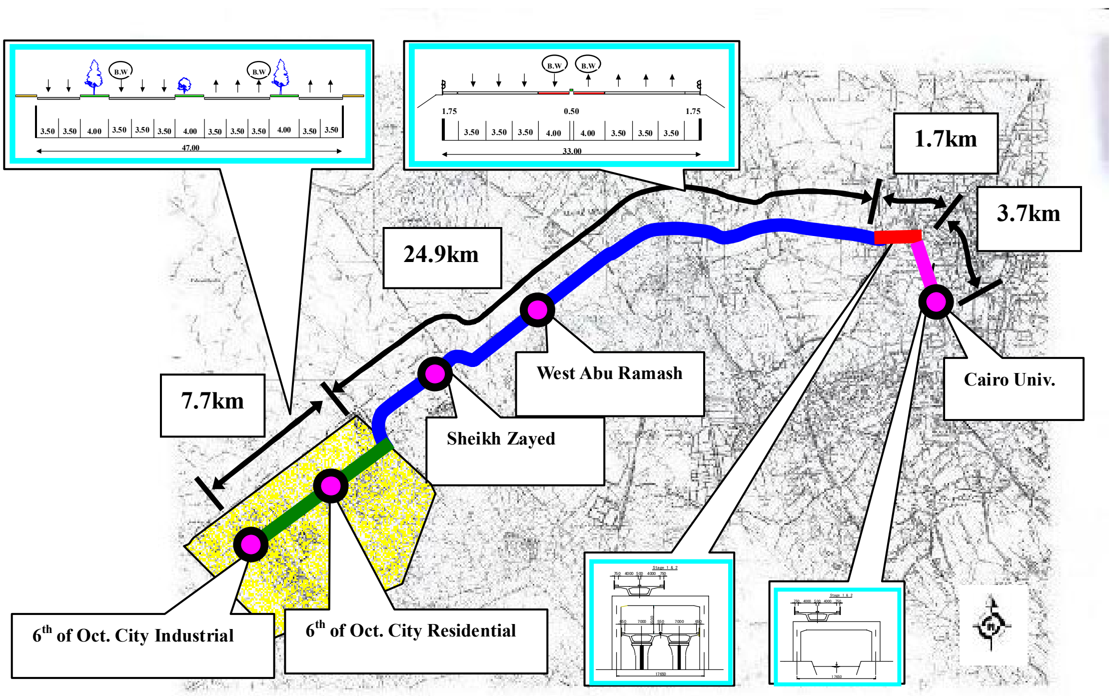
Three different road structure types for the busway system can be considered: At-grade type of bus priority lane system on the central lane, At-grade type of median full segregated busway, and Viaduct type of full segregated busway.

At-grade type of bus priority lane system is a road structure at the same level as existing major streets in 6th of October City. At-grade type of median full segregated busway is a road structure at the same level as the existing 26th of July Corridor. The viaduct type of full segregated busway is a road constructed for use over the 26th of July Corridor and the canal along the ENR, which is located between Ring Road interchange and Cairo University station on Metro Line 2. Figure 3.4.6 shows the general profile of busway by type of road structure, and the design section of busway by type of road structure is shown in Table 3.4.7.

Table 3.4.7 Design Section of Busway by Type of Road Structure

Name of Road and Location	Section	Distance (km)	Type of Busway System	Type of Road Structure
Major street in 6th of October City	City industrial area - Boundary of 6th of October City	7.7	Bus priority lane during peak hours	At-grade
26th of July Corridor	Boundary of 6th of October City - Before of Ring Rd. interchange	24.9	Median full segregated busway	At-grade
	Before of Ring Rd. interchange - Tareeq Nahya St. (canal/ENR)	1.7	Full segregated busway	Viaduct
Tareeq Nahya St. (canal/ENR)	26th of July Corridor – Cairo Univ. of Metro Line 2	3.7	Full segregated busway	Viaduct
Total		38.0		

Source: JICA Study Team



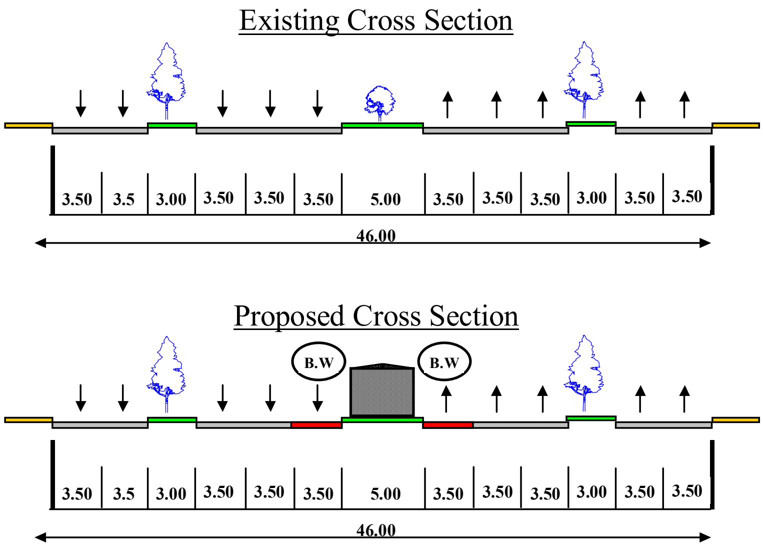
Source: JICA Study Team

Figure 3.4.6 General Profile of Busway by Type of Road Structure

(3) Typical Busway Cross Section

1) Section on Main Streets in 6th of October City

The existing right-of-way ranges between 34 and 50 meters in width, and consists of either 6-lanes or 10-lanes. This road can only take a bus priority lane system with 1-lane per direction on the central lane during peak periods. The bus priority lane cross section is as shown in Figure 3.4.7.

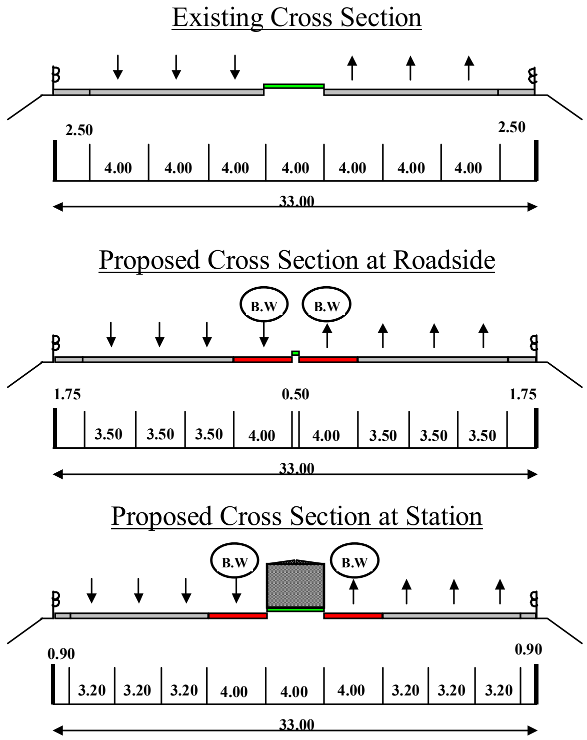


Source: JICA Study Team

Figure 3.4.7 Typical Cross Section on Main Street in 6th of October City

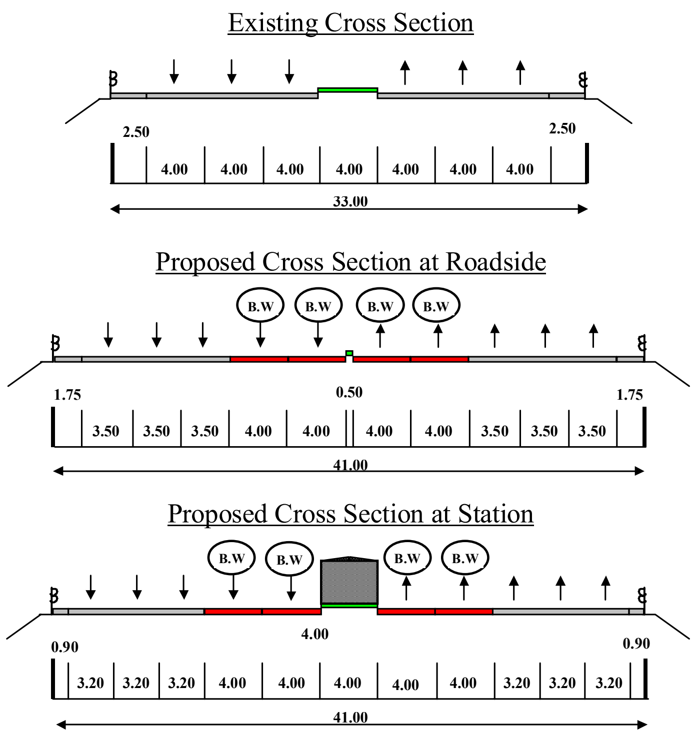
2) Section on 26th of July Corridor

The existing right-of-way is 33 meters wide, and consists of 6-lanes. Since the 26th of July Corridor will be defined as a busway, the operation of buses will be planned for the full median segregated busway. It is necessary to reduce the width of median in order to provide 2-lanes for the busway. In Stage 1 and 2, this road should be reserved for a 1-lane busway per direction by reduction of the lane width for other traffic as follows: at the roadside, 2-lanes of 4.0m for the busway, 6-lanes of 3.5m for other traffic, and at the station, 2-lanes of 4.0m for the busway, 6-lane of 3.2m for other traffic. The section between Ring Road and the canal (Tareeq Nahya St.) on 26th of July Corridor should be upgraded by introducing a viaduct busway with 1-lane per direction: 2-lanes of 4.0m for the busway, 6-lanes of 3.5m for other traffic. In Stage 3, this road should be reserved for a 2-lane busway per direction by the widening of 26th of July Corridor as follows: at the roadside, 4-lanes of 4.0m for the busway, 6-lanes of 3.5m for other traffic, and at the station, 4-lanes of 4.0m for the busway, 6-lanes of 3.2m for other traffic. The section between Ring Road and the canal on 26th of July Corridor should be upgraded by an additional viaduct busway with 2-lanes per direction on the existing 26th of July St.: 4-lanes of 4.0m for the viaduct busway. The cross section of median full segregated busway is as shown in Figure 3.4.8 (1)-(4).



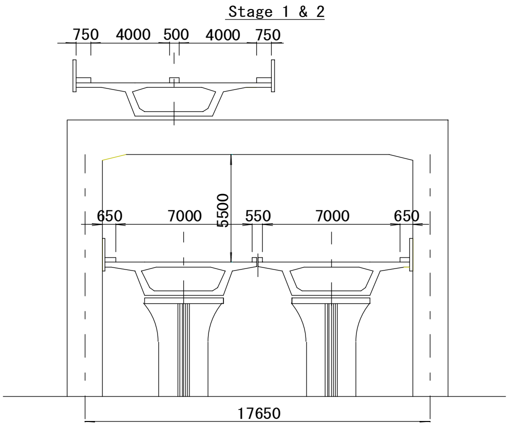
Source: JICA Study Team

Figure 3.4.8 (1) Typical Cross Section on 26th of July Corridor in Stage-1 & 2



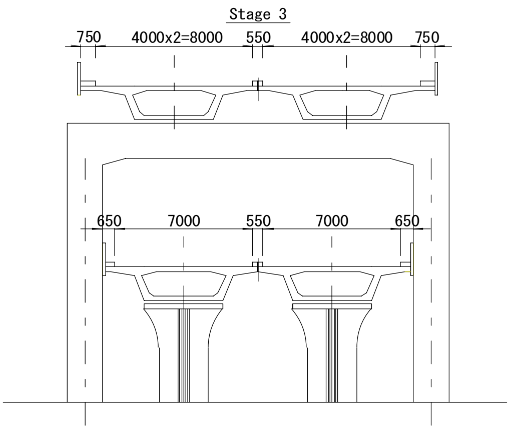
Source: JICA Study Team

Figure 3.4.8 (2) Typical Cross Section on 26th of July Corridor in Stage-3



Source: JICA Study Team

Figure 3.4.8 (3) Typical Cross Section between Ring Road and Canal in Stage-1 & 2

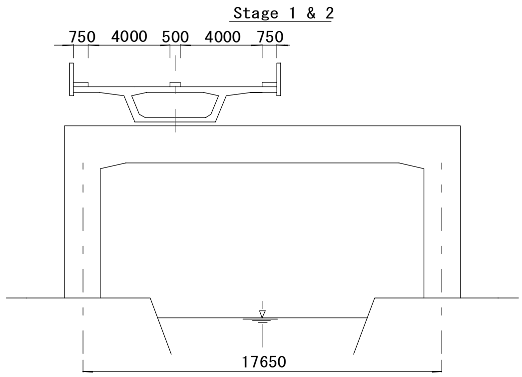


Source: JICA Study Team

Figure 3.4.8 (4) Typical Cross Section between Ring Road and Canal in Stage-3

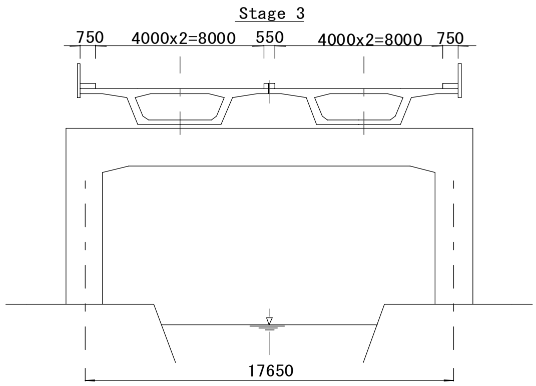
3) Section on Canal Along ENR

The existing canal ranges between 15 and 20 meters width including both banks. The canal will be used by the viaduct busway. In Stage 1 and 2, the operation of the busway will be planned for 1-lane per direction: 2-lanes of 4.0m for the busway. In Stage 3, the busway will be operated using 2-lanes per direction: 4-lanes of 4.0m for the busway. Based on the Master Plan, the elevated expressway system should be constructed between 26th of July St. and Cairo University on Metro Line 2 along the canal. Therefore, the same alignment of the busway system can be shifted to the elevated expressway system. When the busway system is upgraded to a railway system, the railway will be used under the elevated expressway along the canal. The bus priority lane cross section is as shown in Figure 3.4.9 (1)-(2).



Source: JICA Study Team

Figure 3.4.9 (1) Typical Cross Section on Canal along ENR in Stage-1 & 2



Source: JICA Study Team

Figure 3.4.9 (2) Typical Cross Section on Canal along ENR in Stage-3

(4) Stations and Facilities

1) Location of Intermediate Bus Station and Bus Terminal

The estimated passenger boarding demand during the morning peak hour, to selected stations on Option 3, as discussed in 3.4.3 Bus Station, is shown in Table 3.4.8. From this passenger demand, it is observed that the passenger demand at Alexandria Desert Road station is small. This location is not expected to have a station function. Accordingly, the locations of bus stop stations are five stations at 6th of October City Industrial, 6th of October City Residential, Sheikh Zayed, West Abu Rawwash, and Cairo University on Metro Line 2.

Table 3.4.8 Passenger Boarding Demand to Selected Locations for Intermediate Bus Station and Bus Terminal during Morning Peak Hour

Bus Terminal/ Intermediate Station	Selected Location	2007	2012	2022
		Boarding (Pax./Morning peak hour)	Boarding (Pax./Morning peak hour)	Boarding (Pax./Morning peak hour)
Bus Terminal	1. 6th of October City Industrial	500	1,800	2,300
	2. Cairo Univ. of Metro Line 2	580	5,900	19,200
Intermediate Station	1. 6th of October City Residential	50	460	8,550
	2. Sheikh Zayed	400	5,200	11,550
	3. West Abu Rawwash	100	100	1,250
	4. Alex. Desert Road	10	10	10

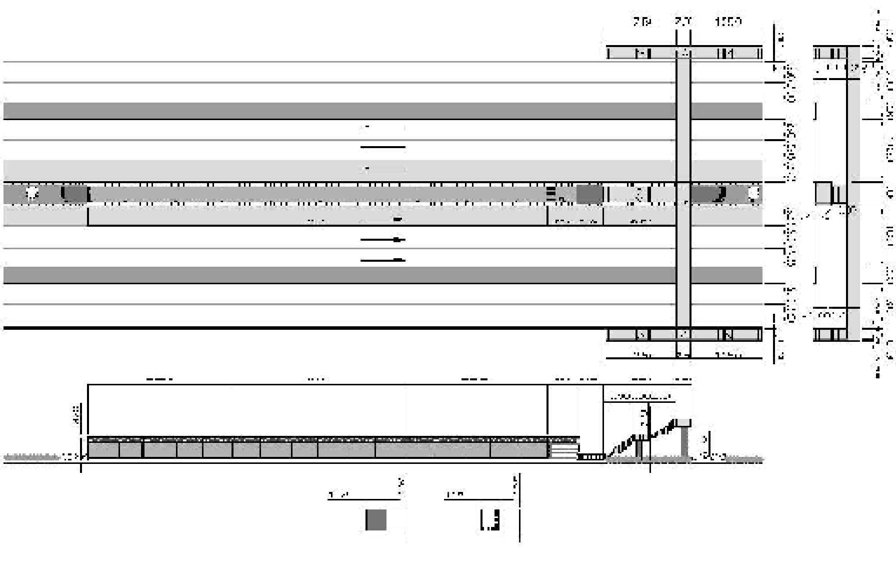
Source: JICA Study Team
Note: Based on the result of the demand simulation.

2) Intermediate Bus Station

a. Station Facilities

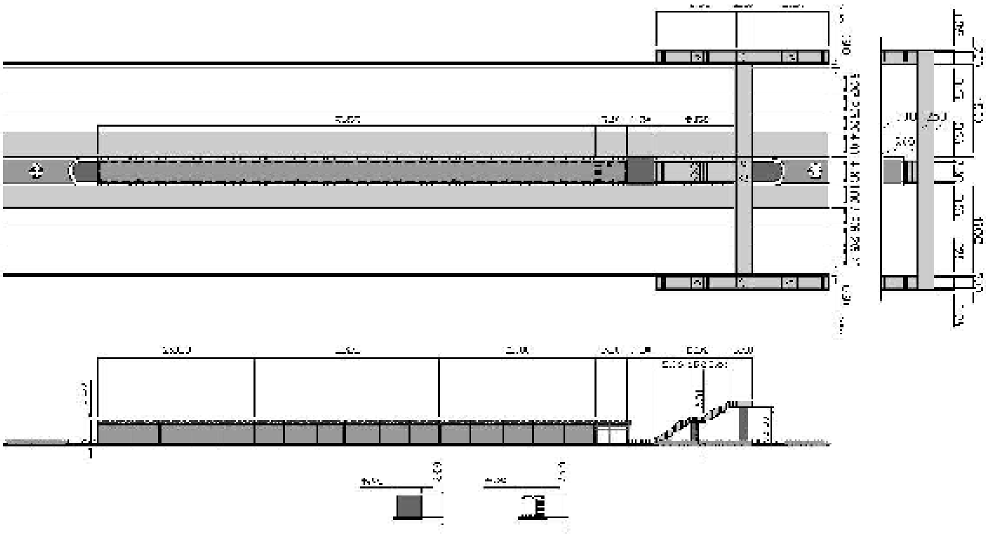
Articulated buses for the busway system will be operated on the bus priority lanes along the median in 6th of October City, and will be operated on full segregated busway on central 2-lanes along a median of the West Wing Corridor. Therefore, a bus stop station should be provided in the median area of the road.

Figure 3.4.10 shows a typical cross section of the bus stop station in 6th of October City. Figure 3.4.11 shows a typical cross section of the bus stop station on 26th of July Corridor. The pedestrian bridge must be installed for passengers. The station facility with an off-board and fast ticketing system is located on a traffic island. Figure 3.4.12 (1) and (2) shows a diagram of the station facility. The number of berths at the platform refers to Table 3.4.9.



Source: JICA Study Team

Figure 3.4.10 Typical Cross Section of Bus Stop Station at Section of 6th of October City



Source: JICA Study Team

Figure 3.4.11 Typical Cross Section of Bus Stop Station at Section of 26th of July Corridor

Source: JICA Study Team

Figure 3.4.12 (1) An Image of Station Facility

Source: TRANSMILENIO Trunk Bus System in Bogota City of Republic of Colombia

Figure 3.4.12 (2) An Image of Quick Ticket System at Station

b. Area Required for Station Facilities

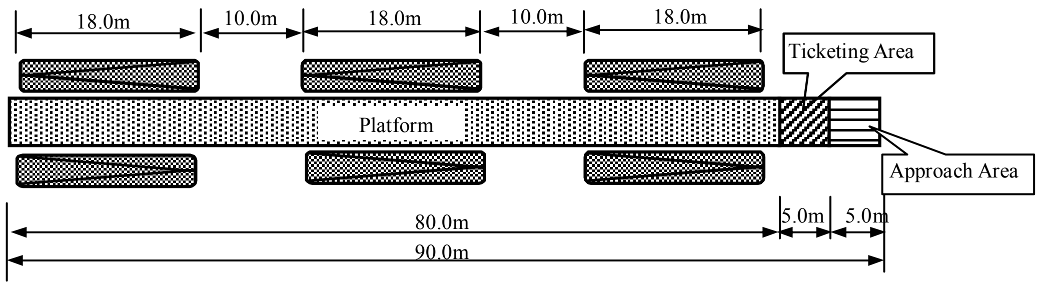
For bus stop stations, the required area for a passenger waiting building, platform, and pedestrian bridge is shown in Table 3.4.9.

Table 3.4.9 Area Required for Station Facilities

Facilities	Unit	Size	Remarks
Passenger waiting building	m	W=4.0, L=90.0, H=3.0	Including approach (L=5.0) and quick ticketing area
Platform	m	W=4.0, L=80.0, H=3.0	No. of berths: 3 berths/dir*
Pedestrian bridge	m	W=2.5, L=38.5, H=6.0	Steel structure

Source: JICA Study Team

*Note: * The number of berths was calculated, based on a combined operating system of 2-bus platoon plus 1-bus normal dispatching with 2 minutes headway during peak periods. The dwell times at the intermediate bus stations are approximately 1.0-2.0 minutes when 50% of full passengers get boarding and alighting. Therefore, 3 bus berths are needed at the same time.*



Source: JICA Study Team

c. Station Plaza

The station plaza, which is located near the intermediate bus stop station, is built outside 26th of July Corridor. The station plaza for the station for 6th of October City Residential will be built on side lanes along the main street, because there is no space due to the built-up area. The station plaza will be constructed to link to bus stop stations, for the transfer from the busway to feeder services for the surrounding areas.

<u>Location and Vehicle Circulation at Station Plaza Along Busway</u>

The locations of station plaza are at intermediate bus stations: 1) 6th of October City Residential, 2) Sheikh Zayed Station, and 2) West Abu Rawwash Station. The system for an efficient vehicle circulation is defined as follows:

The station plaza for the station of 6th of October City Residential should particularly use space containing existing road facilities.

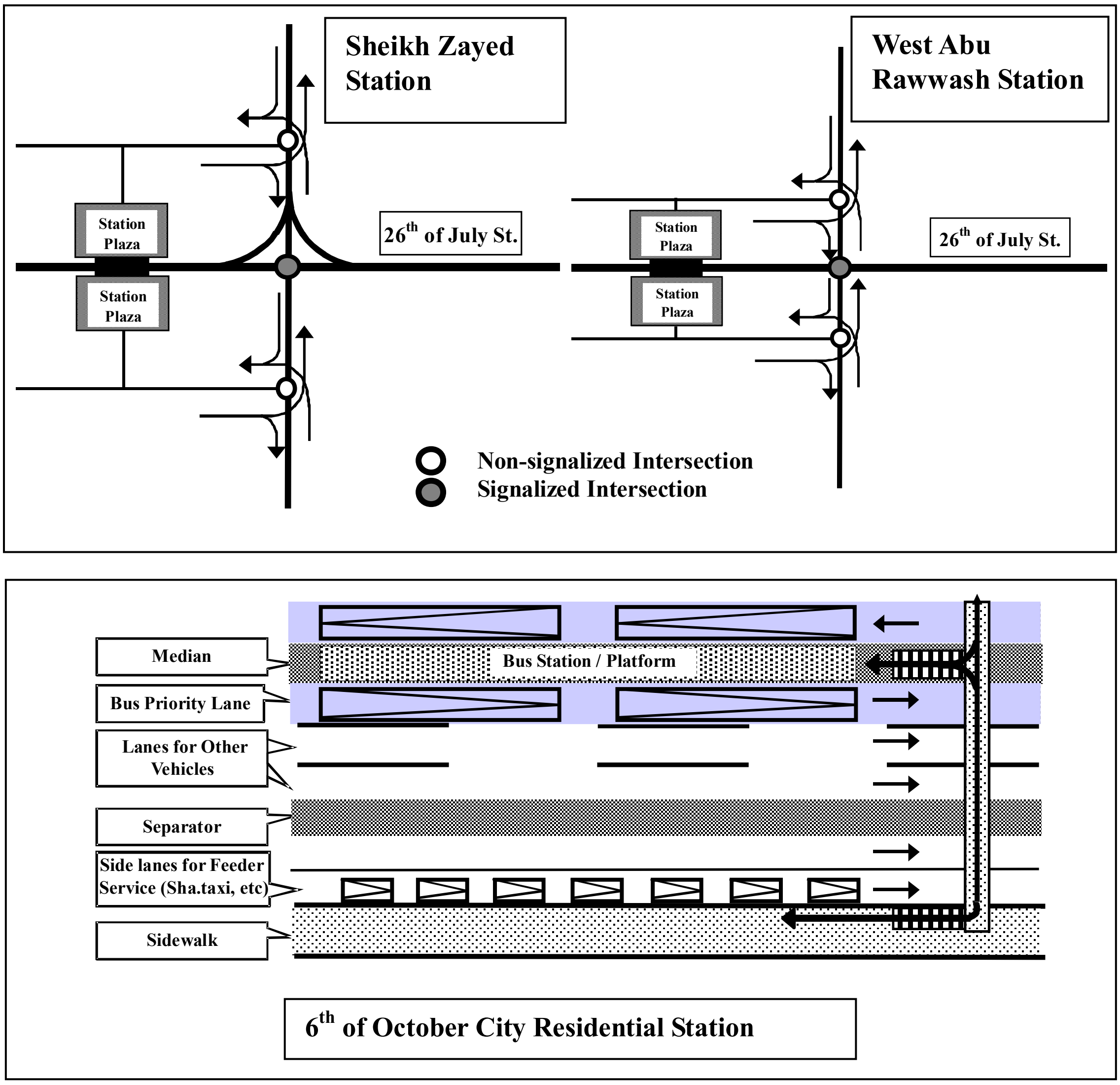
Regarding Sheikh Zayed Station and West Abu Rawwash Station, the major access routes for the feeder buses to the station plaza are two routes from the access road linking to intersections along 26th of July Corridor.

These above-mentioned roads will be developed for the most direct access to the station plaza.

Major access roads and the vehicle circulation at each station plaza are shown in Figure 3.4.13.

Each intersection linking to 26th of July Corridor will be operated by signal lights for the busway priority system.

- The intersection connecting to the access road will be channelized.



Source: JICA Study Team

Figure 3.4.13 Vehicle Circulation at Station Plaza

Development Needs of Station Plazas

The development needs of station plazas were determined according to bus passenger demand and public space in relation to the number of passengers. The required number of bus berths and land area are shown below:

Number of Berths and Area Required for Feeder Service

Based on the estimate of passenger boarding demand as discussed in Table 3.4.8, the passenger demand by mode in 2022 is shown in Table 3.4.10. The vehicle berths of feeder services for the station plaza were estimated, as shown in Table 3.4.11. They consist of local buses, mini buses, shared taxies, taxies, and private cars. The number of required berths is determined by the dispatching turnover. The calculation method is as follows:

- During the peak hour, average occupancy per one mini bus and bus at the station plaza of an intermediate bus station is assumed to be 100%.
- Based on the results of the HIS survey, average passenger occupancy of a car and taxi is as follows: car at 1.5 passengers and a taxi at 2.0 passengers.
- In accordance with the busway frequency, including boarding/alighting time per passenger, the average dispatching interval by mode is defined as follows: Bus at 8.0 min and Mini bus at 8.0 min based on total boarding/alighting time, Shared taxi, taxi, and car at 2.0 min based on the arrival schedule of busway.
- Based on the above, the dispatching turnover per peak hour by mode is expected to be as follows: Bus and Mini bus at 7.5 times based on the dwell time of 8.0 min, Shared taxi, taxi, and car at 30 times based on the dwell time of 2.0 min.
- In addition, the reservation of vehicles berths should be considered.

Table 3.4.10 Number of Passenger Demand by Mode

Intermediate Station	Passenger Demand in 2022 (Pax/peak hour)						
	Walk	Car	Taxi	Shared Taxi	Mini Bus	Local Bus	Total
1. 6th of October City Residential	4,530	850	430	2,740	0	0	8,550
2. Sheikh Zayed	6.120	1,390	460	2,770	230	580	11.550
3. West Abu Rawwash	660	140	50	310	30	60	1,250

Source: JICA Study Team
Note: Based on the result of the demand simulation.

Table 3.4.11 Vehicle Berths Required for Station Plaza of Feeder Service

Intermediate Station	Number of Berth Required in 2022 (Berths/peak hour)					
	Car	Taxi	Shared Taxi	Mini Bus	Local Bus	Total
1. 6th of October City Residential	10(20)	4(8)	4(8)	0	0	18(36)
2. Sheikh Zayed	16(32)	4(8)	4(8)	2(4)	2(4)	28(56)
3. West Abu Rawwash	2(4)	1(2)	1(2)	2(4)	2(4)	8(16)

Source: JICA Study Team
Notes: 1) Number of vehicle berths is for one side of the station plazas at each intermediate station.
2) ( ): Total number of vehicle berths at both station plazas for intermediate station.
3) Boarding and alighting will be done at the same berth.

Based on the above, the total number of berths for the station plazas, at each intermediate station in 2022, is as follows: 6th of October City Residential, 36 berths (car, 20 berths; taxi, 8 berths; and shared taxi, 8 berths), Sheikh Zayed, 56 berths (car, 32 berths; taxi, 8 berths; shared taxi, 8 berths; mini bus, 4 berths; and local bus, 4 berths), and West Abu Rawwash, 16 berths (car, 4 berths; taxi, 2 berths; shared taxi, 2 berths; mini bus, 4 berths; and local bus, 4 berths). In terms of the total land area of parking facilities required, this translates into 900 square meters for 6th of October City Residential, 2,260 square meters for Sheikh Zayed, and 1,160 square meters for West Abu Rawwash. In the case of the inclusion of bus shelters, bays and pedestrian space, the total area is approximately 900 m^2, 10,020 m^2, and 6,050 m^2. Table 3.4.12 shows the total floor space required for the station plaza of an intermediate bus station.

Table 3.4.12 Total Land Space Required for Station Plazas at Each Intermediate Station

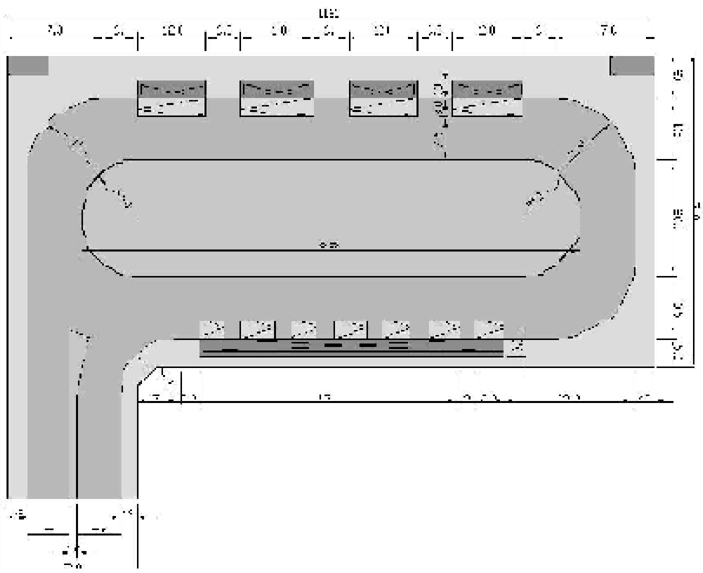
Intermediate Station	Total Area per One Station Plaza		
	Parking Facilities (m^2)	Other Facilities (m^2)	Total (m^2)
1. 6th of October City Residential	900	-	900
2. Sheikh Zayed	2,260	7,760	10,020
3. West Abu Rawwash	1,160	4,890	6,050

Source: JICA Study Team

Notes: Unit area required for vehicle related facilities, Car, Taxi and Shared taxi=27.5 m^2, Mini bus and Local bus=117.0 m^2.

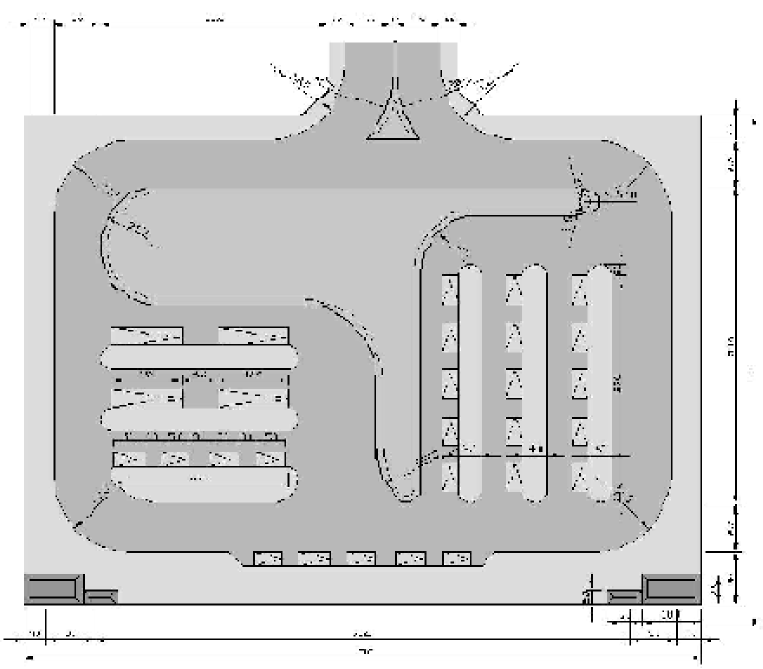
<u>Layout of Station Plaza Along Busway</u>

In the context of vehicle circulation and the total floor space required for a station plaza, the plan of the station plaza is shown in Figure 3.4.14.



Source: JICA Study Team

Figure 3.4.14 (1) Plan of Station Plaza for Sheikh Zayed Station



Source: JICA Study Team

Figure 3.4.14 (2) Plan of Station Plaza for West Abu Rawwash Station

3) Bus Terminal

A bus terminal that is provided at an intermodal point will have a terminal function such as the transfer from buses to Metro, and parking and turning of buses from the busway. Where a terminal is located in an urban area, the size of a terminal should be minimized as much as possible to reduce the physical and social environmental impact on the surrounding area. The bus terminal is discussed below.

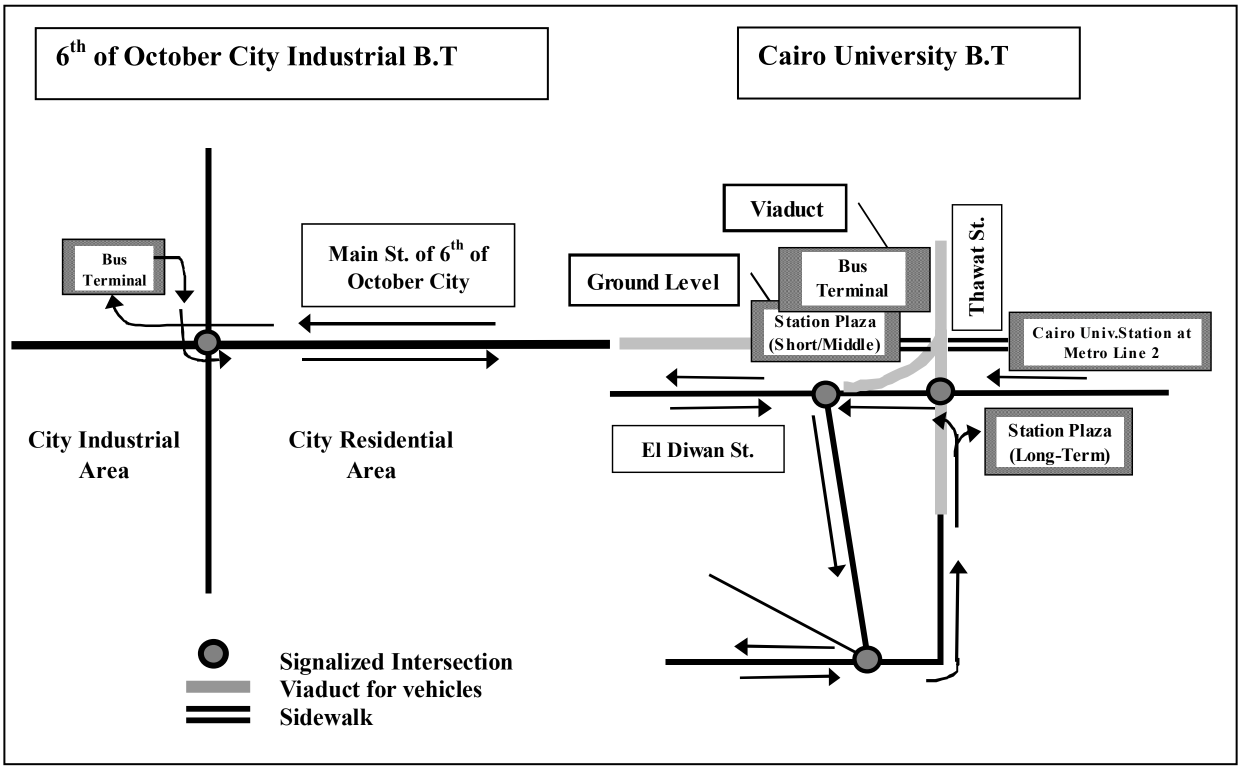
a. Location and Vehicle Circulation at Bus Terminal

The locations of bus terminals are: 1) 6th of October City industrial, and 2) Cairo University Station on Metro Line 2. The system for an efficient vehicle circulation is defined as follows:

- Regarding the bus terminal for 6th of October City Industrial, the major access route for the feeder buses is one route from the existing intersections at the main street of 6th of October City. The bus terminal at Cairo University Station on Metro Line 2 is accessed from existing streets located to the east, west and south.
- The bus terminal at Cairo University Station for buses on the busway will be constructed above a road and a canal, in order to link to the elevated station on Metro Line 2. In addition, a station plaza for feeder services for the local area will be provided near the bus terminal and Metro Line 2 station. Within the area between Diwan St. and Tharwat St. that constitute densely built-up area and narrow width streets, it is very difficult to develop a station plaza linking to West Wing Bus terminal and the Cairo University Station of Metro Line 2.

Accordingly, it is necessary to introduce two alternative solutions of the station plaza that respond to the requirement for short/middle-term and long-term. For the short/middle-term (in 2012), the station plaza should be planned at space under the viaduct bus terminal of West Wing Busway along the existing canal, in order to make the maximum use of the proposed terminal facilities. For the long-term (in 2022), development of station plaza in front of Cairo University station is the most efficient. The plan of station plaza should be considered by using a method of moving out the dwellers and demolishing their buildings in front of the existing Metro Line 2 station. In future, the plan should be introduced in accordance with the regional policy of redevelopment in the area.

- A sidewalk for transferring to the Metro Line 2 station will be constructed from Cairo University bus terminal to Cairo University station on Metro Line 2.
- At the Cairo University bus terminal, a traffic circulation system will be planned by introducing a one-way combination, in order to achieve smooth traffic and to increase the capacity on the existing narrow street network. Tharwat St., at the approach of the flyover bridge linking to Diwan St., will be widened.
- Major access roads and the vehicle circulation at each bus terminal are shown in Figure 3.4.15.
- Traffic signal lights will control the intersections linking to each access road in the bus terminal at 6th of October City Industrial and the bus terminal at Cairo University Station on Metro Line 2.



Source: JICA Study Team

Figure 3.4.15 Bus Terminal/Station Plaza and Vehicle Circulation

b. Bus Terminal Facilities

The function of the two bus terminals comprise of facilities for vehicles, the service facilities for passengers, and the management office. The public facilities consist of bus berths, parking area, service facilities, office for management, information service, etc.

c. Development Needs of Bus Terminal Area

The development needs of the bus terminal area were determined according to the bus demand and the public service in relation to the number of passengers. The required number of bus berths and land area are shown below.

<u>Number of Berths and Area Required</u>

The number of bus berths and other vehicles for the bus terminal, in 2022, were estimated from the peak hour bus volume. The vehicle berths for the bus terminal and station plaza for feeder services were estimated, as shown in Table 3.4.13. Table 3.4.14 shows the passenger demand by mode in 2022. The calculation method is the same as the plan for the station plaza at the intermediate bus station. The number of berths was calculated based on the estimate of passenger boarding demand by mode, boarding/alighting time per passenger, average dispatching interval by mode and the dispatching turnover per peak hour by mode. The station plaza is classified into two alternative solutions, based on response to the requirements for the short/middle-term and the long-term.

Table 3.4.13 Number of Passenger Demand by Mode

Bus Terminal/Station Plaza		Passenger Demand in 2022 (Pax/peak hour)						
		Walk	Car	Taxi	Shared Taxi	Mini Bus	Local Bus	Total
1. 6th of October City Industrial		1,150	0	0	920	0	230	2,300
2. Cairo Univ. of Metro Line 2	Bus Terminal	19,200 (Busway)						19,200
	Station Plaza (S/M)	1,600	400	1,060	5,540	380	1,620	10,600
	Station Plaza (L)	4,000	1,000	2.640	13,860	950	4,050	26,500

Source: JICA Study Team
Notes: Based on the result of the demand simulation. (S/M)=Short/Middle-Term in 2012, (L)=Long-Term in 2022.

Table 3.4.14 Vehicle Berths Required for Bus Terminal and Station Plaza of Feeder Service

Bus Terminal/Station Plaza		Number of Berth Required in 2022 (Berths/peak hour)						
		Car	Taxi	Shared Taxi	Mini Bus	Local Bus	Articu-lated Bus	Total
1. 6th of October City Industrial		0	0	2	0	2	9	13
2. Cairo Univ. of Metro Line 2	Bus Terminal	0	0	0	0	0	9	9
	Station Plaza (S/M)	8	18	17	2	4	0	49
	Station Plaza (L)	20	44	42	3	9	0	118

Source: JICA Study Team
Notes: Boarding and alighting will be done at the same berth. (S/M)=Short/Middle-Term in 2012, (L)=Long-Term in 2022

Based on the above, the total number of berths for the each bus terminal in 2022 is as follows: 6th of October City Industrial, 13 berths (shared taxi, 2 berths; local bus, 2 berths; and articulated bus, 9 berths), and Cairo University station with the station plaza, for the short/middle-term (in 2012), 58 berths (car, 8 berths; taxi, 18 berths; shared taxi, 17 berths; mini bus, 2 berths; local bus, 4 berths; and articulated bus, 9 berths), for the long-term (in 2022), 118 berths (car, 20 berths; taxi, 44 berths; shared taxi, 42 berths; mini bus, 3 berths; local bus, 9 berths; and articulated bus, 9 berths).

In terms of the total floor space of parking facilities required, this translates into 2,050 square meters for 6th of October City Industrial, and 1,760 square meters for the bus terminal, and the station plaza at Cairo University on Metro Line 2 for the short/middle-term and the long-term, 1,880 m^2, and 4,300 m^2 respectively.

In the case of the inclusion of bus shelters, bays and pedestrian space, the total area is approximately 8,030 m^2, 5,220 m^2, 9,200 m^2 and 21,700 m^2 respectively. Table 3.4.15 shows the total floor space required for the bus terminal and the station plaza.

Table 3.4.15 Total Floor Space Required for Bus Terminal and Station Plaza of Feeder Service

Bus Terminal		Parking Facilities (m^2)	Other Facilities (m^2)	Total (m^2)
1. 6th of October City Industrial		2,050	5,980	8,030
2. Cairo Univ. of Metro Line 2	Bus Terminal	1,760	3,460	5,220
	Station Plaza (S/M)	1,880	7,320	9,200
	Station Plaza (L)	4,300	17,400	21,700

Source: JICA Study Team

Notes: Unit area required for vehicle related facilities, Car, Taxi and Shared taxi=27.5 m^2, Mini bus and Local bus=117.0 m^2, Articulated bus=196.0 m^2.
(S/M)=Short/Middle-Term, (L)=Long-Term

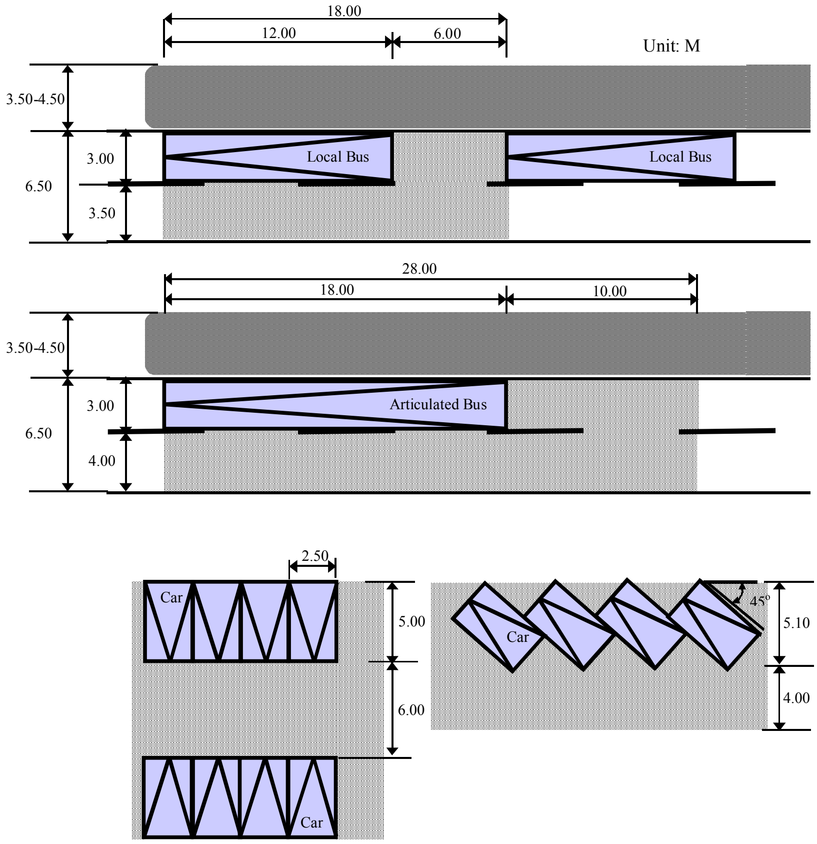
Unit Area Required for Vehicle Related Facilities

For the bus terminal facilities and the station plazas, those related to vehicles are shown in Figure 3.4.16. The unit area by type of vehicles, including access and exit space, are shown below:

Articulated bus: 196.0 m2

Local bus and mini bus: 117.0 m2

- Car and taxi: 27.5 m^2



Source: JICA Study Team

Figure 3.4.16 Unit Area Required for Vehicle Related Facilities

Area Required for Public Service Facilities

The area required for public service facilities will be determined according to the scale of vehicle berths and passenger demand. The area required for the public facilities are as follows: Lot for working people in terminal: 40 m^2; Lot for emergency parking: 45 m^2; Shops (unit area: 25.0 m^2): 25 m^2; Kiosks (unit area: 8.0 m^2): 16 m^2; Restaurants (unit area: 100.0 m^2): 100 m^2; Tea Rooms (unit area: 96.0 m^2): 96 m^2; Telephone boxes (unit area: 0.6 m^2): 6 m^2; Ticket windows (unit area: 6.0 m^2): 6 m^2; and Ticket office (unit area: 200.0 m^2): 200 m^2

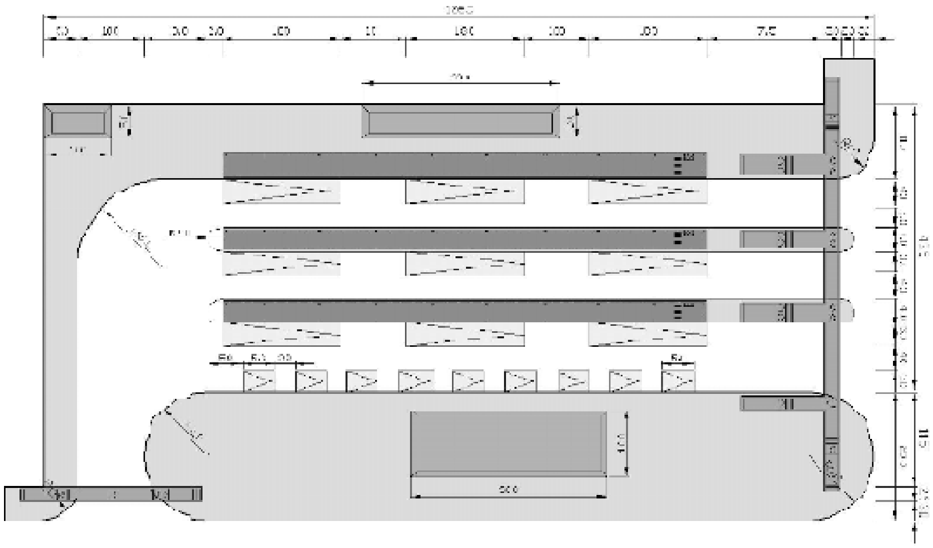
Based on the above, the total floor area of public facilities required at 6th of October City Industrial and Cairo University of Metro Line 2 is assumed to be approximately 530 square meters.

Area Required for Footway and Vehicle Way

In addition, areas for bus shelters, footways and vehicles way are necessary. These areas are as follows; the area of footway is equivalent to 21% (6th of Oct. City), 26% (Cairo Univ.) of the proposed total area of the bus terminal, and the area of vehicle way including parking space is equivalent to 42% (6th of Oct. City), 29% (Cairo Univ.).

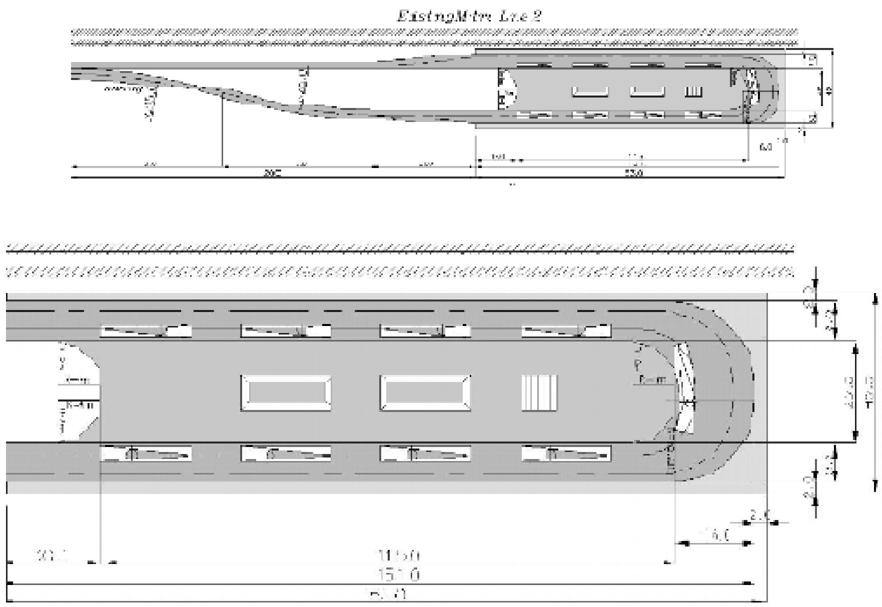
Layout of Station Plaza Along Busway

In the context of vehicle circulation and the total floor space required for the bus terminal and the station plaza, the plan of the bus terminal and the station plaza is shown in Figure 3.4.17 (1)-(3).



Source: JICA Study Team

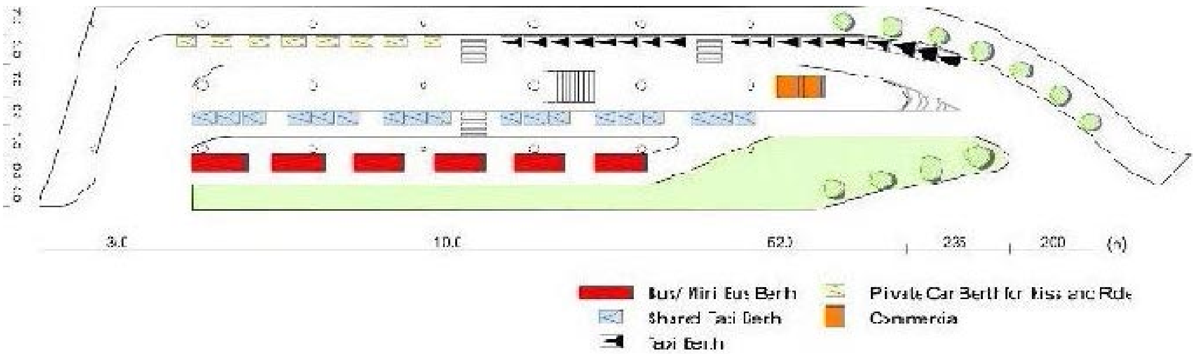
Figure 3.4.17 (1) Plan of Bus Terminal for 6th of October City Industrial



Source: JICA Study Team

Figure 3.4.17 (2) Plan of Bus Terminal for Cairo University Station of Metro Line 2

Station Plaza for the Short/Middle-Term



Station Plaza for the Long-Term

Source: JICA Study Team

Figure 3.4.17 (3) Plan of Station Plaza for Cairo University Station of Metro Line 2

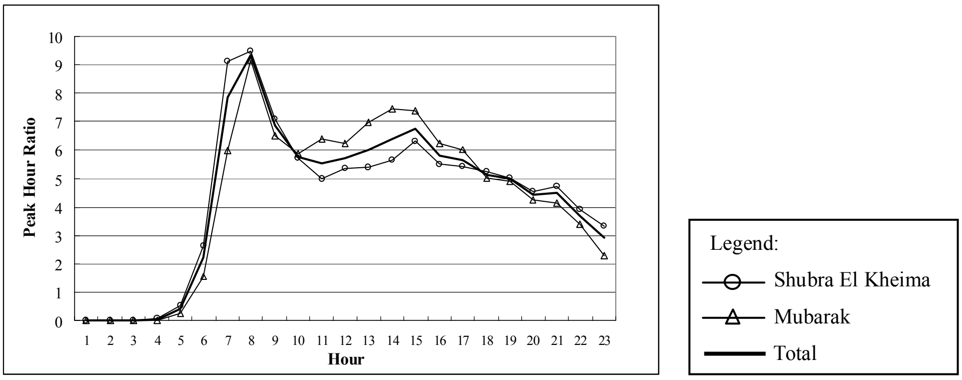
(5) Bus Operation System

According to the passenger demand on the busway, the bus operation system is based on components such as the scheduled service frequency, headway and the allocated bus fleets in the peak periods. The bus operation system is examined based on the following strategies:

- A scheduled service frequency is calculated by maximum demand and bus capacity.
- The dwell time at a bus stop station is reduced on the assumption that an off-board ticketing system as well as a fast ticketing system is employed.
- Operation headway is decided based on the scheduled service frequency by periods.

1) Target Period

The target period for the bus operation is the morning peak period. The busway operation system is proposed during the morning peak period. The peak hour ratio to the daily volume was observed to be 10% approximately, based on the hourly passenger demand on existing Metro 2 in Cairo. Figure 3.4.18 shows the fluctuation of the hourly ratio to the total daily ridership.



Source: CMO,2003

Figure 3.4.18 Fluctuation of Hourly Ratio to Total Daily Ridership

2) Type of Bus Service

Two types of bus services will be provided in specified target years: normal buses with air-conditioning and an articulated bus, and a 2-lanes busway system or a railway connection will be operated before 2022.

- Stage 1: Busway system operated by normal bus for 1-lane per direction
- Stage 2: Busway system operated by articulated bus for 1-lane per direction.
- Stage 3: 2-lanes busway system or a railway connection should be operated*.

Note: * Taking a safety operation into consideration, the minimum headway will be more than 2.0 minutes. Therefore, the busway maximum capacity operated by normal dispatching system should be estimated at 6,000~8,100 pax/hr/lane/dir based on the minimum headway. Given one-lane per direction and a two-bus platoon dispatching system, the reasonable capacity of the busway is 12,000-16,200 pax/hour/dir. When the demand exceeds this level, “rail connection” will be one of conceivable alternative options, although the “busway with 2 lanes per direction” is still a possible option. Of course, the introduction of a “rail system” should be carefully examined in terms of economic and financial justifications.

3) Bus Interior and Capacity

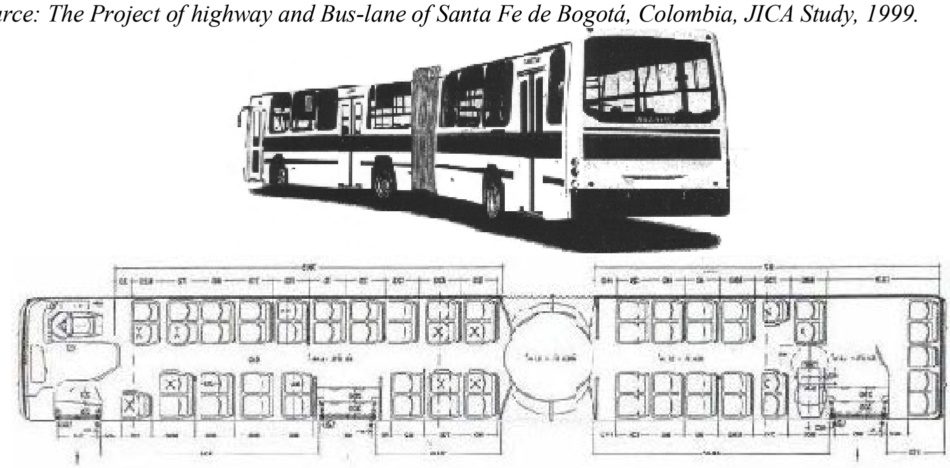
a. Bus Capacity by Type

Table 3.4.16 and Figure 3.4.19 (1) (2) (3) show the bus capacity in Curitiba, Brasil and Nagoya, Japan where trunk bus systems have been introduced. In Curitiba, a single-body bus with a capacity of 110 passengers is used for the trunk bus, and articulated buses with two bodies and a capacity of 200 and 270 passengers, as well as three-body buses, are used for express buses. In the Nagoya Key Route bus system, a single-body bus is operated on the trunk busway. The total capacity is 73 passengers with 27 seats. They are designed with two types of seating e.g. transversal seating and longitudinal seating. Transversal seating is more comfortable than longitudinal seating because passengers are more sensitive to lateral than to forward/backward forces. Since transversal seats also give more privacy, they are used wherever possible. For the comfort and safety of those standing, buses have sufficient holding bars so that passengers can catch one from any standing location.

Table 3.4.16 Bus Capacity in Curitiba, Brasil and Nagoya, Japan

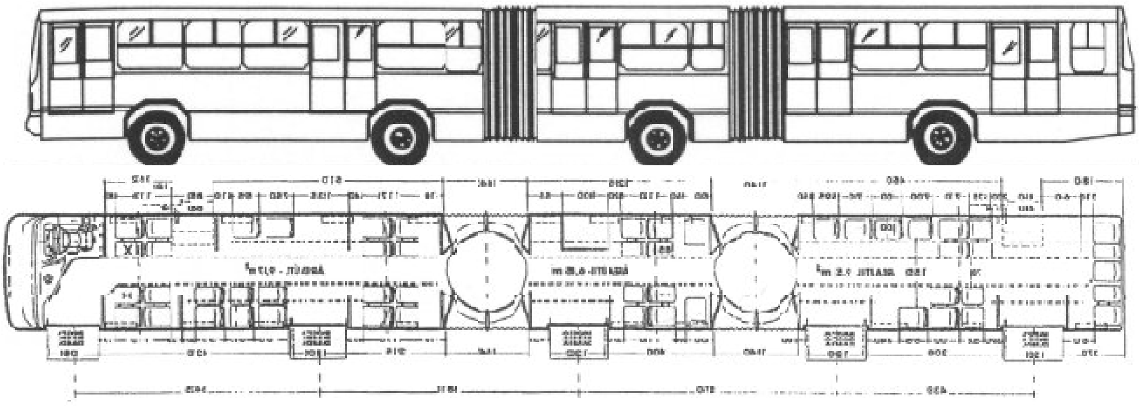
Type of Bus	Passenger Capacity			Body Size			No. of Entrance /Exit	Seat Layout
	Seats	Standees	Total	Length (m)	Width (m)	Height (m)		
1. Cuririba, Brasil								
1) Express Padron	30	80	110	12.46	2.54	2.97	2	Transversal Seat
2) Express Articulated	60	140	200	18.00	2.50	3.00	3	
3) Express Biarticulated	57	213	270	24.52	2.50	3.42	5	
2. Nagoya, Japan								Transversal Seat
1) Key Route Bus System	27	46	73	10.64	2,49	3.07	2	

Source: The Project of highway and Bus-lane of Santa Fe de Bogotá, Colombia, JICA Study, 1999.



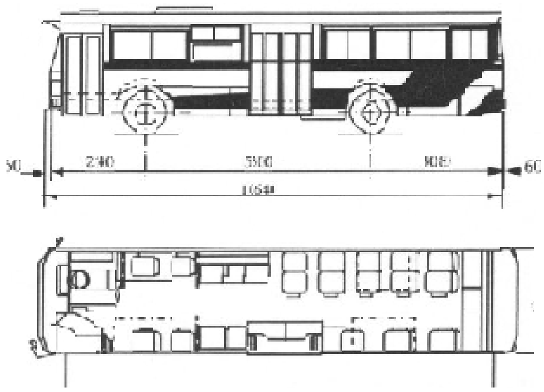
Source: MARCOPOLO SA, Brazil

Figure 3.4.19 (1) Layout of Articulated Bus in Curitiba, Brazil



Source: MARCOPOLO SA, Brazil

Figure 3.4.19 (2) Layout of Biarticulated Bus in Curitiba, Brazil



Source: Transportation Bureau, City of Nagoya, Japan

Figure 3.4.19 (3) Layout of Trunk Bus in Nagoya, Japan

b. Proposed Bus Capacity for Busway System

With heavy passenger demand, the larger bus on the busway on West Wing Corridor should be introduced, offering both lower operating costs and higher service reliability. The general strengths of the large bus are as follows:

- Operation costs per unit of offered capacity decrease as bus fleet size increase;
- Total capacity on route increases nearly linearly with bus size;
- Vehicle manoeuverability decreases with bus size, and
- Riding comfort increases with bus size.

Table 3.4.17 shows the bus capacity proposed for the busway system. A normal single-body bus with a capacity of 100 passengers is used during Stage 1. Articulated buses with two bodies and a capacity of 200 passengers are used in the next stage (Stages 2. & 3.). The standing density refers to the capacity in Curitiba. The passenger load factor in terms of passenger capacity per bus will exceed 1.0 in the peak periods.

Table 3.4.17 Proposed Bus Capacity for Busway System

Stage	Type of Bus	Body	Seats	Standees	Total
Stage-1.	Normal Bus with Air-condition	Single body	30	70	100
Stage-2. & 3.	Articulated Bus	Two bodies	60	140	200

Source: JICA Study Team

4) Bus Commercial Speed

In Cairo, the travel speed of public buses is less than 10km/h in the peak periods due to traffic congestion. The travel speed of the busway on the West Wing Corridor can be improved by a segregated bus lane system. According to Research Report 329 of TRRL, existing busway systems in other countries, commercial speeds of 25-30km/h were recorded in the morning peak periods. The commercial speeds are; Cristiano Machado busway in Belo Horizin, Brazil, nearly 30km/h; Curitiba busway in Brazil, 20-25km/h; Bogotá busway system in Colombia, 26km/h; and Nagoya Key Route bus system in Japan, approximately 20km/h. The average interval of bus stops (stations) is in the range of 0.5km to 1.0km. Such commercial speeds are influenced by the interval of the bus stops. Regarding the relationship between bus stop interval and commercial speed, from the report for Busway Transit by TRRL, the commercial speed rises by approximately 1.3-1.4 times, when the interval is longer than 0.6km to 1.0km.

In this Study, based on the assumption of 5 bus stop stations and the 5-7km intervals (about 20.8km between West Abu Ramash and Cairo Univ.), it will be assumed that for a commercial speed of approximately 40-50km/h on the busway on West Wing Corridor, the bus operating system should planned using a busway structure. The commercial speed will be finalized based on the scheduled frequency and headway.

1. Bus Ticketing System and Dwell Time at Station

The main physical determinant for average commercial bus speeds appears to be the stations and the ticketing system, in association with bus frequency and headway. An efficient fare collection system on the busway is needed in order to reduce dwell times at the bus stations. Boarding times per passenger are lower in a fare collection system in which entry to a bus is unobstructed by fare collection or ticket validation than with the current bus ticketing system. According to the survey of time duration for boarding and alighting in other countries, it takes less than 2.0 seconds per person, when passengers pay money on board. Therefore, if average dwell times at the intermediate bus stations are approximately 2.0 minutes when 50% of full passengers board and alight, it is possible to operate buses on the busway. On the other hand, at a bus station terminal; it takes about 4.0-5.0 minutes for full passengers to board and alight.

The proposed commercial speed of the busway is determined on the assumption that an off-board and fast ticketing system is introduced. Owing to the few number of stations and an almost railway-type shuttle service system between 6th of October City and the Central Giza area, a high reliance on automation and electronic fare cards is recommended to reduce dwell times and optimize boarding/alighting procedures.

5) Tariff System

a. Current Tariff

The current fare system of bus transport by type, between 6th of October City and the Cairo/Giza central area, is shown in Table 3.4.18. The fare rates by type of vehicle and by type of service are not based on travel length but there is a flat fare rate system. The rates range between 0.5 L.E and 2.5 L.E. The fare rate of air-conditioned bus are at the more expensive rate of 2.0-2.5 L.E., the ordinary bus is cheaper at 0.5-1.0 L.E.

Table 3.4.18 Current Tariff Table

Type of Bus Service	Distance (km)	Fare Level (L.E)	Location of Destination
1. Ordinary Bus	44.0-55.0	0.5-1.0	Kheima, Ramses,
2. Air-conditioned Bus	41.0-55.0	2.0-2.5	Darrasa, Giza Sq., Ramses, Embaba

Source: CTA, 2003

b. Tariff System

Two types of tariff system are considered as follows; a flat rate system, which is the same as that of the current flat rate, and a distance-based system in which the fare rises according to trip length. In the Study, as the busway is a long-distance shuttle bus system, the fare system will use a distanced-based system with an off-board and fast ticketing system. Under the following initial conditions, the tariff system on the busway system is analyzed on the assumption of a distanced-based system in which the fare rises according to trip length. The fare for the busway system was similar to the current fare conditions.

- <u>Base fare</u>: in 2007, 0.94L.E; in 2012 1.11L.E; in 2022, 1.50L.E
- <u>Additional fare per 1.0km of trip length</u>: in 2007, 0.04L.E; in 2012, 0.06; in 2022, 0.08L.E.

The above-mentioned fare level was verified based on the following procedure:

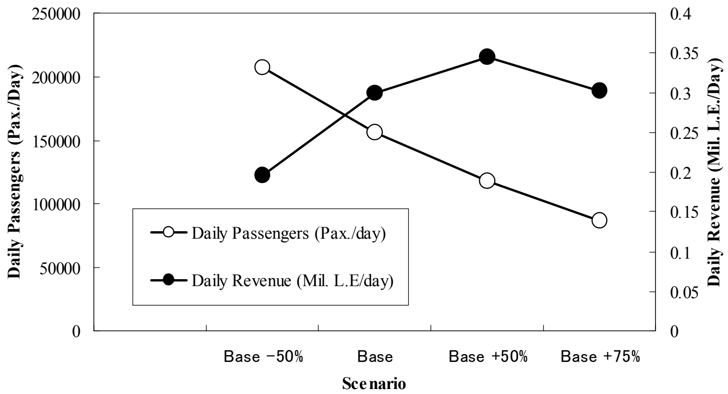
- The fare level of the base case was based on the fare level of Metro Line 2 in Cairo; in 2007, base fare, 0.63 L.E, and an additional fare per distance, 0.03 L.E; in 2012, 0.74 L.E, and additional fare per distance, 0.04 L.E; in 2022, base fare, 1.00 L.E, additional fare per distance, 0.05 L.E.
- A sensitivity analysis for revenue and passenger demand against fare level in 2012 was carried out. The CREATS model was used to evaluate each scenario, as shown in Table 3.4.19 and Figure 3.4.20.
- In the case of the fare level at the base fare of 1.11 L.E and an additional fare by distance of 0.04 L.E, there will be a high revenue for the west wing bus way.

- Based on the above, to the fare level in 2012, the fare level by stage was determined by a 50% increase for each base fare.

Table 3.4.19 Sensitivity Analysis Revenue and Passenger Demand against Fare Level Changes

Scenario	Fare Level (L.E)		Daily Passengers (Pax./day)	Daily Revenue (Mil.L.E/day)	Average Fare per Trip (L.E)
	Base	Distance			
Base –50%	0.37	0.02	207,000	0.195	0.94
Base	0.74	0.04	156,000	0.299	1.92
Base +50%	1.11	0.06	118,000	0.345	2.92
Base +75%	1.30	0.07	86,900	0.302	2.54

Source: JICA Study Team
Note: This is a summary of the sensitivity analysis in the year 2012.



Source: JICA Study Team

Figure 3.4.20 Sensitivity Analysis of Revenue and Passenger Demand against Fare Level Changes

6) Scheduled Service Frequency

<u>Operating Headway and Passenger Demand</u>

The scheduled service frequency is examined by the passenger demand and headway during peak periods. Table 3.4.20 shows the minimum operating headway based on the passenger demand during the peak hour. In 2007-2009, the minimum operating headways for both the normal buses and the articulated buses are estimated to be approximately 4.0 min and 10.5 min, respectively. In 2012-2017, the minimum operating headway is 2.0 min. As can be seen, as the minimum operating headway in 2022 is less than 1.0 min., it is difficult to operate the busway with one lane per direction. Therefore, between 2018 and 2022, two (2) lanes of busway per direction are needed.

In this context, a flexible busway system should be considered, depending on the development of new communities along the West Wing Corridor. The recommendation for the development of the busway system will be incorporate a demand-adapted approach as following:

Stage 1. (2007-2008): Busway system operated by normal bus with air-conditioning for 1-lane per direction.

Stage 2. (2009-2017): Busway system operated by articulated bus for 1-lane per direction: after 2012, a 2-bus platoon dispatching system will be operated.

Stage 3. (2018-2022): Busway system operated by articulated bus for 2-lanes per direction: 2-bus platoon dispatching system will be operated.

After 2022, a railway connection will be a possible option to enhance the West Wing public transport service function to meet the projected passenger demand of over 20,000 passengers per hour per direction. In this study, the Study Team proposes 2-lanes busway after 2018 up to 2022 for the maximum use of the invested facilities of the busway system, and no railway options are discussed.

Table 3.4.20 Minimum Operating Headway in Peak Hour

Item	2007 (Nrm.Bus)	2009 (Art.Bus)	2012 (Art.Bus)	2017 (Art.Bus)	2022 (Art.Bus)
Daily Passengers Transported (Pax./2-dir.)	11,500	54,000	118,000	240,000	384,200
Peak Hour Passengers Transported (Pax./dir.)	580	2,700	5,900	12,000	19,200
Bus Passenger Capacity (Pax./Bus)	100	200	200	200	200
Minimum Operating Headway (Min)	10.5	4.0	2.0	1.0	0.6 (N.A)

Source: JICA Study Team
Note: Nrm.Bus-Normal Bus with air-condition, Art.Bus-Articulated Bus

The assumed peak ratio of 10% was verified, based on the result of the traffic count survey carried out on the 26th of July Street in the period of the Master Plan Study. As shown in Table 3.4.21, the largest volume of the outbound traffic flow was observed in the morning from 8:00 hrs to 9:00 hrs, sharing about 10% of the total outbound traffic volume. Whilst, the largest volume of the inbound traffic was observed in the evening from 17:00 hrs to 18:00 hrs, achieving at around 9% of the total inbound traffic volume. These facts suggest that a 10% peak ratio (for one direction) can be reasonably used as a planning parameter to estimate the peak-hour passenger traffic volume along this corridor.

Table 3.4.21 also suggests that traffic volumes of the inbound and outbound are almost same, that is, 50:50. Therefore, when future traffic volumes of both directions along this corridor is predicted, 5% of the total traffic volume can be almost regarded to be the peak passenger traffic volume for one direction.

The estimated daily traffic fluctuation pattern is summarized by time-zone as shown in Table 3.4.22. Thus, the morning peak hours are recognized as the time zone from 7:30 to 9:30 hrs (2 hours), which shares 20% of the total daily volume.

Table 3.4.21 Number of Passenger Cars on 26th of July Street

Time of Day		Outbound		Inbound	
From	To	Number of Cars	Percentage (%)	Number of Cars	Percentage (%)
6:00	7:00	240	1.54	82	0.55
7:00	8:00	1,056	6.76	317	2.14
8:00	9:00	1,577	10.10	641	4.32
9:00	10:00	1,389	8.89	675	4.55
10:00	11:00	1,257	8.05	485	3.27
11:00	12:00	1,121	7.18	684	4.61
12:00	13:00	899	5.76	769	5.19
13:00	14:00	797	5.10	880	5.93
14:00	15:00	727	4.65	997	6.72
15:00	16:00	655	4.19	1,218	8.21
16:00	17:00	633	4.05	1,254	8.46
17:00	18:00	631	4.04	1,353	9.12
18:00	19:00	482	3.09	1,062	7.16
19:00	20:00	455	2.91	786	5.30
20:00	21:00	522	3.34	613	4.13
21:00	22:00	575	3.68	542	3.66
22:00	23:00	763	4.89	678	4.57
23:00	0:00	640	4.10	582	3.92
0:00	1:00	463	2.96	413	2.79
1:00	2:00	311	1.99	297	2.00
2:00	3:00	169	1.08	182	1.23
3:00	4:00	103	0.66	122	0.82
4:00	5:00	65	0.42	80	0.54
5:00	6:00	88	0.56	117	0.79
Total		15,618	100.00	14,829	100.00

Source: JICA Study Team
Notes: The survey was conducted by the Study Team in October 2001.

Table 3.4.22 Forecast Future Passengers by Time-Zone (Two Directions)

Time	Share (%)*1)	2007	2009	2012	2017	2022	Hourly Ratio (%)*2)
5:30-7:30	6.0	690	3,240	7,080	14,400	23,060	3.0
7:30-9:30	20.0	2,300	10,800	23,600	48,000	76,840	10.0
9:30-13:30	20.0	2,300	10,800	23,600	48,000	76,840	5.0
13:30-16:30	21.0	2,415	11,340	24,780	50,400	80,680	7.0
16:30-21:30	27.0	3,105	14,580	31,860	64,800	103,720	5.4
21:30-23:30	6.0	690	3,240	7,080	14,400	23,060	3.0
Total	100.0	11,500	54,000	118,000	240,000	384,200	-

Source: JICA Study Team
*Notes: *1) Time-zone share of the total daily passengers;*
**2) Hourly share in the corresponding time-zone.*

Table 3.4.23 shows the hourly passengers transported and the operating headway per one direction. In the year 2022, 2-lanes per direction on the busway will be operated.

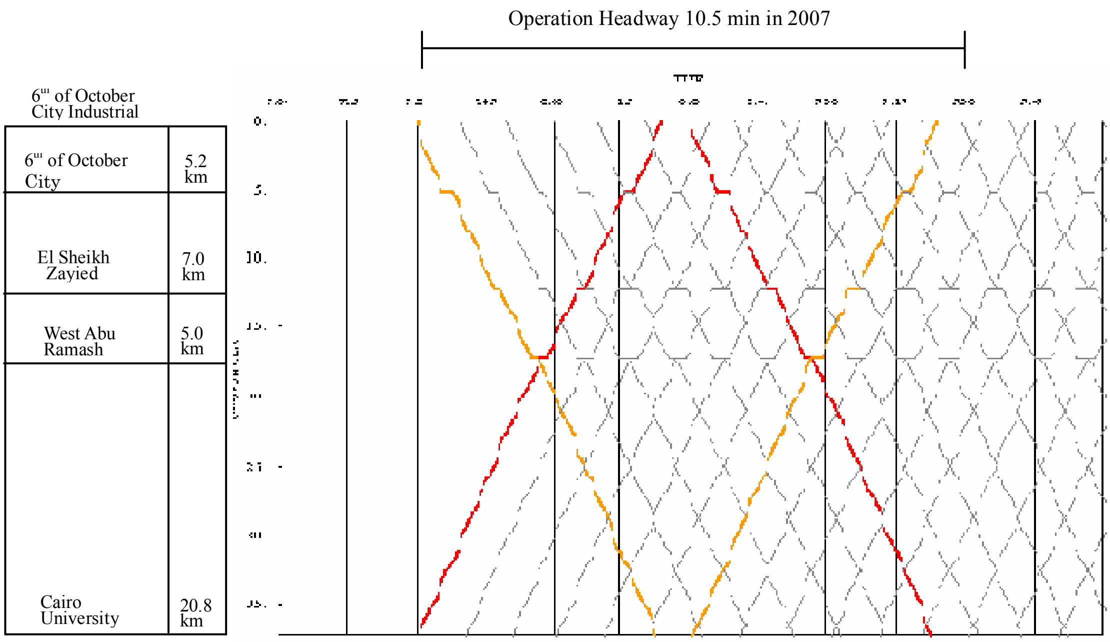
Table 3.4.23 Hourly Passengers Transported and Average Operating Headway

Time	2007 (Nor.B)		2009 (Art.B)		2012 (Art.B)		2017 (Art.B)		2022 (Art.B)**	
	Pax. /dir.	Oper. H.W (min)	Pax. /dir.	Oper. H.W (min)	Pax. /dir.	Oper. H.W (min)	Pax. /dir.	Oper.* H.W	Pax. /dir.	Oper.* H.W
5:30-7:30	170	34.5	810	14.5	1,770	6.5	3,600	6.5	5,770	8.0
7:30-9:00	580	10.5	27,00	4.0	5,900	2.0	12,000	2.0	19,210	2.5
9:30-13:30	290	20.5	1,350	8.5	2,950	4.0	6,000	4.0	9.610	5.0
13:30-16:30	400	14.5	1,890	6.0	4,130	2.5	8,400	2.5	13,450	3.0
16:30-21:30	310	19.5	1,450	8.0	3,190	3.5	6,480	3.5	10.370	4.0
21:30-23:00	170	34.5	810	14.5	1,770	6.5	3,600	6.5	5,770	8.0

Source: JICA Study Team

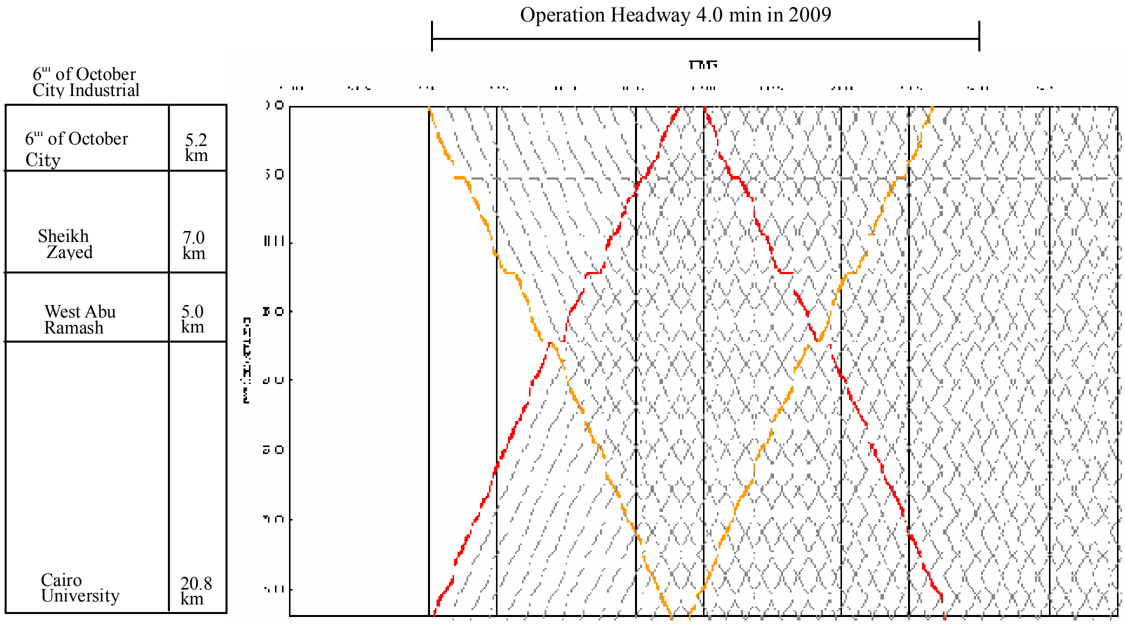
Note: 1) Nor.Bus: Normal Bus with air-condition; and Art..Bus: Articulated Bus
2) Pax./dir.: Passenger transported during periods per direction; and Oper.H.W: Operating Headway
*3) *: Operating by 2-bus platoon dispatching system (Stage-2/3), bus capacity=200Pax.x 2buses=400Pax.*
*4) **: A critical year operated by the busway with 2-lanes per direction (Stage-3), bus capacity=800Pax.*

Figure 3.4.21 (1) (2) (3) shows diagrams of operating headway on the busway, when it is operated at the average commercial speed of 40-50km/h during the peak periods. Therefore, the total travel time is about 45-50 minutes between 6th of October City industrial station and Cairo University station, during peak periods.



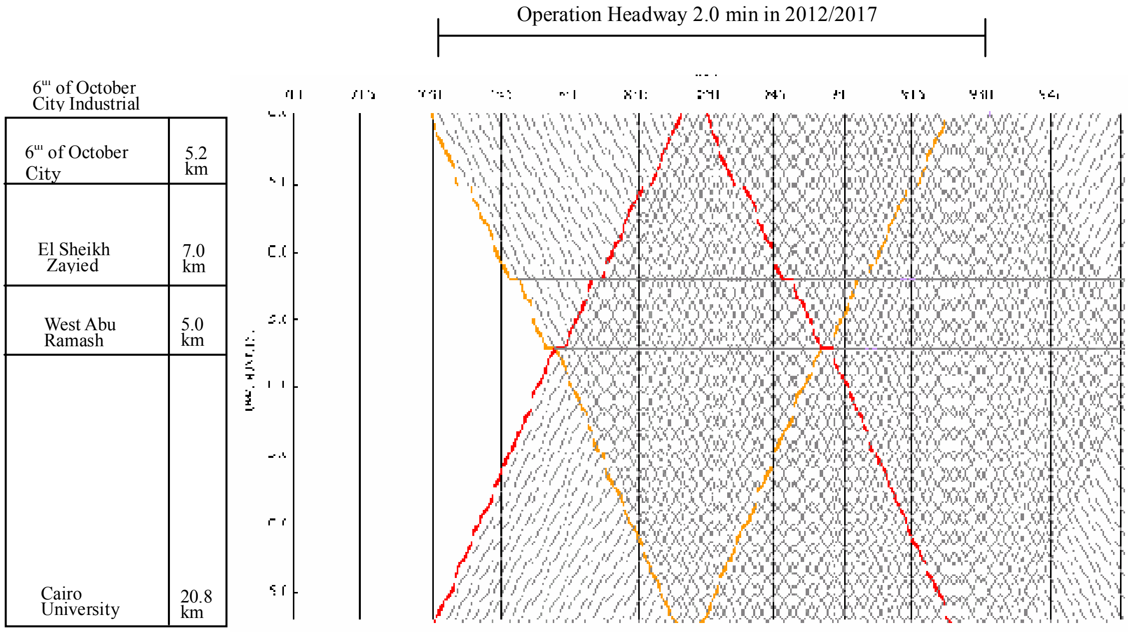
Source: JICA Study Team

Figure 3.4.21 (1) Diagram of Operating Headway on Busway with 1-Lane per Direction during Peak Periods in 2007 (Normal Bus)



Source: JICA Study Team

Figure 3.4.21 (2) Diagram of Operating Headway on Busway with 1-Lane per Direction during Peak Periods in 2009 (Articulated Bus)



Source: JICA Study Team

Figure 3.4.21 (3) Diagram of Operating Headway on Busway with 1-Lane per Direction during Peak Periods in 2012/2017 (Articulated Bus)

7) Allocated Bus Fleets in Peak Periods

Based on the commercial speed, bus capacity, minimum headway and number of passengers transported, the number of allocated buses in the peak hour periods is estimated taking into account a round trip operation to return to a starting terminal. In addition, the maintenance and supply of buses should be based on a factor of 1.2. Table 3.4.24 shows the number of allocated buses per hour in the peak periods. In Stage 1 (2007-2008), the total number of allocated buses is 15 articulated buses/hour in the peak periods, in Stage 2 (2009-2017), 36-140 articulated buses/hour, and in Stage 3 (2013-2017), 210 articulated buses respectively. The articulated buses will need to be purchased new.

Table 3.4.24 Number of Allocated Bus Fleets in Peak Periods by Stage

Stage		Proposed Bus Operation Speed (km/h)	Average Headway During Peak /off Peak (min)	Dwell Time at Intermediate/Terminate Bus Station (min)	Number of Allocated Bus Fleets	Bus Fleets including Maintenance/ Reservation (x 1.2)
Stage-1 (2007-2008)		40-50km/h	10.5-14.5/19.5-34.5	2.0/5.0	12	15
Stage-2 (2009-2017)	-2009	40-50km/h	4.0-6.0/8.0-14.5	2.0/5.0	30	36
	-2012	40-50km/h	2.0-2.5/3.5-6.5	2.0/5.0	58	70
	-2017	40-50km/h	2.0-2.5/3.5-6.5	2.0/5.0	116 1)	140
Stage-3 (2018-20122)		40-50km/h	2.5-3.0/4.0-8.0 2)	2.0/5.0	174 3)	210

Source: JICA Study Team

Notes: 1): Owing to the 2-bus platoon dispatching system, the number of allocated bus fleets=58 busesx2-bus platoon
2): The average headway shows per 2-lane busway per direction, dispatching interval=1.0-1.5 min.
3): Stage-3 will be operated by both 2-bus platoon dispatching system and normal dispatching system.

(6) Maintenance System and Depot Facility

The maintenance system for the operating buses is comprised of a periodical maintenance program and a corrective maintenance program. The periodical maintenance is a predetermined program, and the activities follow a pre-set cycle such as daily maintenance and monthly maintenance based on hours of operation, and 50,000km/100,000km maintenances per bus based on kilometer operation. The corrective maintenance is required in the case of mechanical failures, accidents etc. These maintenance programs will be carried out at the depot.

Depot facilities will be constructed for the functions of inspection, maintenance and storage of buses, including a workshop. The depot facilities required are as follows:

<u>Parking Area:</u>

This parking area will serve the storage of the articulated bus fleet. The number of articulated buses is as follows: Stage 1, 15 buses; Stage 2, 70 buses; and Stage 3, 140 buses. In the final stage, the required area is large, the other area of 50% of the total parking area should be planned at the early stage.

<u>Maintenance Workshop:</u>

The bus maintenance workshops should allow for storage and mechanical workshops including vehicle testing.

Washing Facility:

The washing machine for buses, in accordance with a daily inspection, will be provided near the workshop house.

Filling Station:

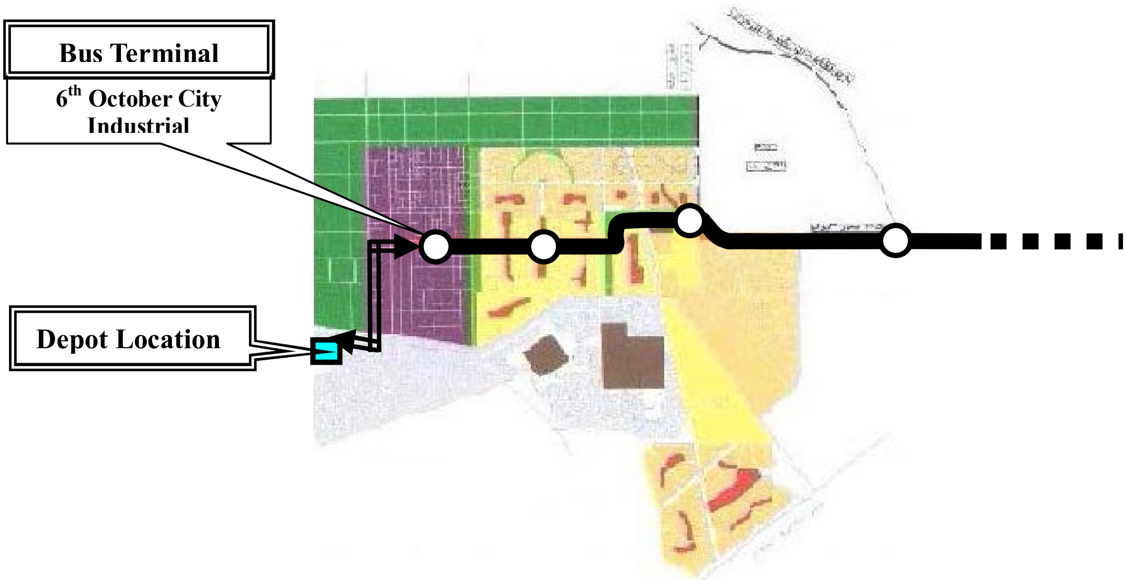
The filling station should be provided in order to supply daily gasoline.

Administrative Office and Staff Facilities:

The administrative office and staff facilities, for administration personnel of the busway organization and the operating facilities, should be provided in a common building on the depot area, in order to co-ordinate maintenance and operation. The total floor of depot facilities required at 6th of October City is assumed to be approximately 3,000 square meters.

Owing to the high density of buildings around the station of Cairo University in the Giza area, it will be difficult to construct a large-scale depot facility. Therefore, in addition to ensuring the smooth vehicle circulation of long buses, the candidate site of the depot facility must be considered for the City of 6th of October. Any operating buses will dispatch from/to the depot site in 6th of October City.

A candidate site for the depot facility in 6th of October City is shown in Figure 3.4.22, which gives the layout of the depot facility.



Source: JICA Study Team

Figure 3.4.22 Candidate Site for Depot Facility in 6th of October City

3.5 TRAFFIC MANAGEMENT PLAN IN CENTRAL GIZA INTERMODAL PLAN

3.5.1 Intermodal Facility

(1) General

Cairo University Station stands as a station on Metro line 2 between Giza suburban area and Cairo CBD, which also will be a terminus of the West Wing for commuters from/ to 6th of October City. In the CREATS Master Plan, it is proposed that Metro line 3 could link with Metro line 2 at Cairo University Station. Thus, the Cairo University Station is likely to be a major intermodal point in Giza area.

In terms of social background, there is large population in the catchment area, which is defined as a 800 m radius around Cairo University Station. The population in the catchment area will increase to almost double in two decades, which is a high ratio compared with the national average and even similar areas in Giza. Since the population is about 66,500 in 2001 and the estimated population is about 110,500 in 2022, the annual growth rate is 4.7 percent. It is thought that Cairo University has a geographical advantage for going to Cairo CBD directly via Metro line 2. On the other hand, the Cairo University station is used by many students since Cairo University has around 155,000 students and 12,000 employees as well as another 198,000 students in different schools.

However, there is room for improvement at Cairo University station if it is to be a major intermodal station. At present, the intermodal facility is in a poor condition except for the metro station itself. Many shared taxis and taxis block the middle of the streets in the surrounding area due to a lack of terminal facilities. Moreover, the safety of pedestrian is not assured because of the narrow streets, limited footway and also people try to catch shared taxis and taxis in the middle of the streets.

In 2022, 0.45 million passenger will use Metro Line 2. Of these passengers, about 40 percent will transfer from West Wing to Metro, about 48 percent will transfer from public transport. The number of the passenger by mode is shown in Table 3.5.1.

Table 3.5.1 Number of Passenger Demand of Metro Line 2 by Mode (1 direction) at Cairo University Station in 2012 and 2022

Year	Number of Passenger Demand by Mode (Pax/peak hour)							
	Wing	Bus	Mini Bus	Shared Taxi	Taxi	Car	Walk	Total
2012	5,900	1,620	380	5,540	1,060	400	1,600	16,500
2022	19,200	4,050	950	13,860	2,640	1,000	4,000	45,700

Source: JICA Study Team

Note: This indicator was estimated based on the framework of the Master Plan by using CREATS Model. The population of the new cities was projected based on possible future economic growth scenario, because the economic growth was considered as a key factor to develop the new communities. There is a possibility that the development of the new cities might take place to delay due to the Government policy or an economic condition. Therefore, it is necessary to review again, when the detail design will be done.

The objectives arising from the above issues are as follows:

1. To improve intermodal facilities in order to provide convenience for passengers and pedestrian-friendliness, and
2. To provide a station plaza for feeder services, depending upon the future passenger demand.

(2) Strategy

It is believed that three strategies can be deduced from the above objectives:

<u>To create sidewalks and crossings for pedestrian-friendliness linking West Wing bus terminal and Metro line 2:</u>
West Wing bus terminal will be developed at approximately 100m north of the Metro station because of the constraints of land availability and existing flyovers. However, 85% of the total passengers of the West Wing will transfer to Metro line 2. It is necessary to create sidewalks and crossings for pedestrian-friendliness, in order to assure safety and smooth transfer.

<u>To develop a station plaza for feeder services:</u>
48% of the passenger is anticipated to transfer from Metro line 2 to public transport in 2022. Thus, the development of the station plaza, including berths for public transport as well as space for a kiss-and-ride system, is essential not for only passengers but also for the large number of local residents.

Within the area between Diwan St. and Tharwat St. that constitute densely built-up area and narrow width streets, it is very difficult to develop a station plaza linking to West Wing Bus terminal and the Cairo University Station of Metro Line 2. Accordingly, it is necessary to introduce two alternative solutions of the station plaza that respond to the requirement for short/middle-term and long-term:

a. Alternative 1 for the short/middle-term (in 2012):

For the short/middle-term, the station plaza should be planned at space under the viaduct bus terminal of West Wing Busway along the existing canal, in order to make the maximum use of the proposed terminal facilities.

b. Alternative 2 for the long-term (in 2022):

From an intermodal point of view, development of station plaza in front of Cairo University station is the most efficient. The station plaza requires large land area, it is very difficult to find such vacant area. Therefore, the plan of station plaza should be considered by using a method of moving out the dwellers and demolishing their buildings in front of the existing Metro Line 2 station. In future, the plan should be introduced in accordance with the regional policy of redevelopment in the area.

<u>To formulate traffic management system:</u>
It is necessary to formulate a traffic management system to mitigate current traffic congestion. This includes the formulation of a traffic management plan for smooth traffic circulation, road widening of the station plaza, a signalized-control system and an one-way circulation system for each street.

(3) Facility Plan

1) Sidewalk and Crossings for Pedestrian-Friendly

Pedestrians in the study area are generally accorded low priority. Drivers generally pay little attention to pedestrians even when the latter are using pedestrian crossings; pedestrians are regarded as “outsiders in traffic”. This attitude must be changed, with pedestrian traffic considered as important as vehicular traffic through the provision of safe and convenient facilities and according to sufficient priority to pedestrians at sidewalks and intersection. In the area of Cairo University Station, the traffic safety facilities are not sufficient in number, such as sidewalk and pedestrian crossings.

In view of the findings stated above, the construction of sidewalk and crossings must be improved by according pedestrians a higher priority than is given now to ensure a safe pedestrian environment.

a. Plan Locations

The plan of sidewalk and crossing for pedestrian-friendly in the study area involves following locations:

- Construction of Sidewalk: between West Wing Bus Terminal and Cairo University Station (total length = 0.10 km).
- Improvement of Pedestrian Crossings at Intersection: Diwan St.-Saft El Labban St. intersection, Diwan St.-Tharwat St. intersection and Saft El Labban St.-Mashtal St. intersection.

b. Design Description

Construction of Sidewalk

The sidewalk between under the West Wing Bus Terminal and existing Cairo University Station of Metro Line 2 will be constructed. The total length is 0.10 km, the width of the sidewalk should be planned more than 5.0 meters for taking account of the capacity of the passengers. The sidewalk will link to existing pedestrian deck where crossing over the Metro and ENR line, makes more convenient for passengers. Figures 3.5.1 (1) (2) show the location map of the construction for sidewalk.

Improvement of Pedestrian Crossing at Intersection

In order to ensure a safe pedestrian environment, the guideline marking and the signal phase for pedestrian crossing should be provided on the points adapting to pedestrian environment, where the signal light is installed at intersections. In this study, two (2) types of exclusive signal phase for pedestrian crossing will be installed such as: a) scramble pedestrian crossing, b) signal phase of all red time for pedestrian crossing at intersection. The width of pedestrian crossing should be generally 4.0-5.0 m. Figures 3.5.1 (1) (2) show the location map of the construction for pedestrian crossing at intersection. The designs of intersections with signal phase are shown in Section of 3.5.2 Traffic Management Program in Central Giza.

2) Station Plaza

a. Plan Location

The locations of station plaza in the study area are shown as follows:

- Alternative 1 for the short/middle-term (in 2012): the location of station plaza covers about 0.01 km^2, under the viaduct bus terminal of West Wing Busway along the existing canal.
- Alternative 2 for the long-term (in 2022): the location of station plaza covers about 0.022 km^2, bordered by Diwan St. and Tharwat St.

The locations of the station plaza for the short/middle-term (in 2012) and the long-term (in 2022) are shown in Figures 3.5.1 (1) (2).

b. Number of Berths and Area Required for Feeder Service

In addition to the expected number of passengers, the required berths for public transport and the land area for the station plaza are shown in the following tables. The station plaza should be planned to include small-scale commercial facilities such as kiosks, cafés, and small restaurants. The number of berths was calculated based on the estimate of passenger boarding demand by mode, boarding/alighting time per passenger, average dispatching interval by mode and the dispatching turnover per peak hour by mode. The calculation method is as follows:

- During peak hour, average occupancy per Mini bus and Bus at station plaza of intermediate bus station is assumed at 100%.
- Based on the result of HIS survey, average passenger occupancy of car and taxi is as follows: Car at 1.5 passengers, and Taxi at 2.0 passengers.
- In accordance with the busway frequency including boarding/alighting time per passenger, average dispatching interval by mode is defined as follows: Bus at 8.0 min and Mini bus at 8.0 min based on total boarding/alighting time, Shared taxi, taxi, and car at 2.0 min based on the arrival schedule of busway.

Based on the above, the dispatching turnover per peak hour by mode is expected as follows: Bus and Mini bus at 7.5 times based on the dwell time of 8.0 min, Shared taxi, taxi, and car at 30 times based on the dwell time of 2.0 min.

Based on the estimate of passenger boarding demand as discussed in Table 3.5.1, the number of berths and area required by mode in 2012 and 2022 are shown in Tables 3.5.2 and 3.5.3.

Table 3.5.2 Number of Berths Required for Cairo University Station Plaza in 2012 and 2022

Year	Number of Berth Required in 2022 (Berth/Peak hour)				
	Car for Kiss & Ride	Shared Taxi	Bus	Mini Bus	Taxi
2012	8	17	4	2	18
2022	20	42	9	3	44

Source: JICA Study Team

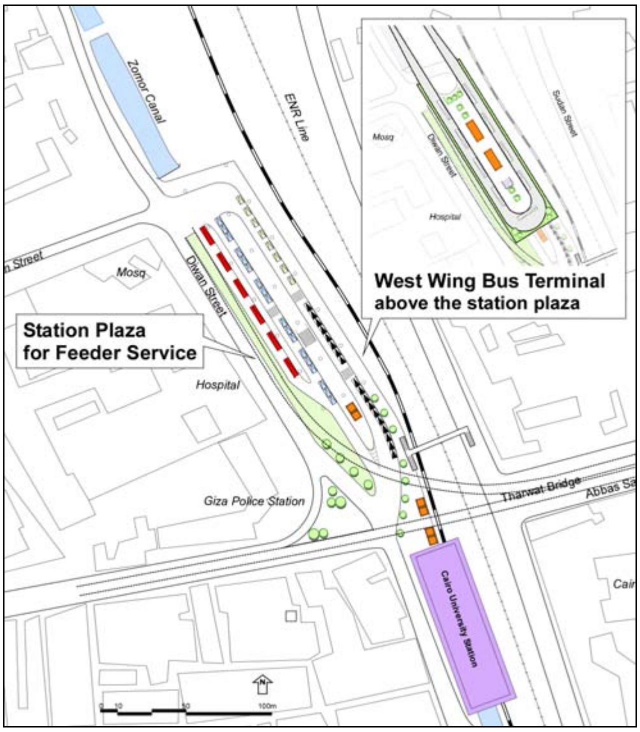
Table 3.5.3 Required Land Area for Cairo University Station Plaza in 2012 and 2022

Year	Vehicle Way (sq.m)	Foot Path (sq.m)	Green Area (sq.m)	Total Area (sq.m)
2012	4,900	4,300	1,600	10,800
2022	11,900	8,000	1,800	21,700

Source; JICA Study Team

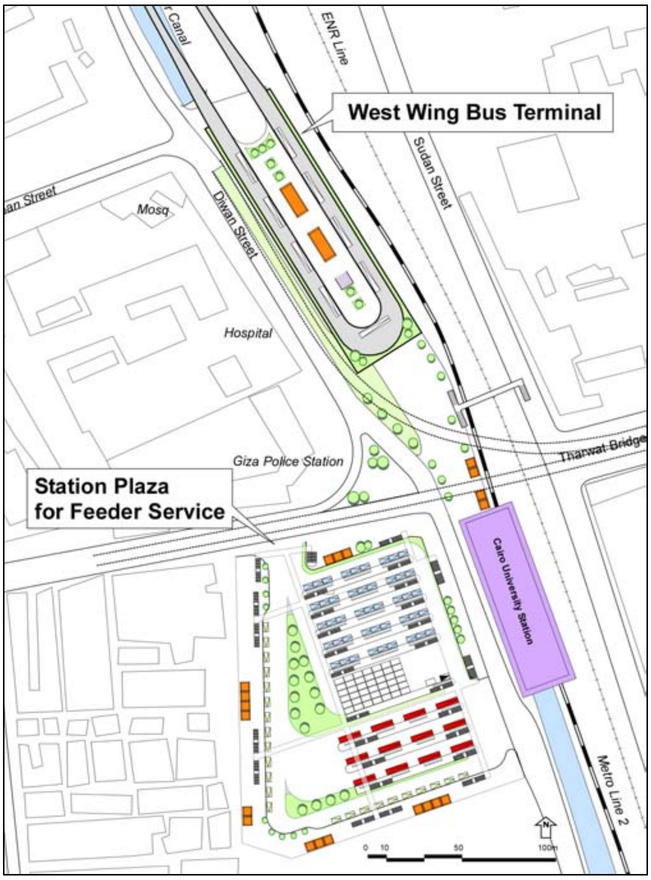
c. Layout of Station Plaza for Short/Middle-Term and Long-Term

In the context of the total floor space required for the station plaza, the plans of the station plaza for the short/middle-term (in 2012) and the long-term (in 2022) are shown in Figures 3.5.2 (1) (2).



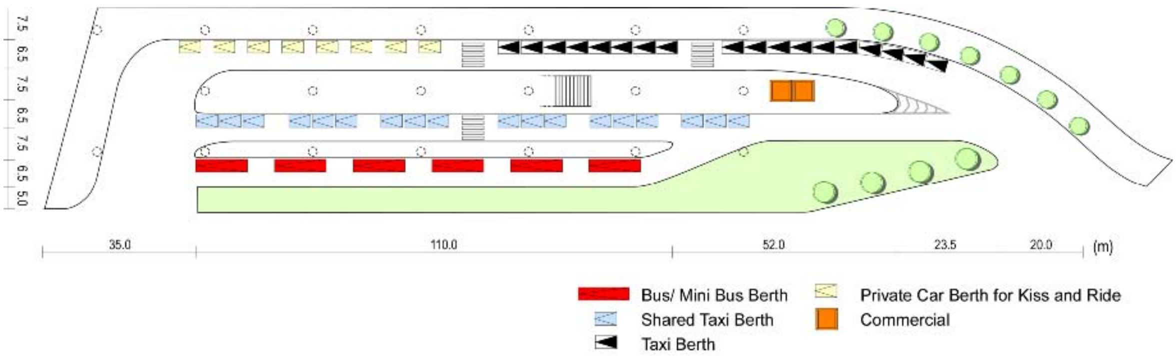
Source: JICA Study Team

Figure 3.5.1 (1) Location Map of the Intermodal Facilities for Short/Middle-Term (in 2012)



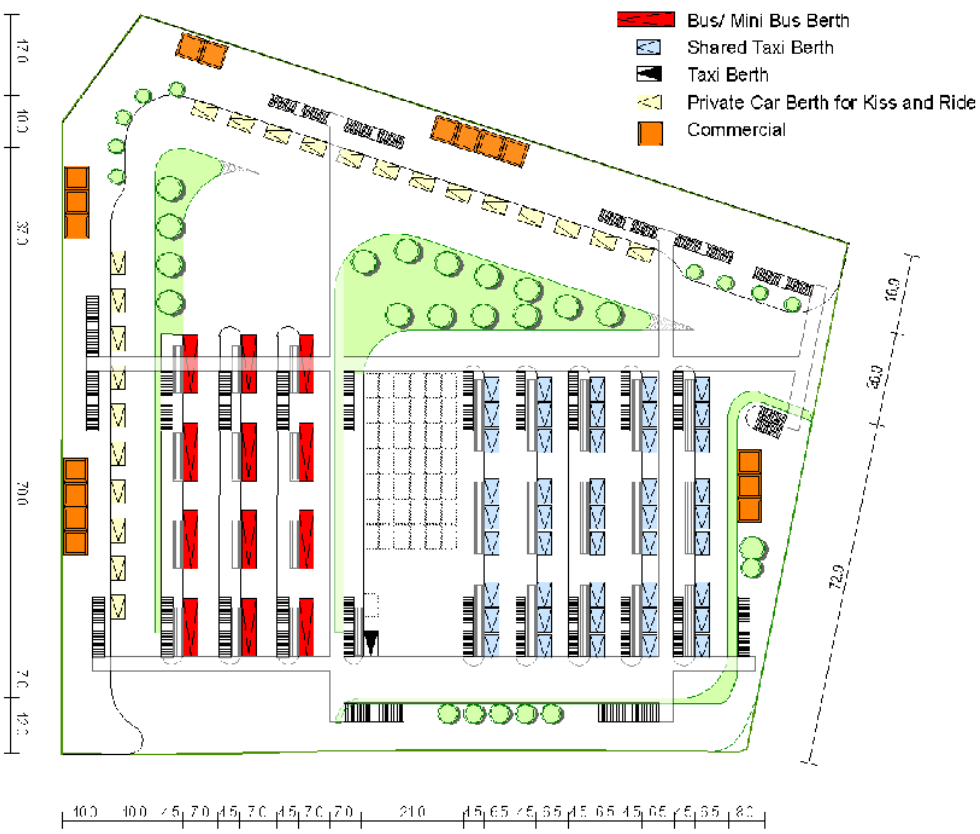
Source: JICA Study Team

Figure 3.5.1 (2) Location Map of the Intermodal Facilities for Long-Term (in 2022)



Source: JICA Study Team

Figure 3.5.2 (1) Proposed Design of the Station Plaza at Cairo University Station for Short/Middle-Term (in 2012)

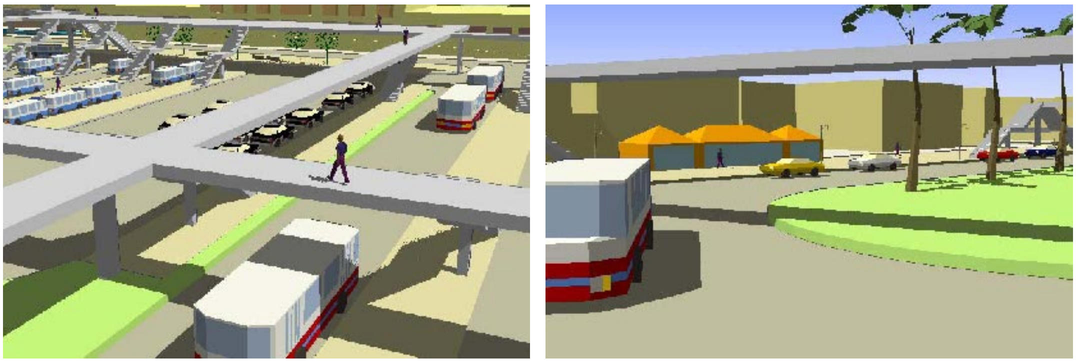


Source: JICA Study Team

Figure 3.5.2 (2) Proposed Design of the Station Plaza at Cairo University Station for Long-Term (in 2022)

Source: JICA Study Team

Figure 3.5.3 Image of the Proposed Station Plaza (1)



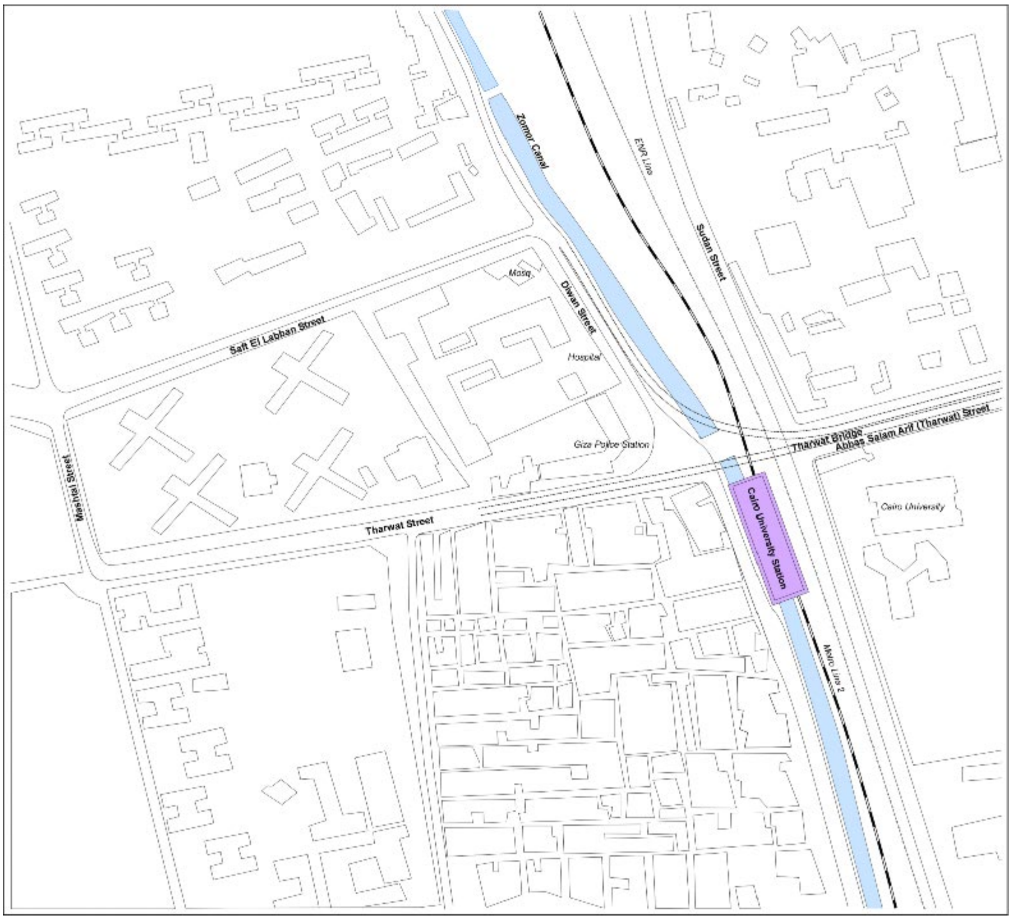
Source: JICA Study Team

Figure 3.5.4 Image of the Proposed Station Plaza (2)

3.5.2 Traffic Management Program in Central Giza

(1) General

As previously pointed out in the analysis of the current traffic status at the intermodal area in Central Giza, the traffic congested sections/or intersections and the causes, in the context of traffic engineering, were verified by the traffic investigations. Major current traffic congestion is caused by inadequate road capacity including the lack of a well-developed traffic management and control system. With a view to achieving smooth traffic flow at the intermodal area in Central Giza, it is highly recommended to promote the service level of the public transport system, and to mitigate traffic congestion. In addition, the plan must consider how to create an attractive urban environment that is amenable to pedestrians as well as for public transport. In accordance with the plan of intermodal facilities, an improvement of traffic management facilities on major gateways linking to West Wing Bus Terminal and Cairo University Station will be effective to achieve a smooth flow of traffic. The study area, as shown in Figure 3.5.5, covers the area boarded by Diwan St., Tharwat St., Saft El Labban St., and Mashtal St. It is necessary to introduce the traffic management program that responds to the changing requirement of different times; therefore, the plan will be formulated for short/middle-term.



Source: JICA Study Team

Figure 3.5.5 Study Area for Traffic Management Program

(2) Planning Approach

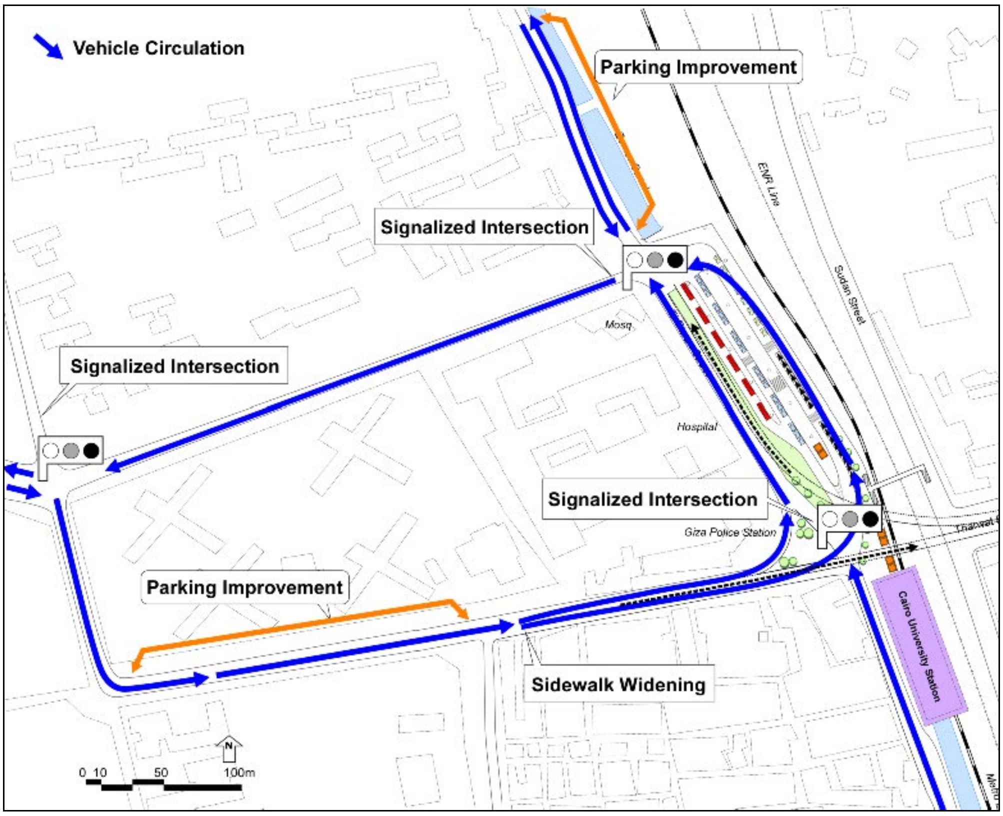
A traffic management program that takes into account the following basic strategies, based on these issues, is envisioned for the intermodal area in Central Giza. These strategies are as follows:

- A signal control system can be effectively operated, as traffic to and from side roads without traffic lights disturbs the main traffic flows. These non-signalized intersections will be considered for the installation of traffic signal lights, in order to control both motor vehicles and pedestrian traffic.
- Around the Central Giza area, a bus stop/or terminal for transfer purposes will be established depending on passenger demand. At present, bus passengers who transfer are observed at Cairo University station on Metro Line 2, where there are bottleneck points. An improvement of the bus stop/or pedestrian facility is necessary for transfers.
- In accordance with the installation of traffic signal lights at the above-mentioned intersections, it is necessary that the intersection improvement should be planned by introducing the traffic channelization system, in order to reduce traffic accidents.

- In the area of Cairo University Station, the traffic safety facilities are not sufficient in number, such as sidewalks and pedestrian crossings. The construction of sidewalks and crossings must be improved by according to pedestrians a higher priority than given now to ensure a safe pedestrian environment.
- In order to enlarge the road capacity, on-street parking is to be restricted around the intermodal area in Central Giza. Two kinds of parking measures will be recommended i.e. the prohibition of on-street parking and an on-street parking charge system by introducing a parking ticket system.
- Since there is no space in the built-up area, in the short-term, it is very difficult to construct new roads. Accordingly, it is necessary to increase road traffic capacity through the maximum use of the existing road facilities. The traffic circulation system will be introduced by using one-way regulation, in order to achieve a smooth traffic flow and to enlarge the road capacity. An attractive urban environment can be created that is amenable to pedestrians as well as for public transport.

(3) Plan Location

Based on the above-mentioned basic strategies, the plan of the traffic management programs in the study area is shown in Figure 3.5.6. The locations for traffic management programs in the study area were determined based on the following analysis of the current situation.



Source: JICA Study Team

Figure 3.5.6 Plan of Traffic Management Programs in Intermodal Area

1) Installation of Signal Light

a. Locations for Installation of Traffic Signal Light

From the traffic analysis of vehicle traffic flow data and the site observation survey, heavy vehicles are seen moving from/to the study area during peak periods, where there are located major gateways such as Diwan St., Tharwat St., Saft El Labban St., and Mashatal St.. The non-signalized intersections on these gateways linking the intermodal area will be considered for the installation of signal lights, in order to control both motor vehicles and pedestrian traffic. The locations for the installation of traffic signal light are as follows:

- Diwan St.-Saft El Labban St. intersection
- Diwan St.- Tharwat St. intersection
- Saft El Labban St.-Mashatal St. intersection

b. System Function and Control Concept

System Function

In order to control both motor vehicles and pedestrian traffic, based on the calculated capacity, the signal phases and splits will be designed. The plan includes the channelization system.

Control Concept

In order to reduce crossing time for pedestrians by minimizing the carriageway crossing distance, and to contribute to pedestrian safety, an exclusive signal phase for pedestrian crossings at signalized intersections is proposed. For Diwan St.-Saft El Labban St. intersection, and Saft El Labban St.-Mashatal St. intersection and Diwan St.- Tharwat St. intersection, the signal phase of 3 phases and 4 phases, with all red for pedestrian-friendliness, will be installed. They need to be modified according to specific traffic conditions.

c. Design of Signal Cycle Time an Split Time

The calculation of the saturation flow rate and the saturation degree of the intersection was carried out, in order to formulate adequate signal splits. The saturation flow rate of each intersection is shown in Tables 3.5.4 (1)(2)(3). Figures 3.5.7 (1)(2)(3) show the plan of signal cycle time and splits. The cycle length with all-red indication is determined from the degree of saturation of the intersection and time for pedestrian crossing.

Table 3.5.4 (1) Saturation Flow Rate and Phase Ratio Required at Diwan St.-Saft El Labban St. Intersection

Approach		N-S			S-N			E-W (Fly-Over)			E-W (Bus-Terminal)				
		R	S	L	R	S	L	R	S+L	L	R	S	L		
1) No. of lanes		0	0	1	1	1	0	0	1	0	-	2	1		
2) Basic value of saturation flow rate (PCU)		-	-	2,000	1,800	2,000	-	-	2,000	-	-	2,000	1,800		
3) Adjustment factor lane width		-	-	1.000	0.950	0.950	-	-	1.000	-	-	1.000	1.000		
4) Adjustment factor for heavy vehicles		-	-	1.000	1.000	1.000	-	-	1.000	-	-	1.000	1.000		
5) Adjustment factor for left-turns		-	-	1.000	1.000	1.000	-	-	0.850	-	-	1.000	1.000		
6) Adjustment factor for right-turns		-	-	1.000	1.000	1.000	-	-	1.000	-	-	1.000	1.000		
7) Saturation flow rate (PCU)		-	-	2,000	1,710	1,900	-	-	1,700	-	-	4,000	1,800	S.D of phase	Total S.D
8) Flow rate		0.250			0.277			0.294			0.172				
9) Necessary phase ratio	1Φ	0.250			0.277									0.277	0.744
	2Φ							0.294						0.294	
	3Φ										0.172			0.172	
	4Φ	All Red for Pedestrians													

Source: JICA Study Team. Note: R=Right-turn, S=Straight, L= Left-turn, S.D=Saturation Degree

Table 3.5.4 (2) Saturation Flow Rate and Phase Ratio Required at Diwan St.-Tharwat St. Intersection

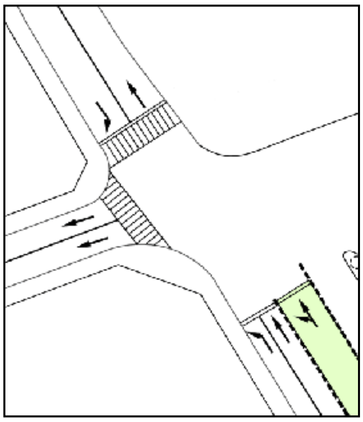
Approach		S-N			W-E										
		R	S	S+L	R	S	L	R	S	L	R	S	L		
1) No. of lanes		0	1	1	1	1	0	-	-	-	-	-	-		
2) Basic value of saturation flow rate (PCU)		-	2,000	2,000	1,800	2,000	-	-	-	-	-	-	-		
3) Adjustment factor lane width		-	0.950	0.950	1.000	1.000	-	-	-	-	-	-	-		
4) Adjustment factor for heavy vehicles		-	1.000	1.000	1.000	1.000	-	-	-	-	-	-	-		
5) Adjustment factor for left-turns		-	1.000	0.850	1.000	1.000	-	-	-	-	-	-	-		
6) Adjustment factor for right-turns		-	1.000	1.000	1.000	1.000	-	-	-	-	-	-	-		
7) Saturation flow rate (PCU)		-	1,900	1,615	1,800	2,000	-	-	-	-	-	-	-	S.D of phase	Total S.D
8) Flow rate		0.284			0.395										
9) Necessary phase ratio	1Φ	0.284												0.284	0.679
	2Φ				0.395									0.395	
	3Φ	All Red for Pedestrians													

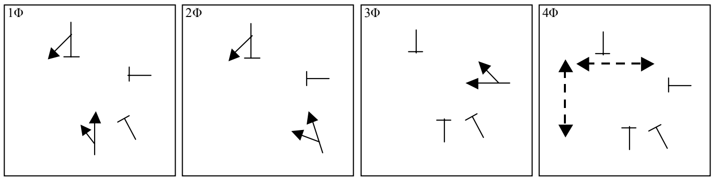
Source: JICA Study Team. Note: R=Right-turn, S=Straight, L= Left-turn, S.D=Saturation Degree

Table 3.5.4 (3) Saturation Flow Rate and Phase Ratio Required at Saft El Labban St.-Mashatal St. Intersection

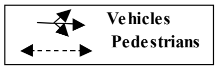
Approach		N-S			E-W			NE-S							
		S+R	S	L	S+R	S+L		R	S+L	L	R	S	L		
1) No. of lanes		1	1	0	1	1		0	1	0	-	-	-		
2) Basic value of saturation flow rate (PCU)		2,000	2,000	-	2,000	2,000	-	-	2,000	-	-	-	-		
3) Adjustment factor lane width		1.000	1.000	-	1.000	1.000	-	-	1.000	-	-	-	-		
4) Adjustment factor for heavy vehicles		1.000	1.000	-	1.000	1.000	-	-	1.000	-	-	-	-		
5) Adjustment factor for left-turns		1.000	1.000	-	1.000	0.850	-	-	0.850	-	-	-	-		
6) Adjustment factor for right-turns		0.850	1.000	-	0.850	1.000	-	-	1.000	-	-	-	-		
7) Saturation flow rate (PCU)		1,700	2,000	-	1,700	1,700	-	-	1,700	-	-	-	-	S.D of phase	Total S.D
8) Flow rate		0.270			0.294			0.118							
9) Necessary phase ratio	1Φ	0.270												0.270	0.682
	2Φ				0.294									0.294	
	3Φ							0.118						0.118	
	4Φ	All Red for Pedestrians													

Source: JICA Study Team. Note: R=Right-turn, S=Straight, L= Left-turn, S.D=Saturation Degree





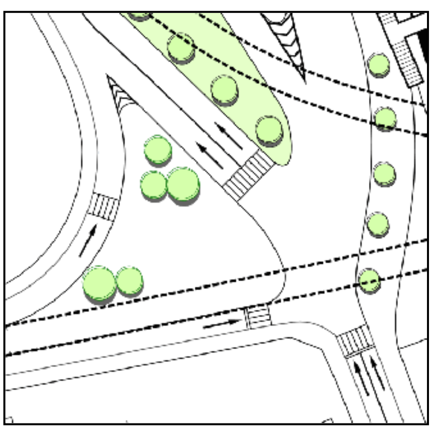
Proposed Signal Step: Cycle Length = 105 sec					
Phase	Time (sec) (20 / 40 / 60 / 80 / 100)				
1Φ	G (29)	Y	R (55)		AR
2Φ	R (33)	G (31)	Y	R (20)	AR
3Φ	R (68)	G (16)	Y		AR
4Φ	R (88)				AR

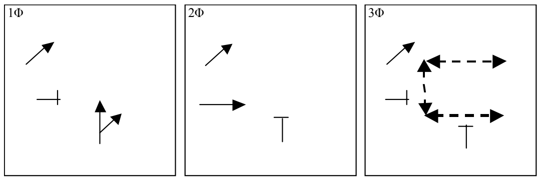


Note: G=Green time, R=Red time,
AR=All-red time, Y=Yellow time : 4 sec

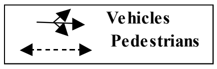
Source: JICA Study Team

Figure 3.5.7 (1) Plan of Signal Cycle Time and Splits at Diwan St.-Saft El Labban St. Intersection





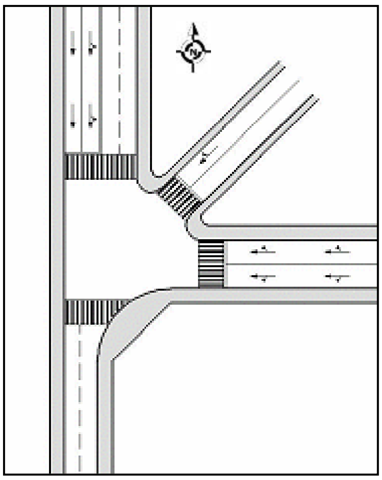
Proposed Signal Step: Cycle Length = 100 sec				
Phase	Time (sec) (20 / 40 / 60 / 80 / 100)			
1Φ	G (31)	Y	R (48)	AR
2Φ	R (35)	G (44)	Y	AR
3Φ	R (83)			AR

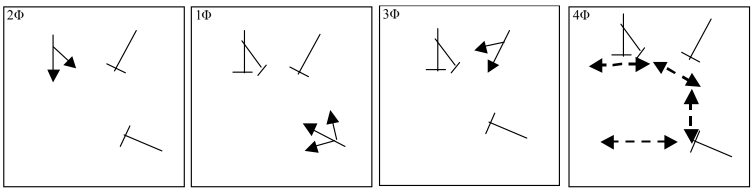


Note: G=Green time, R=Red time,
AR=All-red time, Y=Yellow time : 4 sec

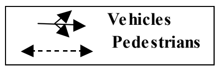
Source: JICA Study Team

Figure 3.5.7 (2) Plan of Signal Cycle Time and Splits at Diwan St.- Tharwat St. Intersection





Proposed Signal Step: Cycle Length = 100 sec					
Phase	Time (sec) (20 / 40 / 60 / 80 / 100)				
1Φ	G (29)	Y	R (50)		AR
2Φ	R (33)	G (32)	Y	R (14)	AR
3Φ	R (69)	G (10)	Y		AR
4Φ	R (83)				AR



Note: G=Green time, R=Red time,
AR=All-red time, Y=Yellow time : 4 sec

Source: JICA Study Team

Figure 3.5.7 (3) Plan of Signal Cycle Time and Splits at Saft El Labban St.-Mashatal St Intersection

2) Improvement of Bus Stop and Pedestrian Facility for Transfer Purpose

In accordance with the construction of bus terminal on the busway, a pedestrian flow axis from the bus terminal of the busway should be established so that it will enhance linkage to the Metro Line 2 station and the neighbouring business/commercial area. A sidewalk between the busway station and Metro Line 2 station will be considered. The plan description for the improvement of station plaza and pedestrian facility for transfer purposes refers to the Section of 3.5.1 Intermodal Facility.

3) Intersection Improvement

a. Locations for Installation of Intersection Improvement

Based on the plan of signalized intersection, the intersections at Diwan St.-Saft El Labban St., Diwan St.- Tharwat St. and Saft El Labban St.-Mashatal St will be improved by channelization e.g. as pavement marking for lanes, pedestrian crossings and stop lines, in order to control traffic flow on major and miner approaches and to ensure the safety of pedestrians.

b. Improvement Items

In conjunction with the installation of traffic signal lights at non-signalized intersections, a channelization plan for these intersections was prepared, in order to control traffic flow on major and miner approaches and to ensure the safety to pedestrians. Salient points of the improvement are discussed below. These improvements are listed in Table 3.5.5. The proposed improvement plans are shown in Figure 3.5.7

Table 3.5.5 Improvement Measures for Signalized Intersection

Improvement Measures	Diwan St.-Saft El Labban St. Intersection	Diwan St.-Tharwat St. Intersection	Saft El Labban St.-Mashatal St. Intersection
1. Improvement of pavement markings where lane operation to be altered	○	○	○
2. Addition of exclusive left-turn/right-turn lanes	○	○	-
3. Installation of pedestrian crossings	○	○	○
4. Improvement of channelizing island	-	○	-
5. Improvement of corner cut	○	○	○

Source: JICA Study Team

<u>Improvement of Pavement Markings Where Lane Operation to be Altered</u>

Pavement markings such as arrows, stop lines and center lines will be improved at intersections where the system of lane operation is to be altered due to changes in traffic demand.

<u>Addition of Exclusive Left-Turn/Right-Turn Lanes</u>

Exclusive left-turn/right-turn lanes will be established at intersections with a high volume of left-turning traffic and right-turning traffic, in order to ensure the smooth flow of straight-through traffic and to process left-turning traffic and right-turning traffic more efficiently. The exclusive lanes will be added at Diwan St.-Saft El Labban St. intersection and Diwan St.- Tharwat St. intersection. The plan of addition of lanes should be designed based on the following items:

- Exclusive left-turn/right-turn lanes will be provided with left-turn pockets or channelizing islands.
- Left-turn pockets will be constructed either by cutting off the median and allotting the resulting space to the pocket or, where there is no median, by shifting the centerline to the lane in the opposite direction.

Installation of Pedestrian Crossings

In conjunction with installation of signal lights, pedestrian crossings will be provided at intersections.

Improvement of Channelizing Islands

Improvements with respect to the locations and shapes of channelizing islands will be reviewed for Diwan St.- Tharwat St. intersection, in order to ensure the smooth flow of left-turning traffic.

Improvement of Corner Cut

Corner cut will be reviewed at intersections where the channelizing islands are provided.

4) Parking System

On-street parking will be prohibited from 8:00 AM to 8:00 PM along the main gateway to the intermodal area. The prohibition of on-street parking will be adopted at the section which has high parking occupancy. In addition, parking spaces should be provided along Tharwat St. by introducing an on-street parking charge system.

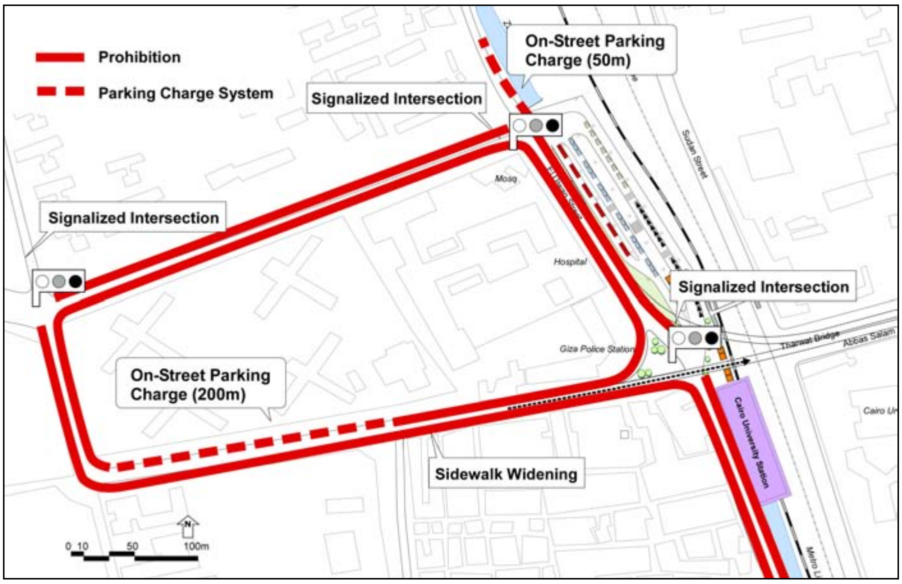
a. Locations for On-Street Parking System

On-street parking will be prohibited on the following sections along major gateway in the area. In addition, a parking charge system will be adopted along sections with high occupancy of on-street parking. These two measures ought to be applied at the same time and within one system. Figure 3.5.8 shows the location plan for the parking system in study area. The plan location covers as below.

- Section between Diwan St. and Mashatal St on Saft El Labban St: The section is 7.0 m wide, composes of 2-lanes. Both sides of section will be prohibited.
- Section between Saft El Labban St. and Salam St. on Diwan St: The section is 5.5-6.0 m wide, composed of 1-lane and 2-lanes. The both sides of section

will be prohibited, however, northern approach from Saft El Labban St. along canal will be introduced by a parking charge system (50 m).

- Section between Diwan St. and Saft El Labban St on Tharwat St: The section is 12.0 m wide including approach of fly-over construction, composed of 2-lanes and 4-lanes. The one side of section will be prohibited, other side will be introduced by an on-street parking charge system (200 m).



Source: JICA Study Team

Figure 3.5.8 Location Plan for On-Street Parking System

b. Plan Description of Parking Charge System

For the parking charge system, refer to Chapter 2, section 2.7, Ain Shams intermodal plan, and Chapter 4 Traffic Management Program along Metro 4 Corridor.

5) Traffic Circulation System

Within the area between Diwan St., Tharwat St. and Saft El Labban St., where there are narrow streets, a substantial volume of traffic is concentrated. These streets must be restricted by a one-way system in order to improve the existing traffic capacity. These streets are; Diwan St. (one-way from Salam St. to Saft El Labban St.), Tharwat St. (one-way from Saft El Labban St. to Diwan St.).

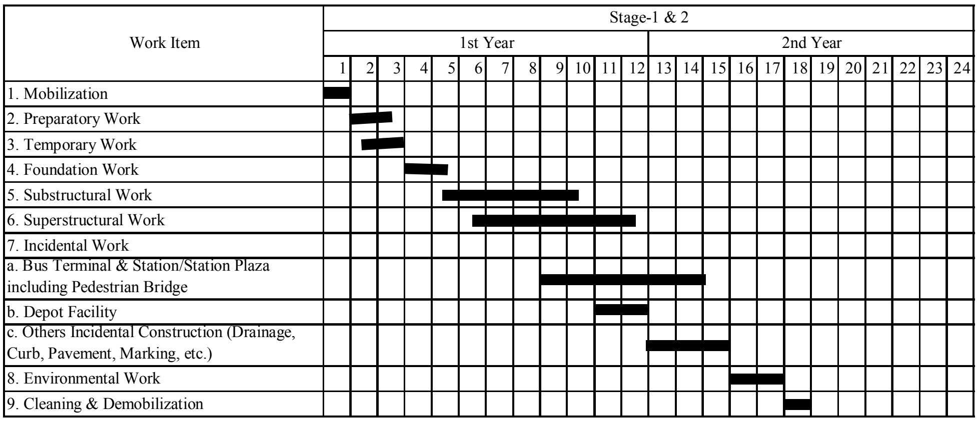
3.6 COST ESTIMATION AND IMPLEMENTATION

3.6.1 Construction Plan: Construction Schedule by Stage

This section describes implementation plan for facilities of the busway system on West Wing Corridor. Since the construction works are carried out on the existing roads on which many vehicles travel, it is most advisable to select construction methods to avoid interference with traffic and to minimize the construction period and cost.

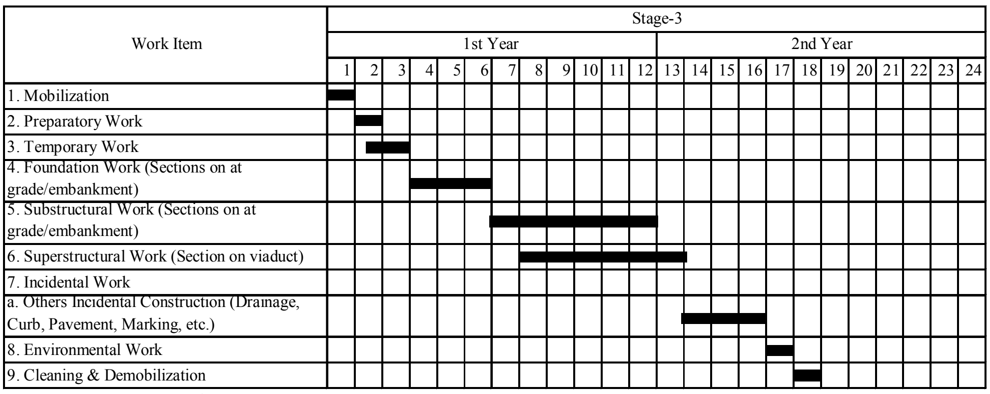
The construction period for busway on Stage-1 and 2 will take 1.5 years from commencement of work up to completion, and the construction period for busway on Stage-3 will also take 1.5 years. Construction schedule by stage is shown in Tables 3.6.1 (1)(2).

Table 3.6.1 (1) Construction Schedule for Busway on Stage-1 & 2



Source: JICA Study Team

Table 3.6.1(2) Construction Schedule for Busway on Stage-3



Source: JICA Study Team

Construction Schedule for Busway on Stage-1 & 2 (Proposed Length = 38.0 km)

The busway system operated by normal bus with air-conditioning for 1-lane per direction during two years between 2007 and 2008; thereafter, the busway system operated by articulated bus for 1-lane per direction during four years between 2009 and 2017. The busway system has three (3) different sections. On the first section between the terminated station (bus terminal) in 6th of October City and the entrance of 26th of July Corridor, a bus priority lane for 1-lane per direction will be constructed. On the second section, between the entrance of 26th of July Corridor and Ring Road, full segregated median busway system will be provided at the central side lanes. The other vehicle lanes will be reduced from 4.0 m to 3.5 m, in order to provide 1-lane per direction for the busway. On the third section, between Ring Road and Cairo university station of Metro Line 2, where a viaduct for single lane dual carriageway busway will be built on the canal. In advance, the foundation work and substructural work for 2-lanes busway in Stage-3 will be implemented.

Mobilization, preparatory work and temporally work will be carried out within three (3) months. The main work consisting of foundation work, substructural work and superstructural work will be implemented during 8.5 months. For the construction of bus terminal/station plaza and depot facilities, it will take six (6) months. In addition, other incidental work, environmental work and cleaning/demobilization will be carried out during six (6) months.

Construction Schedule for Busway on Stage-3 (Proposed Length = 31.2km)

Based on the increasing of passenger demand transported, between 2018 and 2022, 2-lanes busway per direction is needed. The busway, therefore, will be widened for preserving more 1-lane per direction. The widening section has three (3) different sections as follows: at grade section between the entrance of 26th of July Corridor and Alexandoria Desert Road, embankment section between Alexandoria Desert Road and Ring Road, and viaduct section between Ring Road and Cairo University station. On the sections of at grade and embankment, 8.0 m in both roadsides will be widened, in order to provide 2-lanes per direction for busway. On the viaduct section, major work is superstructural work for providing more 1-lane per direction.

Mobilization, preparatory work and temporally work will be carried out within three (3) months. On sections of at grade and embankment for widening construction, foundation work and substructural work will be implemented during nine (9) months. Superstructural work for viaduct section will be carried out during six (6) months. In addition, other incidental work, and cleaning/demobilization will be carried out during five (5) months.

3.6.2 Project Cost

The project cost consists of construction, materials, labor, land acquisition, compensation and engineering costs. Most of these costs are estimated based on the unit cost of work items obtained from a unit price analysis and in comparison with costs of similar projects in Cairo. The estimate of the project cost was based on the results preliminary engineering design, quantity take-off of each work item, and the studies on construction method and operation and maintenance.

The fundamental concepts in estimating the project cost are as follows:

- Unit cost of each work item was determined based on the economic condition prevailing in August 2003.
- Engineering services and construction management cost are assumed to be 8% for detailed engineering and 5% for local administration of the construction cost.
- Land acquisition and compensation (resettlement) cost is estimated by information of Ministry of Housing.
- Physical contingency is estimated to be 10% of the total of construction cost and engineering services cost.

The project cost for the busway is classified into four (4) items such as busway, intermediate station, bus terminal (terminated station), depot/workshop and buses for busway system. The busway consists of at-grade section and viaduct section. The major work items are as follows: earthwork, pavement, viaduct structure, bridge construction, platform with station building, building for depot/workshop and incidental construction. Construction cost by items is shown in Table 3.6.2.

Land acquisition and compensation cost are estimated based on the information of Ministry of Housing. Land acquisition and compensation cost for the affected houses and lands by widening of road, construction of bus terminals/station plazas /depot are estimated based on land prices on similar projects in the city.

Table 3.6.2 Construction Cost for Busway

A: Initial Investiment Cost of the West Wing Project

1) Stage-1 & Stage-2

Investment Item		Unit	Unit Cost (L.E)	Quantity	Total Cost (Mill.L.E)	Local (%)	Foreign (%)	Local Amount (Mill.L.E)	Foreign Amount (Mill.L.E)
Bus Way									
At- Grade	Earthwork (Cut)	m^3	10	59,760	0.60	100	0	0.60	0.00
	Curb	m^2	450	49,800	22.41	100	0	22.41	0.00
	Pavement (Surface)	m^3	180	1,245	0.22	100	0	0.22	0.00
	Pavement (Binder Course)	m^3	180	1,245	0.22	100	0	0.22	0.00
	Pavement (Base Course)	m^3	50	6,225	0.31	100	0	0.31	0.00
Viaduct 1.	Structure	m^2	4,500	17,000	76.50	60	40	45.90	30.60
	Pavement	m^3	180	680	0.12	100	0	0.12	0.00
Viaduct 2	Structure	m^2	3,000	37,000	111.00	60	40	66.60	44.40
	Pavement	m^3	180	1,480	0.27	100	0	0.27	0.00
	Sub-Total				**211.66**			**136.66**	**75.00**
Intermediate Station (3 Stations)									
Earthwork	Cut	m^3	10	2,592	0.03	100	0	0.03	0.00
Pavement	Surface	m^3	180	216	0.04	100	0	0.04	0.00
	Binder	m^3	180	216	0.04	100	0	0.04	0.00
	Base Course	m^3	50	1,080	0.05	100	0	0.05	0.00
	Subbase	m^3	40	1,080	0.04	100	0	0.04	0.00
Pedestrian Bridge (Steel)	Bridge	m	33,000	146	4.82	80	20	3.85	0.96
	Staircase	m	8,500	188	1.59	80	20	1.28	0.32
Station House	Shelter with ticketing system, etc.	Unit	2,500,000	3	7.50	60	40	4.50	3.00
	Sub-Total				**14.1**			**9.8**	**4.3**
Station Plaza (2 Station Plazasx2 places+1 Station Plaza)									
Earthwork	Cut	m^3	10	32,304	0.32	100	0	0.32	0.00
Pavement	Surface	m^3	180	2,283	0.41	100	0	0.41	0.00
	Binder	m^3	180	2,285	0.41	100	0	0.41	0.00
	Base Course	m^3	50	11,425	0.57	100	0	0.57	0.00
	Subbase	m^3	40	11,425	0.46	100	0	0.46	0.00
Waiting Space	Shelter with bench	Piece	10,000	71	0.71	100	0	0.71	0.00
Green area	Planting	m^2	38	8,156	0.31	100	0	0.31	0.00
Pedestrian Bridge with stair (Concrete)		m^2	1,000	2,900	2.90	90	10	2.61	0.29
Access Road & Signalized intersection	Earthwork (Cut)	m^3	10	52,800	0.53	100	0	0.53	0.00
	Surface	m^3	180	4,400	0.79	100	0	0.79	0.00
	Binder	m^3	180	4,400	0.79	100	0	0.79	0.00
	Base Course	m^3	50	22,000	1.10	100	0	1.10	0.00
	Subbase	m^3	40	22,000	0.88	100	0	0.88	0.00
	Installation of signal lights	Piece	500,000	5	2.50	10	90	0.25	2.25
Land Acquisition	Land (S. Zayed & W. A. Ramash)	m^2	100	32,140	3.21	100	0	3.21	0.00
	Land (Cairo Univ.)	m^2	300	21,700	6.51	100	0	6.51	0.00
	Resettlement (Cairo Univ.)	m^2	150	86,800	13.02	100	0	13.02	0.00
	Demolishment (Cairo Univ.)	m^2	200	86,800	17.36	100	0	17.36	0.00
	Sub-Total				**52.79**			**50.25**	**2.54**
Bus Terminal (2 Terminated Stations)									
Earthwork	Cut	m^3	10	5,544.00	0.06	100.00	0.00	0.06	0.00
Pavement	Surface	m^3	180	462.00	0.08	100.00	0.00	0.08	0.00
	Binder	m^3	180	462.00	0.08	100.00	0.00	0.08	0.00
	Base Course	m^3	50	2,310.00	0.12	100.00	0.00	0.12	0.00
	Subbase	m^3	40	2,310.00	0.09	100.00	0.00	0.09	0.00
Waiting Space	Shelter with bench	Piece	10,000	50.80	0.51	100.00	0.00	0.51	0.00
Pedestrian Bridge (Steel)	Bridge	m^2	11,000	180.00	1.98	80.00	20.00	1.58	0.40
	Stair case	m^2	2,840	324.00	0.92	80.00	20.00	0.74	0.18
Station House	Shelter with ticketing system, etc.	Unit	2,500,000	5.00	12.50	60.00	40.00	7.50	5.00
Viaduct Section	Structure	m^2	3,000	7,075.50	21.23	60.00	40.00	12.74	8.49
	Pavement	m^3	180	84.00	0.02	100.00	0.00	0.02	0.00
Land	(6^{th} of Oct. City)	m^2	200	9,240.00	1.85	100.00	0.00	1.85	0.00
	Sub-Total				**39.43**			**25.36**	**14.07**

Table 3.6.2 Construction Cost for Busway (Continued)

Depot & Workshop									
Bus Parking		m^2	500.00	11,200.00	5.60	100.00	0.00	5.60	0.00
Depot & Workshop	Earthwork	m^3	10	16,800.00	0.17	100.00	0.00	0.17	0.00
	Surface	m^3	180	1,120.00	0.20	100.00	0.00	0.20	0.00
	Binder	m^3	180	1,120.00	0.20	100.00	0.00	0.20	0.00
	Base Course	m^3	50	5,600.00	0.28	100.00	0.00	0.28	0.00
	Subbase	m^3	40	5,600.00	0.22	100.00	0.00	0.22	0.00
Building	Management	m^2	3,000.00	800.00	2.40	80.00	20.00	1.92	0.48
	Maintenance	m^2	1,500.00	4,000.00	6.00	20.00	80.00	1.20	4.80
Land		m^2	200.00	28,000.00	5.60	100.00	0.00	5.60	0.00
	Sub-Total				**20.68**			**15.40**	**5.28**
Buses									
Normal Bus with air-condition		Vehicle	400,000.00	15.00	6.00	40.00	60.00	2.40	3.60
Articulated Bus		Vehicle	900,000.00	70.00	63.00	0.00	100.00	0.00	63.00
	Sub-Total				**69.00**			**2.40**	**66.60**
Total					**407.66**			**239.89**	**167.77**
Engineering and Construction Management (8%)					32.61	10.00	90.00	3.26	29.35
	Local Administration (5%)				20.38	100.00	0.00	20.38	0.00
	Sub-Total				**460.66**			**263.53**	**197.12**
	Contingency (10%)				46.07			26.35	19.71
Total					**506.72**			**289.89**	**216.84**

Source: JICA Study Team

2) Stage-3

Investment Item		Unit	Unit Cost (L.E)	Quantity	Total Cost (Mill.L.E)	Local (%)	Foreign (%)	Local Amount (Mill.L.E)	Foreign Amount (Mill.L.E)
Bus Way									
At- Grade: Widening Construction	Earthwork (Cut)	m^3	10	1,394,400	13.94	100	0	13.94	0.00
	Curb	m^2	450	49,800	22.41	100	0	22.41	0.00
	Pavement (Surface)	m^3	180	9,960	1.79	100	0	1.79	0.00
	Pavement (Binder Course)	m^3	180	9,960	1.79	100	0	1.79	0.00
	Pavement (Base Course)	m^3	50	49,800	2.49	100	0	2.49	0.00
	Earthwork & Bridge Structure	m^3	4,500	19,664	88.49	70	30	61.94	26.55
	Land Acquisition (widening)	m^2	100	199,200	19.92	100	0	19.92	0.00
Viaduct 1.	Structure	m^2	4,500	17,000	76.50	60	40	45.90	30.60
	Pavement	m^3	180	680	0.12	100	0	0.12	0.00
Viaduct 2	Structure	m^2	3,000	37,000	111.00	60	40	66.60	44.40
	Pavement	m^3	180	1,480	0.27	100	0	0.27	0.00
	Sub-Total				**338.73**			**237.18**	**101.55**
Depot & Workshop									
Bus Parking		m^2	500.00	5,600.00	2.80	100.00	0.00	2.80	0.00
Depot & Workshop	Earthwork	m^3	10	8,400.00	0.08	100.00	0.00	0.08	0.00
	Surface	m^3	180	560.00	0.10	100.00	0.00	0.10	0.00
	Binder	m^3	180	560.00	0.10	100.00	0.00	0.10	0.00
	Base Course	m^3	50	2,800.00	0.14	100.00	0.00	0.14	0.00
	Subbase	m^3	40	2,800.00	0.11	100.00	0.00	0.11	0.00
Building	Management	m^2	3,000.00	200.00	0.60	80.00	20.00	0.48	0.12
	Maintenance	m^2	1,500.00	1,000.00	1.50	20.00	80.00	0.30	1.20
Land		m^2	200.00	28,000.00	5.60	100.00	0.00	5.60	0.00
	Sub-Total				**11.04**			**9.72**	**1.32**
Buses									
Articulated Bus		Vehicle	900,000.00	70.00	63.00	0.00	100.00	0.00	63.00
	Sub-Total				**63.00**			**0.00**	**63.00**
Total					**412.76**			**246.90**	**165.87**
Engineering and Construction Management (8%)					33.02	10.00	90.00	3.30	29.72
	Local Administration (5%)				20.64	100.00	0.00	20.64	0.00
	Sub-Total				**466.42**	58.07	41.93	**270.84**	**195.59**
	Contingency (10%)				46.64			27.08	19.56
Total					**513.07**			**297.92**	**215.14**

Source: JICA Study Team

Table 3.6.2 Construction Cost for Busway (Continued)

3) Additional Investiment (Unit: LE Million)

Investment Item	Total Investiment	Local Amount	Foreign Amount	2012	
				Local	Foreign
Buses					
Articulated Bus, 70 buses	63.00	0.00	63.00	0.00	63.00
Total	**63.00**	**0.00**	**63.00**	**0.00**	**63.00**
Engineering and Construction Management (8%)	5.04	0.00	5.04	0.00	5.04
Local Administration (5%)	3.15	0.00	3.15	0.00	3.15
Sub-Total	**71.19**	**0.00**	**71.19**	**0.00**	**71.19**
Contingency (10%)	7.12	0.00	7.12	0.00	7.12
Total	**78.31**	**0.00**	**78.31**	**0.00**	**78.31**

Source: JICA Study Team

3.6.3 Maintenance Cost

Maintenance cost of the project is estimated based on the applied practice on maintenance works for similar roads and structural conditions in the city, and is estimated for 20 years. On the busway, it is estimated that 5% of total length will require 4.0 cm thick of overlay every year for the first 10 years. For the following 10 years, 3.0 cm thick of overlay will be required for the whole length for one time. On the bus terminal, 10% of the total area will require 5 cm thick of overlay every year for first 10 years, and 15% of total area for following 10 years. Table 3.6.3 shows maintenance cost for busway and bus terminal.

Table 3.6.3 Maintenance Cost for Busway

Investment Item		Unit	Unit Cost (L.E)	Quantity	Total Cost (Mill.L.E)	Local (%)	Foreign (%)	Local Amount (Mill.L.E)	Foreign Amount (Mill.L.E)
Bus Way									
Stage-1 & 2	Pavement (Surface)(Year 2007-201	m^3	180	6,080	1.09	100	0	1.09	0.00
	Pavement (Surface)(Year 2017-202	m^3	180	456	0.08	100	0	0.08	0.00
Stage-3	Pavement (Surface)(Year 2018-202	m^3	180	2,432	0.44	100	0	0.44	0.00
	Sub-Total				**1.61**			**1.61**	**0.00**
Bus Terminal & Station Plaza									
Stage-1 & 2	Pavement (Surface)(Year 2007-201	m^3	180	104	0.02	100	0	0.02	0.00
	Pavement (Surface)(Year 2017-202	m^3	180	156	0.03	100	0	0.03	0.00
	Sub-Total				**0.05**			**0.05**	**0.00**
Total					**1.66**			**1.66**	**0.00**

Source: JICA Study Team

3.6.4 Operating Cost and Revenue Estimation

(1) Operating Cost

Table 4.6.4 shows operating units by type of public transportation in Egypt based on Financial and Economic Central Department Annual Cash Flow Summary. The operating unit for large sized bus in Egypt is as follows: normal bus at 2.14 L.E per revenues kilometers, air-conditioned bus at 1.33 L.E per revenues kilometers respectively. Air-conditioned large bus is quite new bus, while normal large bus is nearly old bus. The estimated operating cost for proposed busway must be based on current operating unit in Egypt; the operating unit of large bus is estimated to be about 2.0 L.E in average (See Table 3.6.4). The operating buses for busway generally have large consumption of repair cost. In comparison with the repair cost of normal large bus, cost of articulated bus for busway is extremely high showing 125-150% of normal large bus. In this context, the operating unit of articulated bus for busway is estimated at about 3.0 L.E per kilometers. The annual operating cost for the busway is shown in Table 3.6.5.

Table 3.6.4 Operating Units by Type of Public Transportation in Egypt

List	Items	Bus	AC Bus	Mini Bus
1	Total Annual Passengers (thousands)	597,467	8,618	135,445
2	Total Annual kilometers (thousands)	170,491	8,627	55,010
Revenues (thousands)				
3	Annual Revenue from Ticket (thousands)	174,083	17,360	62,447
Expenses				
4	Wages	168,334	5,123	28,072
5	Operational Consumption	130,465	6,001	27,939
6	General Consumption	13,740	289	4,507
7	Current Transfers (without Dep. & interest)	10.569	37	4,640
8	Miscellaneous	41,798	80	381
9	Total Cost (without Dep. & interest)	364,906	11.540	65,539
10	Depreciation	95,130	10.291	16,695
11	Total Cost with Dep. & without interest	460.036	21,831	82,234
12	Interest	113,162	0	0
13	Total Cost with % & Without Dep.	478.068	11,540	65,539
14	Total Cost with Dep. & interest	573,198	21,831	82,234

Source: Financial and Economic Central Department-Annual Cash Flow Summary 30/06/2002

Table 3.6.5 Estimated Operating Cost of Busway

Year	Annual Vehicle Kilometers (million)	Operating Cost Per Vehicle-km (L.E)	Annual Operating Cost (million L.E)
2007	1.64	2.0	3.3
2009	3.99	3.0	11.9
2012	8.71	3.0	26.1
2022	22.74	3.0	68.2

Source: JICA Study Team

(2) Revenue Estimation

Multiplying the projected number of daily passengers by an annual factor, and then multiplying the result by the average fare gives the annual operating revenue. The busway ridership was derived from the total number of boarding passengers and average trip length estimated by the CREATS simulation model. For the Busway, it is estimated to be 365 days per year. The results of annul revenue estimated is shown in Table 3.6.6.

Table 3.6.6 Estimated Operating Revenue of Busway

Year	Daily Passenger (million Pax.)	Daily Vehicle-km (million)	Daily Operating Revenue (million L.E)	Annual Operating Revenue (million L.E)
2007	0.0115	0.7000	0.0388	14.2
2009	0.0540	2.6500	0.1568	57.2
2012	0.1180	0.1568	0.4064	148.3
2022	0.3842	57.2000	1.6107	587.9

Source: JICA Study Team

3.7 ENVIRONMENTAL IMPACT ASSESSMENT

3.7.1 Introduction

Transport improvement projects are implemented to improve the mobility of goods and persons, which should result in improved economic development. Consequently, it will improve the social environment of the people involved. However, almost every project has also negative impacts on the environment, being slight or severe.

Environmental Impact Assessment (EIA) is an integral part of the process of project selection, design and implementation. It should be a tool for decision makers to consider the impacts of proposed activities on the (physical and social) environment, in order to seek for alternatives, to prepare steps to mitigate the negative impacts and to enhance the positive impacts. If necessary, a proposed activity should be rejected.

To ensure sustainability for the Trunk Busway, one of the selected transport improvement projects for Greater Cairo (CREATS 2), a **scoped** Environmental Impact Assessment (EIA) has been carried out as part of the feasibility study. The EIA indicates the potential negative as well as the positive environmental impacts to be expected from the selected transport development project. Also mitigation measures, required to alleviate the identified adverse environmental impacts, are provided. The EIA has been carried out by Egyptian consultants (MB Consultants) under the supervision of the Study Team, according to the Egyptian, JICA, and international guidelines and regulations.

For a full description and characteristics of the West Wing Busway Project, refer to the relevant specific chapters in the current report.

Part of the Environmental Impact Assessment includes Environmental Surveys. An Air Quality and Noise Level Survey, and a Social Survey (Social Impact Assessment), were carried out. Their results revealed the present environmental condition of the Project Area, as well as the opinion of the residents on the proposed project.

The following definitions have been applied:

- ***Initial Environmental Examination (IEE)*****:** the examination/assessment to determine the environmental impacts that may be created by a proposed transport development project, based on existing information and data, easily accessible information, and professional judgement.
- ***Screening*****:** the evaluation/judgement on the necessity of an Environmental Impact Assessment.
- ***Scoping:*** the identification of important/significant environmental impacts, resulting from a proposed transport development project, and the formulation of items to be studied in an EIA.

- ***Significant environmental impact***: a fundamental change to the physical, biological, or social environment, resulting from a proposed transport development project.
- ***Environmental Impact Assessment (EIA)***: a detailed and in-depth research study on significant environmental impacts to be expected from a proposed transport development project.
- ***Environmental Management Plan***: a document presenting those efforts that will be made to manage adverse environmental impacts resulting from a proposed transport development project.
- ***Environmental Monitoring Plan***: a document presenting those efforts that will be made to monitor the environmental components, which may be affected by a proposed transport development project.

The Egyptian guidelines and legislation related to Environmental Impact Assessment are already described in Section 2.9.2, Chapter 2.

3.7.2 Environmental Impact Assessment for the West Wing Project

(1) Introduction

Potential adverse and positive environmental impacts have been identified for the proposed the Trunk Busway Project (West Wing). Also, the existing situation in the Project Area has been evaluated for its environmental condition. A total of 36 locations were selected for the measurement of Air Quality and Noise Level Surveys, of which 32 locations are alongside and/or vicinities of the west wing corridor, and 4 locations were alongside the corridor towards Cairo University. The survey locations were also selected to provide environmental implications for the alternative route selection. These measurement locations for the Air Quality and Noise level Surveys are as illustrated on Figure 3.7.1 and described as shown in Table 3.7.1

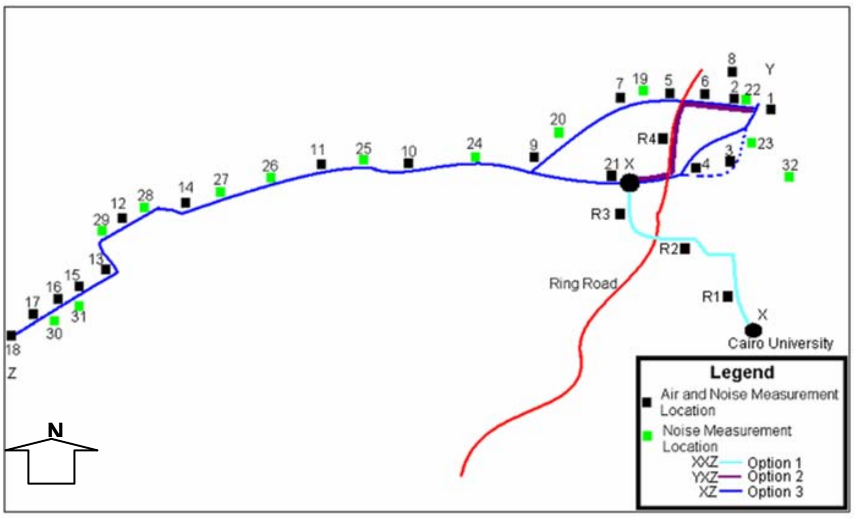


Figure 3.7.1 Measurement Locations for the West Wing Busway Project

Table 3.7.1 Descriptions of Measurement Locations for the West Wing Busway Project

No	Location ID	Location Name and Description
1	01WW7	National Civil Aviation Institute, Next to Imbaba Airport
2	02WW7	Rail Cross at Ezbet El Matar (Ezbet El Matar Clinic)
3	03WW1	Ard El Lewaa Youth Center, Below 26 July Corridor
4	04WW7	Beside 26 July Corridor Wall, after bridge coming from Lebanon Sqr.
5	05WW1	26 July Corridor crossing with ring road
6	06WW1	Below the Ring Road after Barageel Telecommunication center
7	07WW7	Barageel Police Station
8	08WW1	Background of Rail Cross at Ezbet El Matar (Ezbet El Matar Clinic)
9	09WW7	End of Asphalt way at the agricultural land on line sight of 26 July Corridor After Barageel Police Station (at the channel)
10	10WW7	26 July Corridor Police Traffic Station
11	11WW7	Crossing of 26 July Corridor with Alex desert road (at the police center)
12	12WW7	Inside first shopping mall at Sheikh Zayed City Entrance 1
13	13WW1	Next to Zaied 2000 Project Sheikh Zayed City Entrance 2
14	14WW1	At the crossing of the 6 October City road, Alex Desert Road, Lebanon Square and Oasis Road (At Fuel Station on the road between 6^{th} October City and Zaied City)
15	15WW1	6^{th} October City Entrance, next to the club
16	16WW1	6^{th} October City Police Station
17	17WW7	Laylat El-Qadr Sqr., 6^{th} October City
18	18WW1	Industrial area, near Laylat El-Qadr Sqr., 6^{th} October City
19	19WWN	Between Location 5 and 7
20	20WWN	Between Location 8 and 9
21	21WWN	Between Location 9 and 4
22	22WWN	At Imbaba Airport between Location 1 and 2
23	23WWN	Between Location 3 and 1, near Meet Oqba
24	24WWN	Between Location 9 and 10, on 26^{th} July Corridor
25	25WWN	On 26^{th} July Corridor, between Location 10 and 11
26	26WWN	On 26^{th} July Corridor, on the midway between Location 11 and 14
27	27WWN	On 26^{th} July Corridor, between Location 11 and 14, but closer to Location 14
28	28WWN	Between Location 12 and 14
29	29WWN	Between Location 12 and 13
30	30WWN	Between Location 16 and 17
31	31WWN	Between Location 15 and 16
32	32WWN	Close to 26^{th} July Corridor between Tersana Sporting Club, and Zamalek Sporting Club.
R1	19WW7	Cairo university underground station (during holidays for the university)
R2	20WW7	Front of Traffic head office of Al Agooza station (see maps)
R3	21 WW1	At Bolaq El Dakroor road toward option 3 end road (see map)
R4	22WW7	At mid point between the Sekket El Barageel and cross section of the circular road on the side

Note: *Key for Location ID; example 06 WW 7/N:*
06: location number, WW: West Wing, 7: measuring days, N: if used, only noise measurement
Source: JICA Study Team

(2) Air Quality Survey

At the selected survey locations, the following parameters were measured:

- NO, NO_2, NO_x, SO_2, CO, O_3, CH_4, NMHC, THC, TSP;
- PM_{10} and $PM_{2.5}$
- ambient air temperature;
- relative humidity;
- barometric pressure;
- wind direction;
- wind speed; and
- net radiation.

The measured concentrations of air pollutants have been compared with the Air Quality Standards of Egypt (Executive Regulations to Environmental Law No.4 of 1994), and the WHO standards (1999) for air quality. Table 3.7.2 presents the results and their comaprions with the Egyption and WHO standards. It is noted that the survey results carried out on Wednesdays and/or Tuesday are listed for this comparison analysis, because these are the busiest days in Cairo, and consquently have the heaviest air pollution in the week.

From the measured locations, 12 locations were measured for a 7 day period and 10 locations were measured for one day (a total of 94 measuring days in the Project Area of the Trunk Busway).

The following conclusions can be drawn from all the air quality measurements in the Project Area for the Trunk Busway:

- Fine dust (PM_{10}) levels exceed heavily and almost continuously the Egyptian standard (70 μg/m3) at all the measuring locations; the 24 hours average concentration of PM_{10} for all sites was 120 μg/m3.
- Carbon Monoxide (CO) and Ozone (O_3) levels regularly exceed the Egyptian and WHO standards at two locations; and
- Nitrogen Dioxide (NO_2) and Sulphur Dioxide (SO_2) concentration levels reached a considerable level in several locations, however, are still below the Egyptian and/or WHO standards

As seen above, the measured concentrations of PM_{10} appeared to be high. Generally, this type of very fine suspended particles consist of: coal and oil fly ash; metals and metal oxides; tire wear debris; street dust; and Carbon, Sulphate and Nitrate particles. The sources of particles of 10 μm or less (PM_{10}) are generally:

- Combustion of oil, diesel, gasoline, coal, and wood;
- Traffic, and industrial and agricultural operations;
- Construction and demolition operations; and
- Transformations from NO_x and SO_2.

Table 3.7.2 Summary Results Air Quality in the West Wing Corridor

Location (Survey Date)	**NO_2 Nitrogen Dioxide**		**SO_2 Sulphur Dioxide**			**CO Carbon Monoxide**			**PM_{10} Particulate Matter 10 µm**		**O_3 Ozone**	
	Measured	Egypt Standard	Meas'd	Egypt Standard	WHO Standard	Meas'd	Egypt Standard	WHO Standard	Meas'd	Egypt Standard	Meas'd	Egypt & WHO Standard
	(µg/m³)		(µg/m³)			(mg/m³)			(µg/m³)		(µg/m³)	
07WW7 (2/Apr/03)	41	150	23	150	125	3.0	10	10	**339**	70	66	120
09WW7 (2/Apr/03)	45	150	28	150	125	2.5	10	10	**715**	70	107	120
02WW7 (9/Apr/03)	55	150	24	150	125	4.3	10	10	**301**	70	78	120
05WW1 (9/Apr/03)	70	150	87	150	125	7.1	10	10	**177**	70	65	120
04WW7 (16/Apr/03)	38	150	15	150	125	3.5	10	10	**184**	70	111	120
12WW7 (16/Apr/03)	16	150	11	150	125	2.6	10	10	**90**	70	103	120
17WW7 (23/Apr/03)	25	150	31	150	125	3.3	10	10	**168**	70	68	120
01WW7 (23/Apr/03)	33	150	33	150	125	10.7	10	10	**359**	70	64	120
10WW7 (30/Apr/03)	39	150	17	150	125	-	-	-	**177**	70	**124**	120
14WW1 (30/Apr/03)	20	150	17	150	125	-	-	-	**105**	70	68	120
11WW7 (7/May/03)	18	150	9	150	125	-	-	-	**76**	70	**138**	120
19WW7 (16/Jul/03)	31	150	9	150	125	-	-	-	**90**	70	61	120
21WW7 (16/Jul/03)	64	150	18	150	125	-	-	-	**326**	70	44	120
22WW7 (23/Jul/03)	47	150	6	150	125	-	-	-	**135**	70	74	120

Notes : *24-hour average concentrations of air pollutants at survey locations; (Except CO, and O_3 is 8-Hour Averages)*
The shaded cell stands for the item exceeding the standard.

Source: *JICA Study Team, MB Consultants*

(3) Noise Level Survey

The following results came from the Noise Level measurements at 36 locations in the Project Area for the Trunk Busway. The survey results are tabulated in Table 3.7.3.

The Noise Levels stipulated by the Egyptian standards are:

- During the day (>55 dB);
- During the evening (>50 dB);
- During the night (>45 dB);

It should be noted that **the measured noise levels at all the locations exceed the Egyptian Standard** throughout days. No places satisfy the standard. Traffic produces noise that can cause considerable annoyance. It can interfere with daily life, such as work, sleep, study, communication and recreation. Long-term exposure to noise can generate undesirable physical and psychological effects. In calm environments, generally sound levels of 30 - 50 dB(A) are measured. Disruptive sounds have noise levels higher than about 70 dB(A).

Table 3.7.3 Summary of Noise Levels for All Sites, Trunk Busway

Egyptian Standard (Environment Law 4 , 1994) Maximum Permissible Noise Level (dB) in Residential Areas	Day	Evening	Night
	7 am – 6 pm	6 pm – 10 pm	10 pm – 7 am
	45 - 55 dB(A)	40 - 50 dB(A)	35 – 45 dB(A)
Survey Locations	Measured Noise Level (dB)		
Location 1	67.2	66.6	60.6
Location 2	77.0	76.4	72.6
Location 3	73.2	71.6	67.6
Location 4	67.8	67.9	65.2
Location 5	78.1	78.3	76.8
Location 6	72.0	70.2	70.6
Location 7	69.2	67.0	63.8
Location 8	70.0	69.1	69.6
Location 9	73.3	71.9	72.2
Location 10	79.9	79.3	78.8
Location 11	79.8	81.6	79.8
Location 12	60.9	62.9	58.9
Location 13	65.2	64.3	61.7
Location 14	64.7	66.6	62.9
Location 15	65.4	67.7	63.2
Location 16	68.1	65.8	62.1
Location 17	70.5	69.2	65.6
Location 18	64.1	58.0	58.0
Location 19	77.6	78.9	77.1
Location 20	69.4	70.1	70.2
Location 21	79.9	82.0	79.1
Location 22	66.6	65.9	62.6
Location 23	73.2	71.7	67.5
Location 24	80.1	79.9	78.2
Location 25	80.1	81.9	79.1
Location 26	80.2	78.6	78.6
Location 27	80.1	78.9	78.6
Location 28	65.0	65.8	66.7
Location 29	77.8	77.9	77.2
Location 30	70.5	68.6	64.3
Location 31	69.8	69.6	67.1
Location 32	77.9	78.1	75.3
Location R1	65.5	65.6	64.4
Location R2	73.0	72.0	68.9
Location R3	68.8	68.5	65.7
Location R4	64.8	65.5	64.3

Source: JICA Study Team

(4) Social Survey

As early discussed in Section 2.9.4, the Social Survey was carried out to assess the opinion of the residents in the Project Areas to the proposed and selected transport development projects.[1] Out of the results of this social survey, some notable findings can be summarized as follows, referring to Table 3.7.4 (detailed explanations are presented in Section 2.9.4):

- There is evidently agreement with the Projects, inclusive of the West Wing Busway Project.
- Most of the residents concerned would use the new transport system.
- The residents concerned regard the selected projects as highly positive for the physical, as well as for the socio-cultural environment.

As for Question 1, it is not a surprising result that the basic perception level on the Project is significantly low among residents, as only 39% of interviewees know the West Wing Project, because this project is a new idea proposed by the CREATS Master Plan. After this question, however, all interviewees were briefly informed of the Project, and then, next questions on their opinion were made. Therefore, their expectation and acceptance of the Project are based on their knowledge on the Project to some extent.

Table 3.7.4 Summary of Answers of Social Surveys Related to the Projects

Question	Answering Item	Supertram Project	West Wing Busway Project	East Wing Railway Project
1. Do you know about the planned Project ?	(1) Yes	27%	**39%**	59%
	(2) No	73%	**61%**	41%
2. What is your opinion about the Project ?	(1) Agree	97%	**89%**	92%
	(2) Not Agree	0%	**6%**	4%
	(3) Unknown	3%	**4%**	3%
3. Would you use the New Transport System?	(1) Frequently	42%	**65%**	73%
	(2) Not Frequently	9%	**14%**	8%
	(3) Occasionally	42%	**17%**	15%
	(4) No use	6%	**4%**	3%
4. How do you think about the Environmental Impact of the Project?	(1) Positive	97%	**83%**	92%
	(2) Negative	3%	**16%**	6%
	(3) Others	0%	**1%**	2%
5. How do you think about Scio-cultural Impact of the Project ?	(1) Positive	100%	**93%**	95%
	(2) Negative	0%	**6%**	4%
	(3) Others	0%	**1%**	1%

Source: JICA Study Team

[1] Full details of the Social Impact Assessment are referred to the "Social Opinion Survey, CREATS 2, Cairo October 2003" which was carried out by MB Consultants under a subcontract with JICA Study Team.

(5) Expected Negative Environmental Impacts from the West Wing Busway Project

Activities and processes, related to transport development projects, may result in significant negative as well as positive impacts on the environment. Potential adverse impacts on the physical/biological, as well as on the socio-cultural environment, have been identified for the West Wing Busway Project as summarized in Table 3.7.5. Although several negative impacts are anticipated in the process of the development, these environmental impacts are manageable, because:

Table 3.7.5 Expected Adverse Environmental Impacts from the West Wing Busway Project in the Pre-Construction, Construction and O & M Phases

PROJECT ACTIVITIES	EXPECTED ADVERSE IMPACTS *Socio-economic and physical/biological aspects*
Pre-construction/Design Phase - Survey and site investigations. - Land acquisition: area to be acquired for the "right of way". - Demolishing required for low income houses, shops, restaurants near Cairo University Station. - Resettlement.	**Pre-construction Phase** - Loss of land, houses, property, jobs, public facilities. - Impact on affected persons, households. - Fragmentation / split up of areas. - Impact on land use, aesthetics.
Construction Phase 1. Base camp establishment and operation 2. Land clearance 3. Earthworks/embankment fill: - excavation - haulage of fill and construction material - embankment spreading, levelling - compaction of embankment - shaping, finishing of embankment 4. Viaduct construction, 7 km on top of canal: - excavation works - foundation works - construction of piers - construction of beams - erection of beams and casting deck slabs 5. Drainage structures at canal 6. Pavement, asphalt plant in operation 7. Sign posting, road lighting, road marking, and traffic control	**Construction Phase** 1. Disposal of waste, waste spills (oil) 2. **see Pre-construction Phase** 3, 4, 5 Interruption of water flows, erosion/ sedimentation, change in groundwater level, air pollution, spills of waste, vibrations, noise, safety risks for workers, damage to existing roads, traffic congestion, disposal of earth material/spoils, impact on aesthetics 6. Impact of asphalt plant: air pollution, risk of spills
Operation & Maintenance Phase - Busses in operation - Maintenance and repairs of pavement - Maintenance and repairs of signposts, road lights etc. - Cleaning up of road debris - Maintenance of planted trees and grass	**Operation & Maintenance Phase** - Long term effects of increased air pollution and noise/vibrations on the health of affected persons (public health). - Risk of accidents (public health). - Runoff pollution.

Source: JICA Study Team

- The proposed project is a public transport project (versus projects promoting the use of private cars);
- Transportation by bus: less energy is consumed compared to the use of cars;
- The Project is situated in a city environment: there will be no impact on fragile ecology;
- The right of way is mainly owned by the government, and apart from the area near Cairo University Station, predominantly free of houses and other structures.
- The impacts can be mitigated.

(6) Expected Positive Impacts of the West Wing Busway Project

Often the existing transport situation is unsatisfactory in several aspects; this is the reason why transportation improvement projects are initiated and developed. Expected positive impacts after the project implementation for the proposed Busway Project are:

- Reduction of travel time for passengers
- Reduction of operation costs
- Increased economic development
- Improved mobility, facilitating the urban function of the city Increased safety

Further positive impacts expected from the proposed project on the social and physical environment are:

- A number of car users will start using the Trunk Busway *(less emission, less energy consumption);*
- There will be less air pollution compared to the situation of not carrying out the proposed public transport Project (*Zero Option*), especially when the busses are running on gas (*less emission, less energy consumption);*There will be no significant increase in noise levels;
- A more free flowing traffic pattern will be realized, resulting in a reduced number of accidents; and
- Safety for pedestrians will be increased by the construction of pedestrian bridges and underpasses.

(7) Recommended Mitigation Measures

Several negative impacts can be avoided or minimized when appropriate mitigation measures are incorporated in the Design, the Construction, and the Operation & Maintenance Phases of the Project.

It is emphasised that, particularly during the Pre-Construction/Design Phase, as many mitigation measures as possible should be incorporated to minimise adverse environmental impacts in the next project phases.

Table 3.7.6 presents the possible mitigation measures to minimise the identified negative impacts. All the measures should be well considered in the design stage of the Project.

Table 3.7.6 Mitigation Measures against Expected Adverse Impacts for the West Wing Busway Project

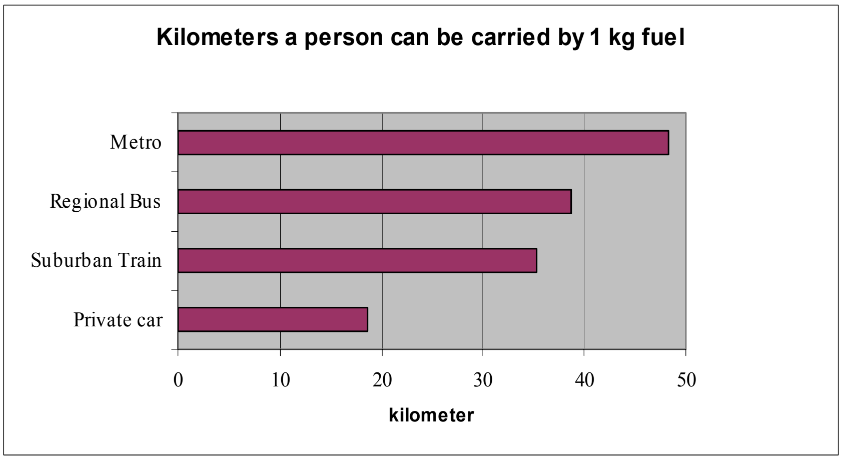
EXPECTED ADVERSE IMPACTS ***Socio-economic and physical/biological aspects***	**MITIGATION MEASURES**
Pre-construction Phase - **Loss of land, houses, property, public facilities, jobs.** - **Impact on affected persons, households.** - Fragmentation / split up of areas. - Impact on land use, aesthetics.	**Pre-construction Phase** - **Resettlement, compensation for lost land, houses, shops, restaurants, public facilities, and jobs (re-employment); development of social housing scheme.** - Proper selection of alignment (Option 3). - Proper design of roads, viaduct and intermodal station - Landscaping, planting trees. - Preparation of Environmental Management and Monitoring Plans and Transport Management Plan.
Construction Phase - Disposal of waste, waste spills (oil). - Interruption of water flows, erosion and sedimentation, change in groundwater level, air pollution, spills of waste, vibrations, noise, safety risks for workers, damage to existing roads, traffic congestion, disposal of earth material/spoils. - Impact of asphalt plant: air pollution, risk of spills. - Impact on aesthetics.	**Construction Phase** - Enforcement of laws and regulations. - Proper Environmental Management and Monitoring during all works. - Execution of Transport Management Plan. - Proper locating of asphalt plant. - Proper disposal of waste. - Proper drainage. - Safety precautions. - Planting of trees, landscaping, re-establishing situation.
Operation & Maintenance Phase - **Long term effects of increased air pollution** and noise/vibrations on the health of affected persons (public health). - Risk of accidents (public health). - Runoff pollution	**Operation & Maintenance Phase**. - Landscaping, trees, plantations. - Proper Operation & Maintenance and repairs. - Proper Environmental Management and Monitoring. - Safety precautions. - **Use of Compressed Natural Gas (CNG).** - Noise and engine control. - Strict enforcement of (environmental) laws and regulations.

Source: JICA Study Team

3.7.3 Environmental Implications of Zero Option (No project Option)

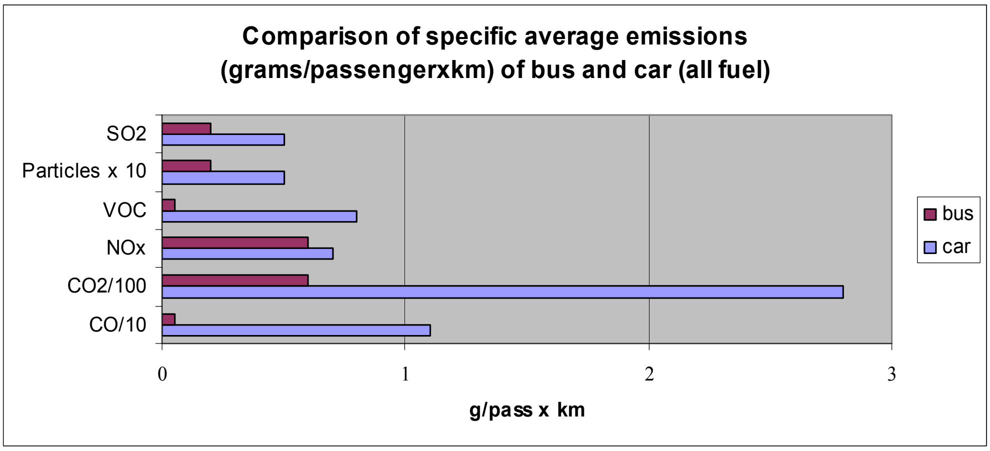
(1) Mitigation of Environmental Burden by Public Transport Systems

It is important to indicate what the environmental situation would be if the West Wing Busway Project would not be carried out. Should the Project not be implemented, the growing traffic demand will be shifted (at least partly) to users of private cars as a consequence. In order to respond to this issue, the same examination as made in Section 2.9.5, Chapter 2, is possible, referring to comparisons in fuel efficiency and the emissions among different transport modes, as shown in Figures 3.7.2 and 3.7.3. In particular, "regional bus" is about 2 times as efficient as private car in terms of fuel consumption, and discharges significantly less emission than car. It is evident that the extension of public transport (metro, bus and train) is the best choice to meet growing traffic demand from an environmental point of view. This is certainly the case in an area like Greater Cairo, where the burden of air pollution and noise is already high.



Source: International Association of Public Transport, Brussels, May 2001

Figure 3.7.2 Fuel Efficiency of Different Modes



Source: International Association of Public Transport, Brussels, May 2001

Figure 3.7.3 Comparison of Emissions from Cars and Busses

(2) A Quantitative Impact on A Global Issue of CO_2 Mitigation

A quantitative environmental impact on a global issue by the Project was examined in terms of deduction of CO_2 emission, based on the same analytical framework in Section 2.9.5 in Chapter 2

The total emission of CO2 in the Study Area was computed in both cases of "with" and "without the Project" (Further details are presented in Section 2.9.5). A summary of the results is shown in Table 3.7.7, where environmental impacts of the other projects are compared.

As seen in this table, the total CO_2 emission in the "Without" case accounts for approximately **16,624 thousand** tons/year in the whole GCR in 2022. Given the **West Wing Project**, the total CO_2 emission will account for **15,992 thousand** tons/ year, therefore, the difference of about **631.7 thousand** tons/year can be regarded as a reduction of CO_2 brought by introduction of the West Wing Project.

For comparisons with the other projects, the Supertram Project will reduce about 16,000 tons/year of CO2 in 2022, and the East Wing Project will also provide with a considerable reduction of CO_2 emission by around 42,000 tons/year in 2022. Thus, it is noted that the West Wing Busway Project will bring out the most largest impact on reduction of the CO_2 emission.

Such a positive environmental impact by the Project in terms of CO_2 reduction can be converted to the fuel energy consumption.[2] It is generally said that as one litter of gasoline generates **2.30 kg** of CO_2, the CO2 reduction of about 631,700 tons is equivalent to the reduction of about **274.7 million litters/year of gasoline**, or 1.63 million bbl./year.

Table 3.7.7 A Summary of Environmental Impact in CO_2 Emission

Case	CO_2 Emission in 2022 (tons/year)	Reduction of CO_2 Emission (tons/year)		
		East Wing	**West Wing**	Supertram 1
Without the Project (Committed Only)	16,623,904	-	-	-
With the East Wing	16,581,752	42,152	-	-
With the West Wing	15,992,197	-	**631,706**	-
With the Supertram Line 1	16,607,848	-	-	16,056

Source: JICA Study Team

[2] For another reference, it is said that one human being generates about 1.0kg CO2 per day, or approximately 0.36 ton per year.

3.7.4 Environmental Management and Monitoring

After assessing the environmental sensitivities, analyzing the potential impacts and their effects, and suggesting mitigation options, the following items present Environmental Management Measures for the West Wing Busway project. These measures should be considered as commitment actions to control the impacts on the environment and provide the framework for the future environmental management of the area in order to minimize the negative impacts of the Project activities during Construction and Operation & Maintenance phases.

Subjects for Environmental Management and Monitoring are particularly the Mitigation Measures that have been proposed. These measures should be carried out (environmental management) and it should be checked whether this is properly done. The following activities should be carried out by contractors and/or government agencies and be monitored by the appropriate authorities:

1. Inform MHUUC, Giza Governorate, local authorities and other operators in the region of the scheduled construction activities, location and route of the project, the exact starting date of execution and the environmental measures taken to avoid damages.
2. Plan the excavation/construction programs to optimize the required equipment and site installations. A base camp should be at least 200m from any residential areas. Reinstate used land to its original state by the end of the activities.
3. Optimize the layout of access roads.
4. Detailed design and layout of viaduct and bridge should be discussed and consulted with the concerned authorities and affected people. All materials will be chosen in such a way as to provide the greatest chance of operational success, and have the lowest practicable impact on the environment.
5. Make available on site, temporary waste disposal facilities and dispose of wastes from the site as much as possible. Burial on site is not suggested. The operating contractor would be required to provide indication of how, where, and when waste will be disposed.
6. Dispose of all scrap metal, plastic bottles, old drums, batteries and others in compliance with EEAA guidelines.
7. Set up an emergency/contingency plan at least 30 days before the start of the project operations. This plan should include any spills. Communicate the plan to the relevant authorities.
8. Keep pictorial and illustration records from before and after operations to monitor and control restoration of sites.
9. Prepare a checklist to drawn up as part of the Environmental Management Plan that will constitute Environmental Performance Indicators (EPI) to monitor the environmental performance of all parties involved in the project activities.

The following authorities should be responsible, each in it's own area of jurisdiction, for Environmental Monitoring of the project performance during the Construction Phase and the Operation and Maintenance Phase of the Trunk Busway Project:

- Ministry of Transportation and Communication;
- Ministry of Housing, Utilities and Urban Communities;
- Giza Governorate; and
- Egyptian Environmental Agency Affairs (EEAA).

3.7.5 Conclusions

The overall conclusions of the environmental studies for the West Wing Busway Project are:

- Major positive environmental impacts are expected.
- Minor negative environmental impacts are expected, which can be mitigated.
- The Project is sustainable and environmentally feasible.

3.8 ECONOMIC AND FINANCIAL ANALYSIS

3.8.1 Procedure of Economic and Financial Evaluation

An economic evaluation provides a useful criterion for the public sector to make a rational decision of allocation of its limited budget to a certain project from the viewpoint of the national economy as a whole. For an economic evaluation, various benefits which are expected to arise by the project and costs to be spent for the operation and maintenance as well as the implementation of the project are considered and calculated in an economic term on an annual basis within a project life to be defined (20~30 years), depending upon the nature of the project. The costs estimated at market prices are converted to the "economic costs" which denotes the project cost to the national economy, excluding transfer items and employing an opportunity cost concept for goods/services to be procured at a distorted market.

While, a financial evaluation shall provide useful implications for the project owner, including the public sector, to predict anticipated returns on the investment, thereby supporting him/her to make a rational decision on the investment of funds, or "do or not", compared to the "cost of money" at a financial market and the returns from other investment opportunities. Furthermore, the financial viability implies a vital indicator on how much the government sector needs to involve in the project through provision of government subsidies.

3.8.2 Major Premises

(1) A Conceptual Setting of "With and Without the Project"

The costs and benefits are calculated as differences between "with" and "without" the Project. The "with" case denotes a situation of how the transport conditions could be in the entire Study Area, given the Project. While, the "without" case does not stands for nothing happened on the current situation, but represents a situation of how the transport conditions would be in the entire Study Area, given only the committed projects completed as scheduled.

Table 3.8.1 shows a list of project components and their status to be considered in the transport network in the entire Study Area in the case of "without", while Table 3.8.2, in the case of "with the Project". It is noted that the time framework proposed hereby is based on the CREATS Master Plan.

Table 3.8.1 Projects Components and Their States in the "Without" Case

Major Components	Without		
	2007	2012	2022
Transport System Improvement in the Master Plan			
Bus Restructuring	As existing	As existing	As existing
Shared Taxi Franchising	As existing	As existing	As existing
Metro 1	Existing+ Committed	Existing+ Committed	Existing+ Committed
Metro 2	Existing+ Committed	Existing+ Committed	Existing+ Committed
Metro 3	Committed	Committed	Committed
Metro 4	None	None	None
Toll Expressway System	None	None	None
Local Roads Improvement	Existing+ Committed	Existing+ Committed	Existing+ Committed
Other Trams Rehabilitation	As existing	As existing	As existing
Focused Projects			
The Supertram 1 Project	None	None	None
The East Wing Project	None	None	None
The West Wing Project	None	None	None

Source: JICA Study calculations

Table 3.8.2 Projects Components and Their States in the "With" Case

Major Components	With the West Wing		
	2007	2012	2022
Transport System Improvement in the Master Plan			
Bus Restructuring	As existing	As existing	As existing
Shared Taxi Franchising	As existing	As existing	As existing
Metro 1	Existing+ Committed	Existing+ Committed	Existing+ Committed
Metro 2	Existing+ Committed	Existing+ Committed	Existing+ Committed
Metro 3	Committed	Committed	Committed
Metro 4	None	None	None
Toll Expressway System	None	None	None
Local Roads Improvement	Existing+ Committed	Existing+ Committed	Existing+ Committed
Other Trams Rehabilitation	As existing	As existing	As existing
Focused Projects			
The Supertram 1 Project	None	None	None
The East Wing Project	None	None	None
The West Wing Project	**As planned**	**As planned**	**As planned**

Source: JICA Study calculations

(2) Price Indices and Project Life

For the economic and financial evaluation, the following assumptions are held.

- Pricing data: as of 2003
- Foreign Exchanges: 1.00 US Dollar = 6.0LE
- Project Life: 27 years from 2004 through 2030.

(3) Investment Costs

The estimated project costs are summarized herewith for the economic and financial evaluation. The Project requires a total of approximately 507 million LE at 2003 prices for the initial investment cost. According to a planned construction schedule, this initial capital costs, including costs for bus way construction, stations and bus terminals, depot & workshop, bus fleets, land acquisition and engineering and administration are allocated in a time framework, as shown in Table 3.8.3. The construction will take 3 years including engineering services, and the operation service will start from 2007. Along with anticipated increasing passenger demands, additional investment, which will be necessary for procurement of bus fleets and expansion of the busway, accounts for about 591 million LE at 2003 prices, as shown in Table 3.8.4. This additional investment will be needed in around 5 years after the commencement of the Project.

Table 3.8.3 Initial Financial Investment Costs for the West Wing Project

(LE Million, at 2003 price)

Financial Cost	2004		2005		2006		Total		
	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Total
Bus Way	0.0	0.0	41.0	22.5	95.7	52.5	136.7	75.0	211.7
Intermediate Station (3 Stations)	0.0	0.0	3.9	1.7	5.9	2.6	9.8	4.3	14.1
Station Plaza	0.0	0.0	4.1	1.0	6.1	1.5	10.1	2.5	12.7
Bus Terminal (2 Terminated Stations)	0.0	0.0	9.4	5.6	14.1	8.4	23.5	14.1	37.6
Depot & Workshop	0.0	0.0	3.9	2.1	5.9	3.2	9.8	5.3	15.1
Buses	0.0	0.0	0.0	0.0	2.4	66.6	2.4	66.6	69.0
Land Acquisition	0.0	0.0	19.0	0.0	28.5	0.0	47.6	0.0	47.6
Engineering	1.0	8.8	1.0	8.8	1.3	11.7	3.3	29.4	32.6
Local Adm.	6.1	0.0	6.1	0.0	8.2	0.0	20.4	0.0	20.4
Contingency	0.7	0.9	8.8	4.2	16.8	14.7	26.4	19.7	46.1
Total Cost	**7.8**	**9.7**	**97.3**	**46.0**	**184.8**	**161.2**	**289.9**	**216.8**	**506.7**

Source: JICA Study calculations

Table 3.8.4 Additional Financial Investment for the West Wing Project

(LE Million, at 2003 price)

Financial Cost	2012		2015		2016		2017		Total		
	Local	Foreign	L	F	L	F	L	F	Local	Foreign	Total
Bus Way	-	-	-	-	71.2	30.5	166.0	71.1	237.2	101.5	338.7
Depot & Workshop	-	-	-	-	1.6	0.5	2.5	0.8	4.1	1.3	5.4
Buses	0.0	63.0	-	-	0.0	0.0	0.0	63.0	0.0	126.0	126.0
Land Acquisition	-	-	-	-	2.2	0.0	3.4	0.0	5.6	0.0	5.6
Engineering	0.5	4.5	1.0	8.9	1.0	8.9	1.3	11.9	3.8	34.3	38.1
Local Adm.	3.2	0.0	6.2	0.0	6.2	0.0	8.3	0.0	23.8	0.0	23.8
Contingency	0.4	6.8	0.7	0.9	8.2	4.0	18.1	14.7	27.4	26.3	53.7
Total Cost	**4.0**	**74.3**	**7.9**	**9.8**	**90.4**	**43.9**	**199.6**	**161.4**	**301.9**	**289.4**	**591.3**

Source: JICA Study calculations

(4) Residual Value

Residual values are appropriated in the last year of the project life, as some investment items have longer useful lives than the project life. Assets invested for the Project still have value till its useful life expires (See Table 3.8.5). Thus, the residual value is computed according to years left for the rest of useful life by each investment item, as shown in Table 3.8.6.

Table 3.8.5 Useful Life of Depreciation Assets of the West Wing Project

Assets	Years
Bus Way	50
Intermediate Station (3 Stations)	30
Station Plaza	50
Bus Terminal (2 Terminated Stations)	50
Depot & Workshop	30
Buses	10

Source: JICA Study calculations

(5) Reinvestment Cost

Reinvestment costs are appropriated for enlargement of the bus transport capacity to meet the passenger demand. This reinvestment will take place in 10 years after the operation starts. Table 3.8.6 shows a summary of such reinvestment costs as well as residual value of the initial investments as discussed above.

Table 3.8.6 Reinvestment and Residual Value for the West Wing Project

(LE Million, at 2003 prices)

Financial Cost	2016		2022		2026		2027		Residual Value	
	Local	Foreign	L	F	L	F	L	F	Local	Foreign
Bus Way									246.6	114.1
Intermediate Stations									2.0	0.9
Station Plaza									5.3	1.3
Bus Terminals									12.2	7.3
Depot & Workshop									4.3	1.8
Buses	2.4	66.6	0.0	63.0	2.4	66.6	0.0	63.0	1.4	96.7
Land									53.2	0.0
Engineering	0.6	5.0	0.5	4.5	0.6	5.0	0.5	4.5	4.4	39.4
Local Adm.	3.5	0.0	3.2	0.0	3.5	0.0	3.2	0.0	27.4	0.0
Contingency	0.6	7.2	0.4	6.8	0.6	7.2	0.4	6.8	35.7	26.1
Total Cost	**7.0**	**78.7**	**4.0**	**74.3**	**7.0**	**78.7**	**4.0**	**74.3**	**392.3**	**287.6**

Source: JICA Study calculations

(6) Operation and Maintenance Cost

The operation and maintenance costs for the bus service include two items: the maintenance cost for the busway infrastructure and the operation and maintenance cost for bus fleets, as shown in Table 3.8.7, taking into account the proposed organization for the West Wing busway service as discussed in the following Section 3.9.4.

Table 3.8.7 Operation and Maintenance Cost for the West Wing Project

(LE Million, at 2003 price)

Financial Cost	2007	2009	2012	2022
Annual Maintenance Cost of Busway	0.1	0.1	0.1	0.1
Annual O&M Cost of Buses	3.3	11.9	26.1	68.2
Total O&M Cost	3.4	12.1	26.2	68.3

Note: It was asssumed that O&M cost is common for economic and financial costs.
Source: JICA Study calculations

3.8.3 Economic Evaluation

The economic evaluation is carried out from a view of whether or not the investment for the West Wing Busway Project will be feasible in terms of the national economy, employing a cost-benefit analysis.

(1) A Special Note of "With" and "Without"

Economic benefits are calculated as differences between "With the Project" and "Without the Project". For the calculation of economic benefits, the situation of the "Without" case is defined identical to the "Do Nothing Scenario" as examined in the CREATS Master Plan. This scenario is not the same situation as the current condition, but depicts such a situation that all committed projects, including Metro Line 3, capacity enhancement of Metro Lines 1 and a number of flyover projects, have materialized in a planned time framework (see the CREATS Master Plan). ***Metro Line 3 is assumed to be operated in 2017. Thus, it should be noted that even the "Without the Project" case hold inclusion of the Metro Line 3 which is very influential to changes in the transport pattern.***

(2) Economic Costs

Economic costs of the Project includes the initial investment cost, additional investment cost, reinvestment cost and residual value cost. These economic costs were derived from the financial costs as described above, after adjusting transfer elements. In order to convert from financial costs to economic costs, conversion rates are assumed to be 81% for local currency items as well as 87% for foreign currency (or imported) items. taking into account the Egyptian taxation and labor market conditions (refer to Section 13.2.2, Volume 3, the CREATS Master Plan for the detailed methodology).

Economic Costs of Initial Investment

The converted economic costs for the initial investment are summarized in Table 3.8.8. The total economic cost is approximately 424 million LE, 55% of which, 235 million LE, is local and 45%, 189 million LE, is foreign currency portion. It is noted that the land acquisition cost is valuated zero at the economic cost, because the land to be acquired is inherently desert land, of which the opportunity value is none.

Economic Cost of Additional Investments

Additional investment cost was converted in the same manner and the result is summarized in Table 3.8.9.

Table 3.8.8 Economic Costs of Initial Investment for the West Wing Project

(LE Million, at 2003 prices)

Economic Cost	2004		2005		2006		Total		
	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Total
Bus Way	0.0	0.0	33.2	19.6	77.5	45.7	110.7	65.3	175.9
3 Intermediate Stations	0.0	0.0	3.2	1.5	4.8	2.2	8.0	3.7	11.7
Station Plaza	0.0	0.0	3.3	0.9	4.9	1.3	8.2	2.2	10.4
2 Bus Terminals	0.0	0.0	7.6	4.9	11.4	7.3	19.0	12.2	31.3
Depot & Workshop	0.0	0.0	3.2	1.8	4.8	2.8	7.9	4.6	12.5
Buses	0.0	0.0	0.0	0.0	1.9	57.9	1.9	57.9	59.9
Land Acquisition	0.0	0.0	15.4	0.0	23.1	0.0	38.5	0.0	38.5
Engineering	0.8	7.7	0.8	7.7	1.1	10.2	2.6	25.5	28.2
Local Adm.	5.0	0.0	5.0	0.0	6.6	0.0	16.5	0.0	16.5
Contingency	0.6	0.8	7.2	3.6	13.6	12.7	21.3	17.1	38.5
Total Cost	**6.3**	**8.4**	**78.8**	**40.0**	**149.7**	**140.2**	**234.8**	**188.6**	**423.5**

Notes: Land cost in economic prices is evaluated at zero. However, necessary costs for engineering, local administration and contingency are included.

Source: JICA Study Team Calculations

Table 3.8.9 Economic Cost of Additional Investment for the West Wing Project

(LE Million, at 2003 prices)

Economic Cost	2012		2015		2016		2017		Total		
	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Total
Bus Way	0.0	0.0	0.0	0.0	57.6	26.5	134.5	61.8	192.1	88.3	280.5
Depot & Workshop	0.0	0.0	0.0	0.0	1.3	0.5	2.0	0.7	3.3	1.1	4.5
Buses	0.0	54.8	0.0	0.0	0.0	0.0	0.0	54.8	0.0	109.6	109.6
Land Acquisition	0.0	0.0	0.0	0.0	1.8	0.0	2.7	0.0	4.5	0.0	4.5
Engineering	0.4	3.9	0.8	7.8	0.8	7.8	1.1	10.3	3.1	29.8	32.9
Local Adm.	2.6	0.0	5.0	0.0	5.0	0.0	6.7	0.0	19.3	0.0	19.3
Contingency	0.3	5.9	0.6	0.8	6.7	3.5	14.7	12.8	22.2	22.9	45.1
Total	**3.3**	**64.6**	**6.4**	**8.5**	**73.3**	**38.2**	**161.7**	**140.5**	**244.6**	**251.8**	**496.4**

Source: JICA Study Team Calculations

Economic Cost of Reinvestment and Residual Value

Reinvestment and residual value are also converted from the financial to the economic costs, the results of which are shown in Table 3.8.10. The economic residual value is appropriated in the last year of the project life as a negative investment.

Table 3.8.10 Economic Costs of Reinvestment and Residual Value

(LE Million, at 2003 prices)

Economic Cost	2016		2022		2026		2027		Residual Value	
	Local	Foreign	L	F	L	F	L	F	Local	Foreign
Bus Way	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	199.7	99.3
3 Intermediate Stations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.7
Station Plaza	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	1.1
2 Bus Terminals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.9	6.4
Depot & Workshop	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	1.6
Buses	1.9	57.9	0.0	54.8	1.9	57.9	0.0	54.8	1.2	84.1
Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.1	0.0
Engineering	0.4	4.3	0.4	3.9	0.4	4.3	0.4	3.9	3.7	32.9
Local Adm.	2.8	0.0	2.6	0.0	2.8	0.0	2.6	0.0	22.8	0.0
Contingency	0.5	6.2	0.3	5.9	0.5	6.2	0.3	5.9	29.0	22.6
Total	**5.7**	**68.5**	**3.3**	**64.6**	**5.7**	**68.5**	**3.3**	**64.6**	**318.6**	**248.7**

Source: JICA Study Team Calculations

(3) Economic Benefits

Economic benefits were estimated by comparing "*without the project*" in which the West Wing Project does not exist and "*with the project*" in which the West Wing Project exists and is utilized by residents in the Study area who select the new public transport service by diverting from their previous modes in the "*without the project*" case. Economic benefits by the implementation of the West Wing Project was estimated, based on this change in the residents' choice of transport modes.

Economic benefits in this economic analysis are assumed to be two: savings in time cost and maintenance & operation costs. Both benefits are considered as an additional surplus to the national economy to be accrued from the implementation of the Project. Time saving benefit is derived from the total travel time saving in the new transport network with the West Wing Project. Alike, the saving of operation and maintenance costs appear for the other transport modes in the new transport network with the West Wing Project, however, the operation and maintenance cost for the West Wing itself will newly be generated, and the increased costs are considered as "cost" to the national economy.

1) Time Saving Benefits

Time saving benefits generated by the introduction of the West Wing Project was calculated as a whole in terms of the reduced total travel time of all people in the Study Area. Passengers of this new bus service who are diverted from the other modes will obtain time saving benefits from their reduced travel time, and passengers who use the other transport modes will also obtain time saving benefits as far as the modes' travel speeds are improved, affected by the introduction of the West Wing Project. Thus, beneficiaries are not only those who diverted from existing vehicles such as buses, shared taxies and cars to the newly improved system, but also those who use the other transport modes, of which traffic conditions would be improved due to the introduction of the West Wing Project.

First, the time saving is estimated as difference between the "without project" and "with project" in terms of the total travel time which is spent to travel activities of residents in the Study Area. Then, the travel time saving is converted into the economic benefits in the national economy in monetary term, using unit economic time value by transport mode.

The Study Team adopted a conventional methodology for travel time saving estimation, based on a comprehensive transport network model approach. The methodology and the manner of computations were already explained in Item (3), Section 2.10.3 in Chapter 2. The same methodology was adopted for the estimation for the West Wing Project as well. For a computing convenience, the benefits are categorized into two groups: one is the benefit that public transport mode passengers will gain; and the other, that private transport modes such as motorcycle, car and taxi will gain.

The result of the computation of the time saving by mode, which be generated by the introduction of the West Wing Project, is tabulated as shown in Table 3.8.11.

Table 3.8.11 Time Saving by Transport Mode Generated by the West Wing Project

	2007			2012			2022		
	With	**Without**	**Saving**	**With**	**Without**	**Saving**	**With**	**Without**	**Saving**
Travel Time of Passengers by Public Transport Modes (*Million Passenger-hour/day*)									
CTA bus	0.908	0.906	-0.003	0.605	0.604	-0.002	0.701	0.699	-0.002
GCBC bus	0.189	0.194	0.005	0.156	0.216	0.060	0.077	0.077	-0.001
A/C bus	0.317	0.330	0.013	0.267	0.412	0.145	0.325	2.499	2.174
Ferry	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tram	0.176	0.174	-0.001	0.120	0.121	0.001	0.249	0.249	0.000
Metro	0.744	0.741	-0.003	1.127	1.122	-0.005	1.830	1.824	-0.006
ENR	0.103	0.104	0.000	0.131	0.132	0.001	0.181	0.180	0.000
Shared Taxi	1.940	1.942	0.002	2.833	2.891	0.058	3.873	4.231	0.359
Minibus CTA	0.244	0.243	-0.001	0.153	0.153	0.001	0.183	0.190	0.007
Mini Coop	0.049	0.050	0.001	0.024	0.023	0.000	0.049	0.050	0.001
West Wing	0.020	0.000	-0.020	0.104	0.000	-0.104	0.380	0.000	-0.380
Sub-total	**4.69**	**4.684**	**-0.007**	**5.52**	**5.674**	**0.155**	**7.848**	**9.999**	**2.152**
Travel Time of Passengers by Private Transport Modes (*Million vehicle-hour/day*)									
Motorcycle	0.099	0.099	0.000	0.169	0.170	0.001	0.598	0.609	0.011
Car	1.291	1.293	0.002	2.208	2.224	0.016	7.804	7.957	0.153
Taxi	0.585	0.586	0.001	1.000	1.008	0.008	3.536	3.605	0.069
Sub-total	**1.975**	**1.978**	**0.003**	**3.377**	**3.402**	**0.025**	**11.938**	**12.171**	**0.233**
Total	**6.665**	**6.662**	**-0.004**	**8.897**	**9.076**	**0.18**	**19.786**	**22.17**	**2.385**

Source: JICA Study Team

The time value to convert saved travel time into money term was estimated for the national economy. Table 3.8.12 shows the estimated time value by each mode user, which was computed, based on the income levels of different transport users as of the year 2001(refer to Section 13. 2, the CREATS Master Plan for the detailed methodology).

The hourly time value for public transport users is computed at 2.40 LE per person, while that of car users, 3.88 LE per person. The hourly time value per a car vehicle can be computed at 7.3 LE, by multiplying that of a car user by the average number of persons in one vehicle, 1.9. Along with the economic growth, the economic time value must inherently increase in the future. Hence, the future time values were estimated at a proportional rate to the GRDP per capita in Cairo.

Table 3.8.12 Time Value Estimates by Transport Mode

(1) Time Value of Public Transport Mode User (LE/hour/person)

Economic Prices	2001	2007	2012	2022
Time Value	2.4	2.6	3.1	4.1

(2) Time Value of Private Mode (LE per hour per vehicle)

Economic Prices	2001	2007	2012	2022
Motor Cycle (1.1)	4.3	4.8	5.6	7.4
Car (1.9)	7.3	8.3	9.7	12.9
Taxi (2.5)	9.7	10.9	12.7	17.0

Notes: The number in parentheses denotes the average number of persons in one vehicles, and that in taxi stands for the average passengers.
Source: JICA Study Team Calculations

The future time saving benefit to be generated by the introduction of the new West Wing Busway service can be computed by mode, simply multiplying the time values by travel time saving by mode at the annual basis. The sum of those of all transport modes is regarded as the time saving benefit of the West Wing Project. the result of which is shown in Table 3.8.13.

As seen in this table, a great amount of the time saving benefit is expected for passengers of "air-conditioned (A/C) bus" and "shared-taxi", because the travel time of passengers who divert from air-conditioned buses and shared taxi will be substantially reduced.

It is noted that in this calculation as seen in this table, the time saving of the West Wing passengers is presented negative. This is the logical result derived from this approach that the total time saving to be generated by the West Wing service is calculated as the summation of modal differences in travel time between the "*with*" and "*without*" cases. West Wing passengers, who divert from the other mode, have to additionally spend the designed travel time additionally for the new mode in the "*With*" case, while they take zero travel time in the "*Without*" case, therefore a negative balance appears in a comparison between both cases, looking at only the West Wing mode. The passengers' time saving, however, is counted in the other mode which would otherwise be used.

For example, suppose an A/C bus passenger takes 30 minuets from A-origin to B-destination in the "*without*" case. Here, no time can be spent for the West Wing service due to no existence. Given the Project, he/she would divert from the A/C bus to the West Wing service for the same A-B trip and spend 20 minutes for it, and no time for the A/C bus. In this case, his/her time saving is 10 minuets (= 30–20), in comparison between both cases.

This CREATS Model indicates a different manner of expressions of the time saving by mode in such a way that the time saving of the new transport mode accounts for a negative figure, - 20 minuets, in a comparison between the "*With*" and "*Without*" cases, and at the same time, the time saving of the A/C bus accounts for a positive figure, 30 minutes in comparison between both cases. Consequently, the time saving of the Project can be computed, summing up both the negative and positive numerical value, thereby resulting in 10 minutes (= -20+30). Thus, the result is the same.

Table 3.8.13 Time Saving Benefit by the West Wing Project

(Unit: Million LE, at 2003 prices)

Economic Cost	2007	2012	2022
Public Transport Passengers			
CTA bus Passengers	-2.6	-1.8	-2.7
GCBC bus Passengers	4.9	67.0	-1.3
A/C bus Passengers	12.7	162.7	1,273.0
Ferry Passengers	0.0	0.0	0.0
Tram Passengers	-1.4	1.2	0.3
Metro Passengers	-3.0	-5.7	-9.3
ENR Passengers	0.1	1.3	-0.1
Shared Taxi Passengers	1.9	65.2	539.4
Minibus CTA Passengers	-0.7	0.8	10.6
Mini Coop Passengers	1.1	-0.4	1.1
West Wing Passengers	-19.6	-116.4	-572.3
Sub-total	-6.6	173.9	1,238.7
Private Transport Modes			
Motorcycle	0.0	2.1	29.8
Car	6.1	56.6	723.2
Taxi	4.0	37.2	428.2
Sub-total	10.1	173.9	1,181.2
Total	**3.5**	**269.7**	**2,419.9**

Source: JICA Study Team

2) Cost Saving Benefit

Bus passengers and car users are likely to divert to the improved bus service. It results in a benefit in saving of vehicle operation costs to the national economy.

The operating costs of the private transport modes are calculated on vehicle-km basis by using the estimated unit vehicle operating cost (VOC) per vehicle-km by speed range. While, as for public transport modes, the operating costs are calculated on passenger-km basis, by multiplying the estimated unit operating cost per passenger-km by the passenger-km obtained as the traffic assignment results in the process of transport demand forecast. The detailed methodologies for the calculation have been mentioned in Section 13.2.4, Volume 3, the CREATS Master Plan.

a. Vehicle Operating Cost Estimate

The unit vehicle operating cost (VOC) by vehicle type was estimated, based on an analysis on the actual performance indicators collected from different transport operators such as CTA and Shared-taxi companies as well as automobile dealers. The following considerations were given to the estimation of VOC.

Representative Vehicles: Table 3.8.14 shows selected vehicle types and their representative vehicles for the estimation of the VOC.

Table 3.8.14 Vehicle Types and Representative Vehicles

Vehicle Type	Representative Vehicle
Private car (Sedan type)	Mitsubishi, 1300cc
Shared Taxi	Toyota, minibus (14 seats)
Pick-up	Nissan
Motorcycle	Jawa
Large Bus	Nasr
Minibus	Nasr
Light Truck	Mercedes (with loading capacity of 8 tons)
Medium Truck	Mercedes (with loading capacity of 15 tons)
Heavy Truck	Mercedes (with loading capacity of 20-22 tons)

Source: JICA Study Team

Vehicle Prices: The market prices of vehicle are obtained by interview to car dealers, trucking companies and CTA Operational Department. For converting from financial (market) prices to economic prices, information about the import duties and the sales tax are incorporated, and the portion of taxes are deducted. While the rates of import duties for imported vehicles are; private car: 55%, motorcycle: 20%, and others: 40%, those for imported chassis fitted with engines (for buses) are 30%. The rates of sales tax are 15% and 10% for private car and others, respectively.

Vehicle Performance Data: The information on vehicle performance in terms of vehicle life (years), vehicle annual kilometers, and vehicle annual operating hours were obtained through interviews to car dealers, trucking companies and CTA.

Tire Prices: The information of the market prices of tire, the tire life and the number of tire per vehicle is obtained by interviews to car dealers, trucking companies and CTA. For converting from financial (market) prices to economic prices, information about the import duties and the sales tax is incorporated, and the portion of taxes are deducted. While the rates of import duties and the rates of sales tax are commonly 20% and 10%, respectively, for each type of tire.

Fuel and Lubricants: For converting from financial (market) prices to economic prices, transfer costs such as tax and subsidy are redacted. Although neither sales tax nor subsidy are imposed on gasoline, some subsidy is given to diesel. CTA has some advantage at the market price of fuel. As for lubricants oil, there are two types: local made and imported. While no sales tax is charged for the local made one, sales tax is charged for the imported one. Since local made one is popular among users, the economic prices is assumed to be the same as financial prices.

Maintenance Spares: The percentages to vehicle price for maintenance spare per 1,000 km are set up based on the data which have been applied in the road transport study regarding other developing countries.

Maintenance Labor Hours and Labor Cost: The information of the maintenance labor hours and the unit labor cost is obtained by interviews with car dealers, trucking companies and CTA. For conversion from the market labor cost to the economic cost, the following were considered: 1) maintenance work for private cars and shared-taxies in Egypt is mostly carried out in private workshops which are available all around; 2) people working in these workshops are almost unskilled, compared with those working in workshops and garages of specialized transport and bus companies; and 3) for this reason, the economic maintenance cost of private cars and shared-taxi are lower than the financial cost.

Crew Cost: The information of the crew cost and crew size is obtained by interview to car dealers, trucking companies and CTA. The economic crew cost is assumed to be the same to the financial cost.

Depreciation: The share percentages of depreciation related to distance and time are estimated, based on the data which have been applied for road transport studies in other developing countries, because no data is available for Egypt.

b. Unit VOC by Speed Range

The unit VOC was examined in accordance with speed ranges. For this purpose, a study of HDM-VOC (version 4) regarding the unit VOC index by speed range is available, however, this is for the inter-city highway condition, not useful for this economic analysis. Therefore, the study of “Urban Transport Study in Bangkok, Thailand” is reviewed and referred for this analysis. Table 3.8.15 summarizes the result in terms of economic prices, and Table 3.8.16 summarizes the result of the unit operating cost per passenger-kilometer. The detailed explanations of the methodology and the computation process have been described in Section 13.2.4, Volume 3, the CREATS Master Plan.

Table 3.8.15 Unit VOC Indices by Speed Range for Private Transport Modes

(Unit: LE/Vehicle-km at 2003 Economic Prices)

Speed (km/h)	MC	Car	Taxi	Truck	Heavy TRK
S<5	0.2616	0.6498	0.6498	1.5505	2.4702
5<S<10	0.2616	0.6498	0.6498	1.5505	2.4702
10<S<15	0.2398	0.6306	0.6306	1.3955	2.3866
15<S<20	0.1962	0.5814	0.5814	1.1629	2.2101
20<S<25	0.1744	0.5301	0.5301	1.0466	2.0801
25<S<30	0.1744	0.4938	0.4938	0.9691	2.0058
30<S<35	0.1744	0.4638	0.4638	0.8916	1.9316
35<S<40	0.1744	0.4435	0.4435	0.8334	1.8851
40<S<45	0.1744	0.4329	0.4329	0.7947	1.8665
45<S	0.1744	0.4275	0.4275	0.7753	1.8573

Source: JICA Study Team Calculations

c. Unit Operation Cost of Public Transport Mode

Table 3.8.16 summarizes the result of the unit operating cost of public transport modes per passenger-kilometer. The detailed explanations of the methodology and the computation process have been described in Section 13.2.4, Volume 3, the CREATS Master Plan.

Table 3.8.16 Vehicle Operation Cost of Public Transport Mode

(Unit: LE/ passenger-km at 2003 Economic Prices)

Transport Mode	2007	2012	2022
CTA bus Passengers	0.0518	0.0518	0.0518
GCBC bus *1	0.0518	0.0518	0.0518
A/C bus *1	0.0518	0.0518	0.0518
Ferry boat	0.2196	0.2196	0.2196
Tram	0.3342	0.3342	0.3342
Metro	0.0531	0.0531	0.0531
ENR	0.0474	0.0474	0.0474
Shared Taxi	0.0708	0.0708	0.0708
Minibus CTA *2	0.0708	0.0708	0.0708
Mini Coop *2	0.0708	0.0708	0.0708

*Notes: *1: CTA cost was used; and *2: Shared taxi cost was used*
Source: JICA Study Team

d. Estimated Cost Saving Benefits

Under an assumption that the West Wing Busway service commences in 2007, the total cost saving benefits in economic prices were computed in 2007, 2012 and 2022, including cost savings of public transport (at the passenger-km basis) and private transport modes (at the VOC basis). The result is as shown in Table 3.8.17.

Table 3.8.17 Cost Saving Benefit of the West Wing Project

(Unit: Million LE, at 2003 prices)

Economic Cost	2007	2012	2022
Public Transport			
CTA bus Passengers	1.0	-1.7	-0.6
GCBC bus Passengers	4.0	12.9	-0.7
A/C bus Passengers	7.8	36.0	199.4
Ferry Passengers	0.0	0.0	0.0
Tram Passengers	-2.1	1.6	0.3
Metro Passengers	-2.3	-3.8	-5.0
ENR Passengers	0.1	0.8	0.0
Shared Taxi Passengers	6.2	16.4	32.5
Minibus CTA Passengers	-0.4	0.2	0.8
Mini Coop Passengers	0.5	-0.2	0.0
Sub-total	**14.8**	**62.2**	**226.8**
Private Transport Modes			
Motorcycle	0.4	2.7	9.0
Car	18.0	96.3	283.2
Taxi	8.2	43.9	128.5
Truck	-3.9	0.0	17.2
Heavy Truck	-2.0	-1.2	0.8
Sub-total	**20.8**	**141.8**	**438.6**
Total	**35.5**	**204.0**	**665.5**

Source: JICA Study Team Calculation

It should be noted that although a considerable amount of cost saving benefits can be expected to accrue from the West Wing Project in the entire Study Area as a whole, no cost saving for the West Wing is counted in this table. As mentioned earlier, the newly introduced transport mode itself requires its operation and maintenance costs, therefore, no savings appear on it. Such costs are regarded as the cost of the Project in terms of "Operation and Maintenance Cost" in the economic evaluation procedure.

(4) Cost-Benefit Analysis

A cost-benefit analysis was made, based on all properties as derived from the above discussions. The analysis yields economic evaluation indicators such as EIRR (Economic Internal Rate of Return), NPV (Net Present Value) and B/C (Benefit-cost Ratio). It is assumed that the social discount rate in the Egyptian economy is 12% p.a. An economically feasible project should satisfy the following conditions:

- EIRR > the social discount rate (12%)
- NPV = positive
- B/C > 1.0

A summary of the computed evaluation indices is shown in Table 3.8.18, and the annual balance sheet of economic costs and benefits is depicted in Table 3.8.19.

Table 3.8.18 A Summary of Economic Evaluation of the West Wing Busway Project

Indicators	Evaluation
Economic Internal Rate of Return (EIRR)	48.9%
Net Present Value (NPV) * at mid-2003 prices	LE 5,243 million
Benefit/Cost (B/C) Ratio *	9.6

*Notes: * at 12% discount rate.*

The EIRR accounts for as high as **48.9%**, which is significantly higher than the social discount rate of 12%. As the result, the NPV accounts for **5,243 million LE**, and the B/C ratio is **9.6,** given a 12% discount rare. All the evaluated values are extremely high as expected [3], and this advocates that the Project will bring a remarkable amount of economic benefits to the national economy as a whole. It can be assessed that the Project is economically feasible, or worth being implemented from the national economic point of view.

(5) Economic Evaluation

Based on the cost benefit analysis, it is concluded that the West Wing Project will be economically feasible. Such a low cost solution in provision of the comfortable bus services yields tremendous economic returns over the investment. Therefore, the issue does not lie on the economic viability, but on how to implement this project to meet the increasing demands and make it financially sustainable. The financial issue is examined in the following section.

[3] The exclusive busway project is likely to indicate a high economic internal rate of returns (EIRR), because such a project is recognized as a low cost solution to improve public transport system with high speed and less impact on the existing road traffic congestion, as far as the exclusive dedicated bus lanes are provided. For instance, the EIRR of the similar trunk busway project in Bogota City, in Colombia, accounted for as high as more or less 40~60%, depending upon the routes.

Table 3.8.19 Economic Analysis for the West Wing Busway Project

EIRR= 48.9% **NPV= 5,243** **B/C= 9.6**

(Million LE, at 200 prices)

Year	Investment Cost	O&M Cost	Cost Total	Time Saving	Cost Saving	Benefit Total	Net Benefit	NPV (2003)
	(a)	(b)	(c) = (a)+(b)	(d)	(e)	(f)=(d)+(e)	(g)=(f)-(c)	(h)
2004	14.7	0.0	14.7	0.0	0.0	0.0	-14.7	-13.1
2005	118.8	0.0	118.8	0.0	0.0	0.0	-118.8	-94.7
2006	289.9	0.0	289.9	0.0	0.0	0.0	-289.9	-206.4
2007	0.0	3.4	3.4	3.5	35.5	39.0	35.6	22.6
2008	0.0	7.7	7.7	56.7	69.2	125.9	118.2	67.1
2009	0.0	12.1	12.1	110.0	102.9	212.9	200.8	101.7
2010	0.0	16.8	16.8	163.2	136.6	299.8	283.0	128.0
2011	0.0	21.5	21.5	216.4	170.3	386.7	365.2	147.5
2012	67.9	26.2	94.1	269.7	204.0	473.7	379.6	136.9
2013	0.0	30.4	30.4	484.7	250.2	734.8	704.4	226.8
2014	0.0	34.7	34.7	699.7	296.3	996.0	961.4	276.4
2015	14.9	38.9	53.8	914.7	342.5	1,257.2	1,203.4	308.9
2016	185.6	43.1	228.7	1,129.8	388.6	1,518.4	1,289.6	295.6
2017	302.1	47.3	349.4	1,344.8	434.7	1,779.5	1,430.1	292.6
2018	0.0	51.5	51.5	1,559.8	480.9	2,040.7	1,989.2	363.4
2019	0.0	55.7	55.7	1,774.8	527.0	2,301.9	2,246.2	366.4
2020	0.0	59.9	59.9	1,989.8	573.2	2,563.0	2,503.1	364.6
2021	0.0	64.1	64.1	2,204.9	619.3	2,824.2	2,760.1	358.9
2022	67.9	68.3	136.2	2,419.9	665.5	3,085.4	2,949.2	342.4
2023	0.0	68.3	68.3	2,419.9	665.5	3,085.4	3,017.1	312.8
2024	0.0	68.3	68.3	2,419.9	665.5	3,085.4	3,017.1	279.3
2025	0.0	68.3	68.3	2,419.9	665.5	3,085.4	3,017.1	249.3
2026	74.2	68.3	142.5	2,419.9	665.5	3,085.4	2,942.9	217.1
2027	67.9	68.3	136.2	2,419.9	665.5	3,085.4	2,949.2	194.3
2028	0.0	68.3	68.3	2,419.9	665.5	3,085.4	3,017.1	177.5
2029	0.0	68.3	68.3	2,419.9	665.5	3,085.4	3,017.1	158.5
2030	-567.3	68.3	-499.0	2,419.9	665.5	3,085.4	3,584.4	168.1
Total	636.6	1,127.7	1,764.3	34,701.4	10,620.7	45,322.1	43,557.7	5,242.5

Note: Year 2003 price

Source: JICA Study Team Calculation

3.8.4 Financial Evaluation

The West Wing Busway Project was evaluated from the financial viewpoint. The following are a summary of the findings.

(1) Assumptions

A number of assumptions are employed for the financial analysis as follows:

- The financial costs are estimated at mid-2003 constant prices, as shown in Section 3.8.2;
- The estimated financial capital costs are allocated in the scheduled time framework up to the year 2022 in such a way that the new bus service will be operated in 2007 and will generate the operating revenues from 2007;
- The evaluation period is assumed to be the period between 2004 and 2030, and the depreciation of depreciable assets are appropriated with a straight line method under an assumed useful life by asset and the residual value of the invested capitals is considered in 2030 as a negative cost.
- For the operating revenue, a distance-based fare system (a base fare plus distance-based charge) is adopted, that is: a 0.94 LE base fare plus an additional 0.04 LE per distance (km) in year 2007; a 1.11 LE base fare plus an additional 0.06 LE/km in 2012; and a 1.50 LE base fare plus an additional 0.08 LE per distance in 2022, as seen in Table 3.8.20. For instance, as the distance between the Cairo University Station and the 6th of October Terminal is about 38 km, the fare is computed at 2.46 LE in 2007. The current CTA bus fare is 0.5 ~1.0 LE for this distance, while the air-conditioned bus fare, 2.0~2.5 LE. Compared to them, the assumed fare level of the West Wing bus service is almost equivalent to the air-conditioned bus.

Table 3.8.20 Assumed Fare Level for the West Wing Busway Service

	2007	2012	2022
Base Fare (LE)	0.94	1.11	1.50
Distance-based (LE/km)	0.04	0.06	0.08
An Example Fare (LE): Cairo University Station ~ 6th of October Bus Station (38km)	2.46	3.39	4.54

Source: JICA Study Team Calculation

- Additional incomes accruing from ancillary sources related to the bus service operation, such as advertisement charges, are considered to be 6% of the operating revenue, taking into account experiences being performed in other countries.

(2) Evaluation Indicators for Financial Feasibility

The Project will be financially evaluated in terms of the following three indices:

- FIRR (Financial Internal Rate of Return)
- The first year when the Project generates a positive annual operating profit;
- The first year when the annual net profit becomes positive (after reduction of interest and depreciation); and
- The year when the accumulated net profit becomes positive.

The FIRR is an indicator to judge the financial robustness of the Project. Given a higher FIRR than any interest rate of a commercial loan, the Project could be financially viable. In other words, the investment capital for the Project, which is procured through a commercial bank, will be able to yield a higher rate of return than the interest rate of the loan. A higher FIRR is favorable, however, it is not necessarily the case, depending upon the availability of loans with a lower interest rate. Thus, the FIRR implies a feasible level of financial costs of the investment capital to be procured through some financial institutions.

Another important judgment from this analysis is whether or not the Project will have a risk for the bankruptcy, or how much risky the investment for the Project is against a complete loss. This will be examined by identifying some indicators in projected financial statements, that is, 1) how many years will take for the Project to generate a positive profit at annual basis?; 2) how many years will take till the annual net profit becomes positive?; and 3) how many years will take till the accumulated net profit will be positive? Needless to say, the Project is expected to yield a positive net profit within an acceptable timeframe, even if some losses annually take place in the initial stage.

(3) Summary Result of the Financial Analysis

The results of the financial analysis are summarized in Table 3.8.21. The FIRR for the West Wing Busway Project is computed at as high as **22.3%**, which implies that the Project will be very viable from the financial point of view, or that the Project is robust enough against any financial scheme.

Looking at the financial state in the long-term, a positive operating profit at an annual basis, even after reduction of the interest and depreciation, will occur in the year 2008, or in the second year after the operation. The accumulated net profit will be positive in the next year, 2009. Thus, the Project is expected to generate sufficient profits to recover the investment in the short-term.

Table 3.8.21 A Summary of Financial Analysis for the West Wing Project

Evaluation Indices	Result
FIRR (Financial Internal Rate of Return)	22.3%
The First Year of Positive Operation Profit at Annual Basis	Year 2008
The First Year of Positive Net Profit at Annual Basis (after Interest and Depreciation)	Year 2008
The First Year of Positive Accumulated Net Profit	Year 2009

3.9 IMPLEMENTATION PLAN

3.9.1 A Recommended Implementation Scheme

It was assessed that the West Wing Project would be economically feasible and financially feasible as well. Moreover, the financial indicators are all assessed to be considerably robust against any local financial scheme. This implies that there exist freedom to explore some types of the funding and implementing mechanism. In this regard, three alternatives are generally conceivable as follows:

(1) Alternative 1 (Government-Initiative):

The government sector shall take full responsibilities for the construction and the operation. This option is rational, because the Project itself is economically feasible. Even under the currently serious resource constraints, the government investment will be soon recovered financially and yield a considerable amount of profit. A constraint, however, will take place in the operation and management of the bus services, because the government sector has no experiences, as required, in operating such modern technologies. Ministry of Housing, Urban Utilities and New Communities may take a responsibility for the construction of the infrastructures including the busway and the stations/terminals, however, it does not have the operating function in its administrative structure. Therefore, it is a practical issue how to organize the operating entity.

(2) Alternative 2 (Privatization):

Since a considerably high rate of financial return can be expected through the Project, a scheme of private sector's participation may be one of the realistic options. The BOT (Build, Operation and Transfer) mechanism is a possible option in this context under a well-planned concession scheme. However, it should be noted that a BOT scheme is not necessarily recommended for this Project, for the following reasons: (1) the private sector will be unlikely to take a financial risk on the investments constantly required over the long-term; (2) the fund raising capacity for the infrastructure construction by the private sector is subject to economic fluctuation, therefore, the private sector is unlikely to guarantee a scheduled construction and operation; and (3) it will normally take a long time to reach an agreement between both the government and private sectors, thereby being likely to loose the otherwise-would-be-benefits.

(3) Alternative 3 (Public-Private Partnership):

A sort of Public-Private Partnership (PPP) mechanism shall be pursued. This option is flexible and applicable for the West Wing Project. The government sector, or Ministry of Housing, Urban Utilities and New Communities, assumes a responsibility for the infrastructure development, and properly owns it, while a private company or a joint venture company with the public and private sectors, shall assume the responsibility for operations and maintenance including procurement of bus fleets, leasing the infrastructure from the owner, who is the government under a concessionaire agreement. The government may recover the investment cost by the concession fee to be levied from the operator. This mechanism reinforces both weaknesses, and integrate both strengths of the public and private sectors. This mechanism, as conceptually illustrated on Table 3.9.1, is suitable for such a project as requiring a considerable amount of the investment and sophisticated technologies for the operation and management.

Table 3.9.1 A Proposed Framework of Public-Private Partnership Scheme

	The Infrastructure Owner (The Government Sector)	**The Operator** (A Private or Joint Entity)
Investment	Provision of capital investments and construction of the infrastructures	Procurement of bus fleets and related facilities and equipment
Tasks & Roles	1) Issuing a Concessionaire for use of the infrastructures 2) Issuing a business operation license with a definite set of rules and regulations 3) Monitoring the operation and the management	1) Assuring a proper operation and services 2) Strengthening the human capacity 3) Generating operational revenues 4) Maintaining the Total System, including the infrasrtructures
Obligations	Recovering the investment with the levied Concession Fees in the long-term	Paying the Concession Fees at an agreed rate of the operating revenue
Accountability	To the public	To the Infrastructure Owner as well as the public
Access to Funds	• Government subsidy • International donor agencies	• International donor agencies • Local financing institutions and commercial banks

Source: JICA Study Team

3.9.2 A Cash Flown Analysis of the Public Private Partnership Model

The Study Team recommends "Alternative 3" as discussed above, to implement the West Wing Project. Under a conceptual mechanism of Public-Private Partnership (PPP), a cash flow analysis was made to evaluate its overall profitability and implementability.

(1) Assumptions for A Business Model

For the business model, two organizations are supposed, namely, the government (the infrastructure owner) and the operator (an operating company), and the following conditions are assumed:

- The government sector, or Ministry of Housing, Urban Utilities and New Communities, is to be the implementing body of the Project, and invests for the infrastructure facilities. The cost of the foreign currency portion shall be procured through an ODA soft loan scheme, while that for the local portion shall be raised internally as a subsidy. Conditions of the ODA soft loan are assumed to be: 3% interest rate; 7 years grace period and 25 years repayment period.

- The operating company is proposed to be "the West Wing Busway Company (WWBC)" to be arrayed under the commercialized CTA as proposed in the CTA Restructuring Program in Volume III. WWBC can be organized in a joint venture form with the private sector's participation. WWBC shall maintain the whole infrastructure facilities and operate the express bus service, procuring a necessary number of bus fleets.
- WWBC can have access to an international soft loan equivalent to the amount of the foreign currency portion necessary for the procurement of bus fleets and equipment. WWBC can also obtain a long-term loan at commercial bank at a 10% interest rate for procurement of local materials, and short-term loans (one year) at a 13% interest rate to fulfil annual financial shortfalls, if necessary.
- It is assumed that the equity of the operating company, or the initial capital, shall be raised at 20% of the initial investment. The remaining necessary funds be covered by loans as mentioned above. Needless to say, the gearing ration (the equity against the total investment) is a crucial factor affecting the financial conditions of the company in the start-up period. The assumed rate of 20% seems rational as a normal business entity.
- It is assumed that WWBC shall operate the bus service, receiving daily fare revenues from passengers and sales revenues from some sorts of commercial business such as advertisement and kiosks, while costing repayments of the loans, depreciations of capital assets, current operating expenses and a concession fee which should be paid to the infrastructure owner for its use. Taking into account experiences in the other countries, such commercial business revenues may be assumed to be 6% of the operating revenue.
- A rate of the concession fee that the operator shall pay the infrastructure owner is assumed to be initially 5% of the operation revenue as a base case, then an appropriate level is examined in a range between 5% to 50% so that both parties' financial situations are not worse off.
- Receiving the concession fees, the government sector, as the infrastructure owner, may earmark them to recover the initial investment cost in the long-term.

(2) Results of the Cash Flow Analysis

Based on the above assumptions, a cash flow analysis was made for both entities. The evaluation criteria are as follows:

For the Operator:

- **FIRR** (Financial Internal Rate of Return) to assess the financial feasibility on the operator's investment; and

- **ROE** (Return on Equity)[4] :to measure the profitability of the equity initially raised by investor(s), in terms of a percentage of returns on the initial investments.

For the Infrastructure Owner:

- **Accumulated Subsidy** to measure the amount of the subsidies that the Government provides for the infrastructure development;
- **Average Annual Subsidy** to assess the magnitude of the average annual subsidy which is shouldered by the Government;
- **Accumulated Net Profit** in 2030 to assess the financial balance between accumulated profits (equivalent to the collected concession fees) and the subsidies in the end of the project life, 2030.

The results are summarized as shown in Table 3.9.2, and the following are major findings derived from this analysis:

- Given a 5% concession fee level, the Operator will obtain as high as 58% of FIRR and 115% of ROE (Return on Equity). On the other hand, the Infrastructure Owner (the Government) needs to provide a total of 656 million LE, and will be able to gain an accumulated net profit of 239 million LE in 2030. Thus, since this situation is too favorable to the Operator, a higher concession fee rate can be imposed.
- Should the concession fee rate be 50% of the operation revenue, the Operator can still enjoy a 37.6% FIRR and a 64.8% ROE, while the Infrastructure Owner will provide a total of 206 million LE, and can gain a net profit of as much as 4,616 million LE in 2030. In conclusion, a scheme with a 50% concession fee rate will be feasible for both parties to manage the Project.

Table 3.9.2 A Summary of Cash Flow Analysis for the PPP Business Model

(Million LE, at 2003 Prices)

Condition	**The Operation Company**		**The Infrastructure Owner (the Government)**		
	FIRR (%)	ROE [2] (%)	Accumulated Subsidy (Million LE)	Average Annual Subsidy (Million LE)	Accumulated Net Profit **in 2030** (Million LE)
Base (CF [1] = 5%)	58.1	114.9	656	47	239
Case of CF=50%	37.6	64.8	206	15	4,616

Notes: 1. "CF" stands for the rate of Concession Fee to the operation revenue.
2. "ROE": Return on Equity
Source: JICA Study Team calculations

[4] **ROE:** A measure of how well a company used reinvested earnings to generate additional earnings. It is used as a general indication of the company's efficiency; in other words, **how much profit it is able to generate given the resources provided by its stockholders. Investors usually look for companies with returns on equity that are higher and growing more than any interest rate of deposits at commercial banks**. For this analysis, ROE is computed as a percentage of the average annual returns on the initial investments during the period of the project life.

3.9.3 Recommendations on the Implementation

As a business model of Public-Private Partnership, the unique scheme was examined, that is, two entities of the infrastructure owner and the operator shall come into the same business ground and integrally play supplemental roles to make the Project successful. The result of the cash flow analysis revealed that the scheme with 50% of the concession fee rate would enable both parties to manage the Project in such a way that both parties will be able to satisfy their own objectives: the operator will enjoy a sufficient level of profits, while the government will recover the vested subsidy in the long run, providing public transport services for the people.

Therefore, it is recommended that this scheme should materialize in consideration of the following aspects:

1. The external financial resource mobilization is not necessarily essential for the Project, because the Project is financially robust enough against even local funding schemes. However, as proven by the business model analysis, the use of some international donor resources will make this project more implementable and practical. Along with this context, technical resources are expected to be introduced from some experienced institutions to properly manage such new technologies for the service operation.
2. Based on this economic evaluation result, the government's definite decision for initiating the Project should be made in the line with the government policy to facilitate the new community development. Since some successful models of the similar project are already available in Bogota City (Colombia), it is recommended that relevant officials study such advanced examples for their prompt decision-making.
3. Under the recommended Public-Private Partnership, the capable operator, say, the West Wing Busway Company needs to be organized with an institutional structure as discussed in the following section, 3.9.4. For this purpose, the private sector can be invited to take part in this business area through a concessionaire bidding process, because the financial profitability of this business will be assured. However, it is recommended as a possible and rational option that CTA shall establish the operating company under a restructuring scheme towards the commercialization, which has been fully discussed in Chapter 5, Volume III. This will provide with a practical opportunity to reform the CTA itself.

3.9.4 West Wing Busway Company Organization

(1) Organization Alternatives for the West Wing Busway Company

It is recommended that the West Wing Busway Company is established as an independent bus service company as a concessionaire to use the West Wing trunk busway facility which Ministry of Housing, Urban Utilities and New Community is to construct, then transfer its ownership to the Giza Governorate. Thus, the company is the exclusive operator for the West Wing bus service, having its bus fleets and relevant facilities and equipment. The entire responsibility for maintaining the infrastructure and bus terminals/stops is assumed by the operating company. The operating company shall be managed on a commercial basis with a profit-oriented and efficiency-driven management system, being assured freedom in managerial resource utilization and deregulated in operational activities.

Two alternatives are conceivable for organizing such an operating company, namely, a CTA affiliated entity, or a pure private company to be selected under an international bidding process.

1) The CTA Affiliated Entity

As discussed in Chapter 5, Volume III, the CTA is recommended to be converted to a holding company under which a number of affiliated companies are organized. Under the umbrella of the CTA Holding Company, the West Wing Busway Company may be established as a new organization that should be more functionally and efficiently managed on a commercial basis. To this end, it should pursue a joint venture with private investors, although the majority of the shares will be kept by the CTA holding company.

This option has a few advantages for the operating side. Firstly, CTA has a long experience in operating bus services with a number of experienced drivers and staffs. Given well training opportunities for them to assure the capacity building necessary for such a new bus service, they will be the core staff for the new company. Secondly, this labor replacement program will be effective to mitigate the overstaffed condition chronically held by CTA. Thirdly, at the initial stage, the existing supporting facilities owned by CTA could be utilized for the provision of such bus services. This may avoid a front-heavy investment scheme, which would otherwise require massive capital investment in the initial set-up and worsen the cash-flow of the company.

Nevertheless, this option has a weakness, in that the new organization will somewhat adopt the previous traditional bureaucratic inefficiency in management. A key is whether or not an innovative management system can be adopted.

2) A Private Entity

Through an international bidding process, the private sector will be given a chance to explore this bus service business as a concessionaire. Both international and local investors may offer their own proposals on how to manage the operating company, bringing their own management know-how and modernized technologies and systems for the operation. For this privatization scheme, the government needs to deregulate the public bus service in such a way that the private sector can pursue the commercial operation though the market mechanism.

Either option is possible. However, the facilitation of the CTA restructuring process is a necessary condition for selection of the former option, or the CTA affiliated company.

(2) Organization Strategy

This section presents an organization for the Busway operator. The organization is proposed according to the selected technical options and the anticipated ridership for the period between 2007-2012 and year 2022. The principal management system is based on the following:

- The organization will not be in charge of the design, construction of the project, but will function as an operating entity of the West Wing Busway service;
- The staff organization will be in charge of the operation, the maintenance and the management of the system;
- The general operating principles will be centralized control of all the different tasks, and
- The recommended general organization for the operation and maintenance of the busway is similar to bus system organizations used throughout the world, regardless of its characteristics as a private or public entity.

The staffing of each department has been adjusted according to the selected technical and operational options and based on an optimal commercialized operation system. Labor efficiency, however, is considered for the local conditions to some extent, in particular for operation and maintenance work.

(3) Organizational Structure

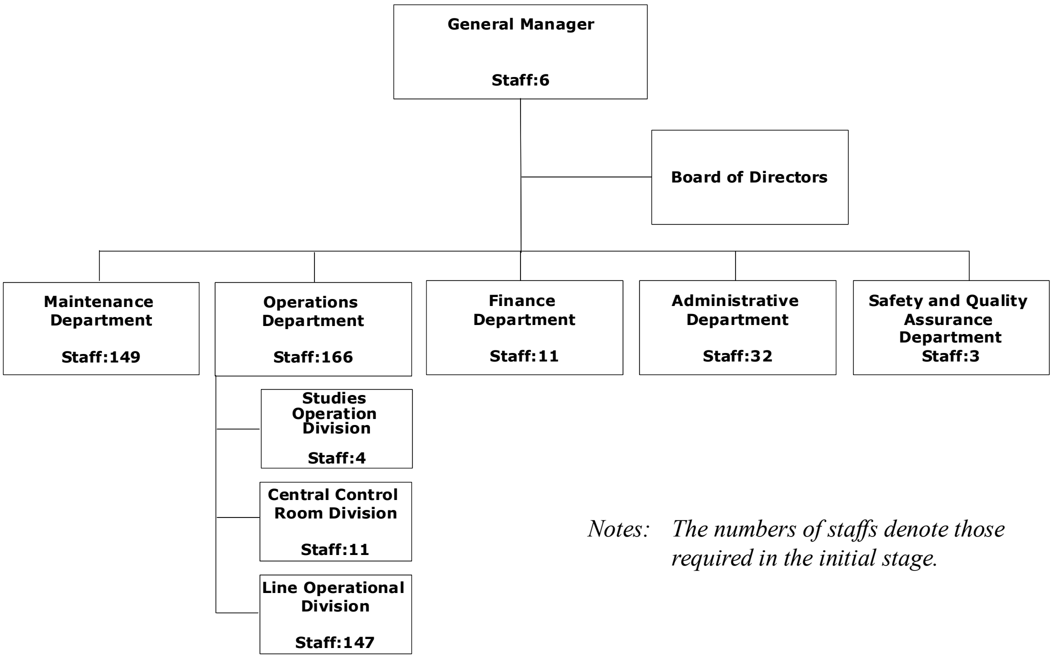
The proposed West Wing Company Organization is structured with five departments under a general management unit as shown in Figure 3.9.1. The Board of Directors shall assume comprehensive management responsibilities. The functions and responsibilities of each department are described as follows:

1) Board of Directors

The functions and responsibilities of the board of directors normally include the following:

- The annual budget.
- The monthly and annual management and financial report.
- The basic functional and operations policies.

- The right to hire and to approve the General Manager.
- The right to approve the persons selected to head the finance department.



Source: JICA Study Team

Figure 3.9.1 West Wing Company Organizational Structure

2) General Manager (GM)

The busway company will be under the responsibility of a General Manager, supervised by the Board of Directors, who will be responsible for the management of all activities. It will be the General Manager's responsibility to define goals and policies for the system and to oversee their implementation. The GM will review the budget and will control major expenditures, being involved in any negotiations with the city or with manufacturers and subcontractors. The GM will have under his/her responsibility four main departments:

- Maintenance Department.
- Operation Department.
- Finance Department.
- Administrative Department.
- Safety and Quality Assurance Department.

3) Maintenance Department

Maintenance Department will be supervised by a Maintenance Manager and will include three main functional units: Bus fleets; Stations/terminals and civil work; and Computerized systems.

4) Operation Department

Operation Department will be supervised by an Operation Manager, and responsible for operating the busway system. It will consist of three main functional units:

- Studies Operation Division;
- The Central Control Room Division; and
- The Line Operational Division.

Studies Operation Division: This Division will carry out studies concerning operation methods. This will include studies on various equipments such as bus, station, fare and ticketing equipment in order to prepare, in co-ordination with the training group, possible regulation modifications. It will also determine the bus tim-table and staff lists according to the line’s ridership scheduling.

Central Control Room Division: This Division will be responsible for:

- The line bus traffic control from the Central Control Room; and
- Managing all the centralized information.

Line Operational Division: This Division will be responsible for:

- Management of the line staff (supervisors, drivers, ticketing staff, ...);
- Bus driving supervision;
- Passenger relations;
- Ticket selling;

5) Finance Department

Finance Department will be supervised by a Financial Manager approved by the Board of Directors, and responsible for all fiscal matters related to the busway service system. The main function of this department will be:

- Provision of all accounting and financial management services required by the organization including salary payments, the maintenance of all bank accounts;
- Preparation of a draft budget proposal for review by management and the provision of monthly and yearly financial performance reports;
- Preparation and execution of all approved purchase orders for spare parts, materials, and supplies for the busway system and the maintenance of detailed procurement records; and
- Establishment of a library of vendor information and specifications.

6) Administrative Department

Administrative Department will be supervised by an Administrative Manager, and responsible for the following tasks:

- Personnel administration, including the maintenance of employment records,;
- Recruitment and staffing, and the administration health and other benefit plans;
- Provision of training for employees in non-technical disciplines; and
- Public relations.

7) Safety and Quality Assurance

Safety and Quality Assurance Department will be supervised by a Safety and Quality Assurance Manager who will report directly to the General Manager, and undertake the tasks of:

- To inform, advise and assist the various operational units of the busway service as to quality and safety, within the limits of the legislation currently in force;
- To review and approve permanent and temporary operating and maintenance procedures proposed by the concerned services;
- To carry out incident inquiries with safety personnel in the concerned service;
- To check the compliance of operating and maintenance procedures through audits; and
- To keep the General Manager informed about the measures which have been introduced.

(4) Staff Requirements

1) General Principles

Staff requirements for management, operation and maintenance under the proposed organizational structure are estimated based on the labor productiveness and efficiency as follows:

- Equivalence of 1.5 rest day every 5.5 work day (7/5.5 factor);
- 1.20 absenteeism factor (holidays, illness, refreshing training, etc.); and
- For the operating staff and posts, an assured 24 hours per day; 2 shifts per day.

2) Staff Requirements in the 2007-2012 period

The number of staff required for each department is estimated by professional/skill category and by class/grade. The result is shown in Table 3.9.3. For the operation during the period between 2007 and 2012, or the initial stage, a total of 367 staffs are needed to be employed.

3) Staff Estimates towards Year 2022

Towards the year 2022, in order to meet an increasing demand, the organization needs to be strengthened in terms of staff capacity for service expansion, while keeping the same organizational structure. The management unit should be kept conservative in its expansion. However, the safety and quality assurance department as well as the operations department and the maintenance department should be further staffed in accordance with the number of actively operating bus fleets in such a way that the work load and the labor efficiency are not both worsened. This crucial decision shall be made by the Board of Directors. A total of 639 staff will be organized for the operation in 2022, increasing by about 270 employees from the staffing in 2012, as shown in Table 3.9.4.

Table 3.9.3 Staff Requirements of the West Wing Busway Company (2007-2012)

Department	Profession/Skill	Class/ Grade [1]						TL
		M	SE	E	ST	T	W	
Management Unit	General Manager	1						1
	Assistant GM	2						2
	Secretary						3	3
	Sub-total	**3**					**3**	**6**
Safe & Quality Dep't	Manager	1						1
	Technician				1			1
	Secretary						1	1
	Sub-total	**1**			**1**		**1**	**3**
Maintenance Dep't [2]	Manager	1						1
	Secretary						2	2
	Bus Fleets		1	3	7	20	90	121
	Civil Work		1	1	3	5	7	17
	Fare Equipment			1	2	3	2	8
	Sub-total	**1**	**2**	**5**	**12**	**28**	**101**	**149**
Operation Dep't	Manager	1	1					1
	Secretary						2	2
	Planning		1	2			3	9
	CCR			1	8		2	11
	Ticket Sales & Control						40	40
	Line Supervisor		1	1	4	8	8	22
	Drivers [3]					85		85
	Sub-total	**1**	**3**	**4**	**12**	**93**	**53**	**166**
Finance Dep't	Manager	1						1
	Secretary						2	2
	Budget Officer		1	1			1	4
	Treasury		1	1				2
	Contracts		1	1	1			-
	Sub-total	**1**	**3**	**3**	**1**	**-**	**3**	**11**
Administrative Dep't [4]	Manager	1						1
	Secretary						2	2
	Personnel Adm.		1	2	2	3	4	12
	Training-Safety		1	2	2	2		7
	Public Relations		1	2	2		2	7
	Sub-total	**1**	**4**	**6**	**6**	**5**	**10**	**32**
Total		**8**	**12**	**18**	**32**	**126**	**171**	**367**

Notes: 1) M: Managerial class; SE: Senior Engineer; E: Engineer; ST: Senior Technician; T: Technician; and W: Worker

2) The repair of certain equipments can be performed under a service contract. Service contracts will be used primarily for components repairs and overhauls which are not time-critical to passenger operation. Cleaning will be performed under a service contract.

3) For the calculation of the driver number, the following are assumed:
A working time per day per driver of 8 hours.
An extra driver time for stabling, maneuvers, refreshing training of 20 %.
An extra driver time for holidays, illness... of 20 %.

4) Certain tasks, such as cleaning or guarding, will be performed under a service contract

Source: JICA Study Team

Table 3.9.4 A Summary: West Wing Busway Company Staffing in 2007-2012 and 2022

Department	Total	Number of Staff by Grade					
		Manager	Senior Engineer	Engineer	Senior Technician	Technician	Other Staff
Initial stage (2007-2012)							
Management	**6**	3	-	-	-	-	3
Safety/Quality	**3**	1	-	-	1	-	1
Maintenance	**149**	1	2	5	12	28	101
Operations	**166**	1	3	4	12	93	53
Finance	**11**	1	3	3	1	-	3
Administration	**32**	1	4	6	6	5	10
Total	**367**	**8**	**12**	**18**	**32**	**126**	**171**
For Operation in 2022							
Management	**6**	3	-	-	-	-	3
Safety/Quality	**7**	1	-	-	3	-	3
Maintenance	**253**	1	3	8	22	50	169
Operations	**302**	1	3	7	35	107	149
Finance	**23**	1	3	3	5	5	6
Administration	**48**	1	4	7	10	11	15
Total	**639**	**8**	**13**	**25**	**76**	**173**	**345**

Source: JICA Study Team

CHAPTER 4

TRAFFIC MANAGEMENT PROGRAM ALONG METRO 4 CORRIDOR

CHAPTER 4: TRAFFIC MANAGEMENT PROGRAM ALONG METRO 4 CORRIDOR

INTRODUCTION

Metro Line 4 (the Pyramid Line) has emerged as a core element of the urban rail mass rapid transit plan. However, limited financial resources, as well as a commitment to the prior construction of Metro Line 3, makes the implementation of Line 4 unlikely until the second half of the planning horizon. Concurrently, the Line 4 axis pass through what are considered to be some of the most heavily utilized transport corridors in the metropolitan area; Haram St. and Malek Feisal St. in Goza, the Cairo CBD and Port Said St. Urgent effective traffic improvement actions are expected along Metro Line 4.

Chronic traffic congestion along the Haram St. and Malek Feisal St. in Goza, the Cairo CBD and Port Said St. becomes very severe during the peak period. The problem of the existing traffic congestion is caused by inadequate road capacity including the lack of well-developed traffic management. For instance, there are manual signal control systems used by traffic police, pedestrians cross the street ignoring signal lights, heavy traffic congestion near bus stops, traffic conflict at non-signalized intersections, a high occupancy of on-street parking, and a high occurrence of traffic accidents involving pedestrians.

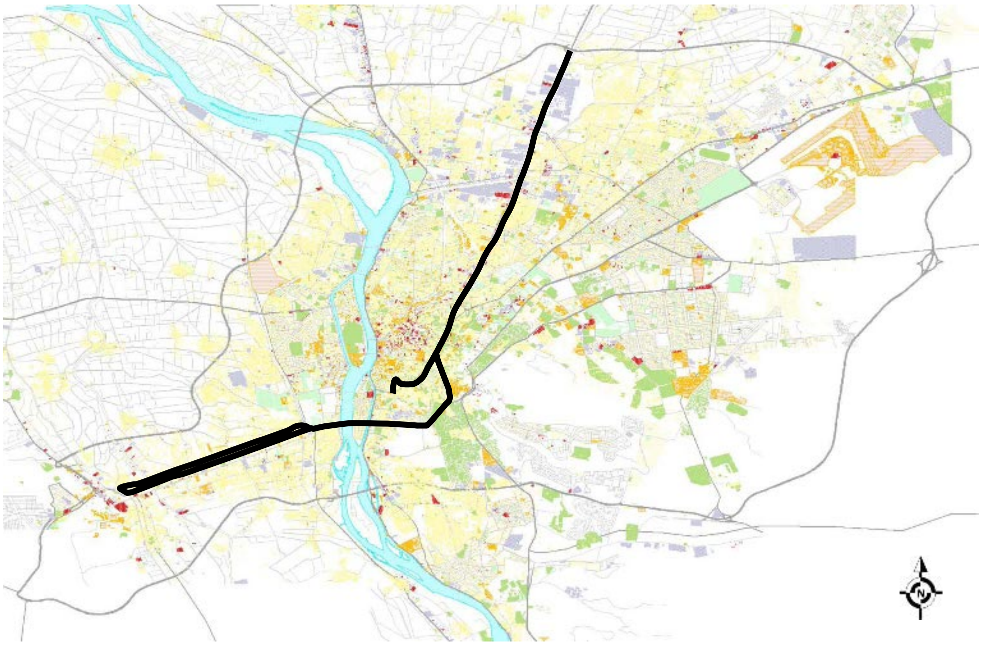
An appropriate, systematic traffic management plan is essential for the safe, smooth flow of the increasing motor traffic on the roads. Traffic management is particularly important in order to make the maximum use of the existing road facilities and to improve the current road capacity. Since a traffic management plan requires relatively low cost, except for those measures which improve facilities of a large size, and since it is possible to carry out a trial-and-error method while observing the effects on the traffic flow and other factors, it is necessary to introduce improvement measures that respond to the changing requirements of different times. With a view to achieving a smooth traffic flow in the central area, it is necessary to increase road traffic capacity through the improvement of traffic management facilities. The focus of the entire effort is low cost traffic management solutions with a rapid implementation potential, and which are likely to catalyze high benefits in terms of enhanced traffic operations, capacity and safety. The focus of the study is to define traffic management strategies which will mitigate, as practical and possible, current problems, but will also serve as an interim solution prior to the realization of Metro Line 4. The potential for bus priority facilities, in the form of bus lanes, emerges as a particularly strong contender in this corridor.

4.1.1 Objectives

The objective of the project is to formulate a short-term transport management program and bus priority system along the proposed Metro Line 4 Corridor (Pyramid Line). With a view to achieving smooth traffic flow on the Metro Line 4 Corridor, the goal of this plan is to induce commuters to shift from private vehicles to public transportation, and to mitigate traffic congestion at bottlenecks.

4.1.2 Study Area

The study area is defined as about 40km in length, along Port Said St. (Ring Road- Abu El Rish Sq.), Qalla St. (Ahmed Maher Pasha Sq.-Salah Salem St.), Salah Salem St. (Sayeda Aisha Br.-Giza Sq.), Ahram St. (Giza Sq.-Mansooreya Canal), and Malek Feisal St. (Mansooreya Canal-Nady St.) (See Figure 4.1.1).



Source: JICA Study Team

Figure 4.1.1 Study Area

The distance of each section along the Metro 4 Corridor are as below:

1) Port Said St. (Ring Rd.- Abu El Rish Sq.): 17.3 km
2) Qalla St. (Ahmed Maher Pasha Sq.-Salah Salem St.): 2.6 km
3) Salah Salem St. – Ahram St. (Sayeda Aisha Br.-Giza Sq.): 12.9 km
4) Malek Feisal St. (Mansooreya Canal-Nady St.): 6.9 km

4.2 CURRENT TRAFFIC CONDITION ALONG METRO 4 CORRIDOR

4.2.1 Description of the Corridor

Metro 4 Corridor is an important part of Cairo city and Giza City from the standpoint of economic and transportation activity; it connects the Cairo CBD and Giza Central area, and the main transportation gateways towards the north and south. Within the Cairo CBD and Giza Central area that constitutes the Cairo city's business and commercial center, a substantial volume of traffic is concentrated on Port Said St., Salah Salem, Ahram St. and Malek Feisal St, causing heavy congestion within the area. In the peak hours, the traffic congestion in the above-mentioned streets is caused by conflict between heavy commuter through traffic and the internal access traffic of the Cairo CBD and Giza Central area. Chronic traffic congestion along Metro 4 Corridor area becomes very severe during the peak period when major intersections reach near-saturated level. In addition, the congested sections caused by buses/shared taxis conflict near bus stops were particularly seen on the Metro 4 Corridor. This traffic congestion was caused by buses/shared taxies that occupy 2-lanes or 3-lanes for the loading and unloading of passengers, and the Metro 4 Corridor in Cairo CBD and Giza Central area, which has a high parking occupancy and where the parking occupancy during business hours exceeds 90%.

Metro 4 Corridor is traversed from north to south by four arterial roads which serve as corridors for Cairo CBD and Giza Central area. These arterial roads are Port Said St., Salah Salem, Ahram St. and Malek Feisal St. Port Said St. connects to several major streets to the east and west such as Tereat El Ismailia St., Sekket El Wayly St., 6th of October Br., Ramses St. and Geish St, Salah Salem St. connects to Corneish St. and Sudan St. to the north and south. Ahram St. and Malek Feisal St. run from east to west in parallel, these roads connect to the major streets Tereat El Zomor El Gharby St., Maryoteya Rd. and Mansooreya Rd.

4.2.2 Traffic Management Facilities

(1) Traffic Signal Light Facility

At present, there are eight signalized intersections on the Metro 4 Corridor, as shown in Table 4.2.1. They are insufficient in number. At many intersections, traffic lights are not visible because of low poles which frequently make it difficult for drivers who are behind large buses to see them. Some traffic lights are not working properly. Currently, during peak periods, almost all signalized intersections are manually controlled by traffic policemen. Manual operations are based on an assessment of spot conditions by visual observation by traffic policemen and/or information received via transceivers. However, it is rather difficult for this manual controlling technique to maintain an effective synchronization situation between intersections because it tends to result in a longer cycle length. The number of signal phase patterns for most intersections ranges between 2 to 3. In particular, the intersection of Port Said St.- Sekket El Wayly St. has been operating with a multiphase system which sets one phase for each direction. Such a signal, with four phases per cycle, leads to a long cycle time. In this context, driver must wait for traffic light change for quite a long time.

Table 4.2.1 Location of Signalized Intersection on Metro 4 Corridor

Street	Intersection	Operation
Port Said St.	1. Port Said St.- Sekket El Wayly St. 2. Port Said St.-Qalaa St. (Ahmed Maher Pasha Sq.)	Working Working
Salah Salem St.	1. Salah Salem St.-Bahary El Oyoon St. 2. Salah Salem St.-Manyal St. (Qayrawan Sq.) 3. Salah Salem St.- Malek Abdel Aziz St. (Giza Br.)	Working No working No working
Ahram St.	1. Ahram St.-Maryoteya Rd. 2. Ahram St.-Mansooreya Rd.	Working Working
Malek Feisal St.	1. Malek Feisal St.-Nady St.	No working

Source: JICA Study Team

In addition, traffic congestions at many U-turn points on Ahram St. and Malek Feisal St. are caused by conflicts between through traffic and entering traffic. This result is that through traffic on the major road will be blocked by a long queue of entering traffic from the U-turn point. It is, therefore, highly recommended that the installation of new traffic signal lights at U-turn points should be considered, in order to control both main traffic flow and entering traffic flow

(2) Traffic Safety Facilities

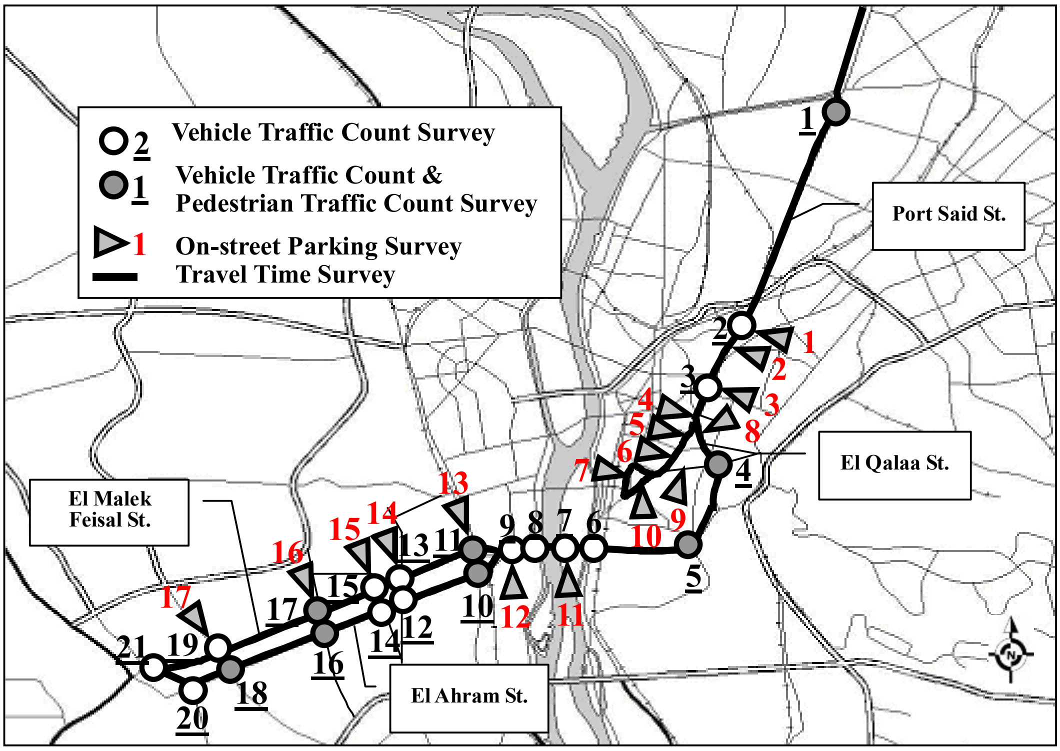
Pedestrian bridges are generally required to be installed on wide streets with many urban facilities attracting many people, i.e., school, hospitals, large bus stops, etc. They are not insufficient in number. In particular, very few streets on Metro 4 Corridor have a pedestrian crossing with traffic signal lights. There are many pedestrian crossings at U-turn points on Ahram St. and Malek Feisal St. However, most pedestrian crossings are not friendly for pedestrians due to th e incessant number vehicles passing on the street. The installation of new traffic signal lights at U-turn points should be considered, in order to control main traffic flow, entering traffic flow and pedestrians crossing.

4.2.3 Current Traffic Flow Condition

A vehicle traffic count survey, a pedestrian traffic survey and an on-street parking survey were conducted to obtain necessary information for the traffic management program along Metro 4 Corridor. The locations of traffic surveys are shown in Figure 4.2.1. The traffic surveys are described below:

(1) Vehicle Traffic Count Survey

The vehicle traffic count survey was carried out to formulate a short-term traffic management plan at major intersections on the Metro 4 Corridor. Twenty-one locations were selected from major intersections and squares on Metro 4 Corridor. The survey locations are shown in Table 4.2.2.



Source: JICA Study Team

Figure 4.2.1 Locations of Traffic Surveys

Table 4.2.2 Survey Locations of Vehicle Traffic Count Survey

No.	Locations
1	Port Said – Sawah
2	Port Said – Daher
3	Port Said – Azhar
4	Sayed Zeina Sq.
5	Salah Salem – Magra El Oyoon
6	Salah Salem – Corneish El Neel
7	Giza Br. –Malek Abdel Aziz
8	Ahram – Gamea D. Afeefy
9	Giza Sq.
10	Ahram – Tereat El Zomor
11	Malek Feisal Br. – Nady
12	Mesaha Sq.
13	Malek Feisal – Naser El Thawra
14	Ahram – Ossman Moharm
15	Malek Feisal – Tareeq Kafr Tohormos
16	Ahram – Sheikh El Sherbeeny
17	Malek Feisal – Sheikh El Sherbeeny
18	Ahram – Maryoteya Canal
19	Malek Feisal – Maryoteya Canal
20	Ahram – Mansooreya Canal
21	Malek Feisal – Mansooreya Canal

Source: JICA Study Team

The types of vehicles for the counts are classified into the following three types: 1) Buses/trucks: large buses (public buses, private buses), large trucks (3 axle trucks, heavy trucks), large military, 2) Shared taxies (urban and intercity), and 3) Others: passenger cars and taxi (urban taxi and intercity taxi), minibuses, small trucks (light commodity vehicle, 2 axle trucks), Others (small military, small police, ambulance and etc.). Survey hours are 6 hours (3 hours in the morning peak from 7:00 to 10:00 hrs. and 3 hours in the afternoon peak from 13:00 to 16:00 hrs.).

(2) Pedestrian Traffic Survey

The pedestrian traffic survey was carried out to formulate a short-term traffic management plan at major intersections on Metro 4 Corridor. Eight locations were selected from major intersections and squares on Metro 4 Corridor. The survey locations are shown in Table 4.2.3. The survey was carried out by direction at intersections. Survey hours are 6 hours (3 hours in the morning peak from 7:00 to 10:00 hrs. and 3 hours in the afternoon peak from 13:00 to 16:00 hrs.).

Table 4.2.3 Survey Locations of Pedestrian Traffic Survey

No.	Locations
1	Port Said – Sawah
2	Sayeda Zeinab Sq.
3	Salah Salem – Magra El Oyoon
4	Ahram – Tereat El Zomor
5	Malek Feisal Br. – Nady
6	Ahram – Sheikh El Sherbeeny
7	Malek Feisal – Sheikh El Sherbeeny
8	Ahram – Maryoteya Canal

Source: JICA Study Team

(3) On-street Parking Survey

Surveys were conducted to formulate a short-term traffic management plan at major intersections on Metro 4 Corridor. Seventeen locations for the parking survey were selected from places where there were known to be serious problems on Metro 4 Corridor. The survey locations for the parking survey are shown in Table 4.2.4. Each location covers right/left sides for 200 meters length on the street. Survey components of the parking survey were: 1) Parking capacity of the on-street at selected locations, 2) Number of parked vehicles on-street by vehicle type (passenger car, taxi, shared taxi, micro bus and small truck), 3) Parking duration, and 4) Parking turnover.

Table 4.2.4 Survey Locations of On-street Parking Survey

No.	Street	Section
1	Port Said St.	Zaher St.-Gaafar St.
2	Port Said St.	Hassan El Saudy St.-Zaher St.
3	Port Said St.	Mosky St.-Darb El Geneina St.
4	Port Said St.	Elshahid Mansour St.-Amry St.
5	Port Said St.	Ahmed Omar St.-Seket Rateb St.
6	Port Said St.	Abdel Mageed El Labban St.-Mohamed Qadry St.
7	Port Said St.	Helwan Station St.-Wafedeen St.
8	Qalaa St.	Hara El Kabeera St.-Noaman Mosque St.
9	Abdel Mageed El Labban St.	Mohamed Aly Preparatory School St.-Lasheen El Seify Mosque St.
10	Sad El Barany St.	Momtaz St.-Hareery St.
11	Salah Salem St.	Malek El Saleh-Qaleat El Manyal St.
12	Salah Salem St.	Mahmoud Fahmy-Neel St.
13	Malek Feisal St.	Abdel Naser St.-Nady St.
14	Malek Feisal St.	Shorbagy St.-Naser El Thawra St.
15	Malek Feisal St.	Hassan Metwaly St.-Kafr Tohormos Rd.
16	Malek Feisal St.	Matbaa St.-Diaa St.
17	Malek Feisal St.	Tereat El Maryoteya St.-Qahwagy Butchery Shop

Source: JICA Study Team

(4) Travel Time Survey

The travel time survey was carried out to obtain information on average speed and stopping time, as well as the reasons for traffic congestion. The obtained information should be helpful to find any bottlenecks at sections and intersections on Metro 4 Corridor. For the total 40km distance, composed of Port Said St., Salah Salem St., Ahram St. and Malek Feisal St., the survey was conducted by two roundtrips in morning peak hours and afternoon peak hours. Survey components were; 1) departure time and arrival time, 2) passing time of checkpoints, and 3) stopping time by reasons.

4.2.4 Traffic Survey Results

The current traffic condition based on the results of the traffic surveys is described below.

(1) Vehicle Traffic Count Survey

Table 4.2.5 depicts the two-way hourly traffic volumes on Metro 4 Corridor. Traffic volume on Metro 4 Corridor is in the range of 1,915 and 10,503 Passenger Car Units (PCU[1]). The highest volume of 10,503 is observed on Salah Salem St. (Section Giza Sq.), which runs from the east to the west of the city. The traffic

[1] PCUs (Passenger Car Unit) are as follows: 1) Buses/trucks: Large buses (Public buses, Private buses), Large trucks (3 Axles truck, Heavy truck), Big military: PCU at 2.5, 2) Shared taxies (urban and intercity): PCU at 1.7, and 3) Others: Passenger cars and Taxi (urban taxi and intercity taxi), Minibuses, Small trucks (Light commodity vehicle, 2 Axles truck): PCU at 1.0, Others (small military, small police, ambulance and etc.): PCU at 1.0.

volumes on the other streets are as follows: Port Said St.: 2,429-6,162 PCU, Salah Salem St.: 3,181-10,503 PCU, Ahram St.: 3,214-4,255 PCU, Malek Feisal St.: 2,624- 9,165 PCU.

Table 4.2.5 Traffic Volume on Metro 4 Corridor

Street	Range of Two-way Hourly Traffic Volume (PCU)
Port Said St.	2,429 - 6,162
Salah Salem St.	1,915 - 10,503
Ahram St.	4,223 - 9,165
Malek Feisal St.	2,624 - 9,130

Source: JICA Study Team

(2) Pedestrian Traffic Survey

Table 4.2.6 shows the two direction hourly pedestrian volumes for crossings at the approach of major intersections on Metro 4 Corridor. The pedestrian crossing volume on Metro 4 Corridor is in the range of 12 and 2,660 pedestrians. The highest volume of 2,660 is observed at Sayeda Zeinab Sq. intersection on Port Said St. The pedestrian traffic volumes on other intersections are as follows; Port Said St.: 85 - 2,660 Pax., Salah Salem St.: 12-113 Pax., Ahram St.: 65 - 1,422 Pax., Malek Feisal St.: 82 – 831 Pax..

Table 4.2.6 Pedestrian Traffic Volume on Metro 4 Corridor

Street	**Range of Two Direction Hourly Pedestrian Traffic Volume (Pax.)***
Port Said St.	85 - 2,660
Salah Salem St.	12 - 113
Ahram St.	65 - 1,422
Malek Feisal St.	82 - 831

Source: JICA Study Team
*Note: * Pedestrian traffic volume indicates a total of all direction for crossing at intersection.*

(3) On-street Parking Survey

1) Parking Occupancy

Table 4.2.7 shows the ratio of on-street parked vehicles to legally allowed on-street parking capacity (referred to as parking occupancy). Hassan El Saudy St.-Zahar St., Shaheed Mansoor St.- Amry St., Ahmed Omar St.-Seket Rateb St. and Helwan Station St.-Wafedeen St. sections on Port Said St., and Hara El Kebeera - Nouman Mosque St. on Qalaa St. have a high parking occupancy, where the parking occupancy during business hours exceeds 90%. The characteristics of parking occupancy by peak periods are:

a. Morning peak period (9:00-10:00)

Sections of Hassan El Saudy St.-Zahar St., Shaheed Mansoor St.- Amry St., Ahmed Omar St.-Seket Rateb St., and Helwan Station St.-Wafedeen St. on Port Said St., Hara El Kebeea - Nouman Mosque St. on Qalaa St., and Mahmoud Fahmy St. - Neel St. on Salah Salem St. show high parking occupancy which exceeds 90%. In particular, it can be seen that the sections with high parking occupancy are in the central area on Port Said St.

b. Midday peak period (13:00-14:00)

Parking occupancies in the sections Hassan El Saudy St. - Zahar St., Shaheed Mansoor St. - Amry St., Ahmed Omar St. - Seket Rateb St. and Helwan Station St. - Wafedeen St. on Port Said St., Hara El Kebeera - Nouman Mosque St. on Qalaa St., and Tereat El Maryoteya - Qahwagy Butchery Shop on Malek Feisal St, are above 90%. On the sections Hara El Kebeera - Nouman Mosque St. on Qalaa St., the parking occupancy is above 95%.

c. Evening peak period (17:00-18:00)

Parking occupancy in the sections Mahmoud Fahmy St. - Neel St. and Manyal St. - Malek El Saleh St. on Salah Salem St. is less, while parking occupancy in the section Zaher St.-Gaafar St., Shaheed Mansoor St. - Amry St., Ahmed Omar St. - Seket Rateb St. on Port Said St., Qalaa St., Sad El Barany St. and section Hassan Metwaly St. - Kafr Tohormos Road on Malek Feisal St. exceeds 90%.

Table 4.2.7 On-Street Parking Occupancy by Section on Metro 4 Corridor

Peak Hour	Port Said St.						
	Zaher St -Gaafar St.	Hassan El Saudy St. - Zahar St.	Mosky St. - Darb El Geneina	Shaheed Mansoor St. - Amry St.	Ahmed Omar St. - Seket Rateb St.	Abdel Mageed El Labban St. - Mohamed Qadry St.	Helwan Station St. - Wafedeen St.
09-10	59.6%	91.5%	67.7%	93.4%	95.7%	74.5%	92.4%
13-14	86.5%	90.1%	88.7%	94.0%	93.2%	88.8%	94.6%
17-18	90.4%	79.4%	86.5%	92.8%	94.4%	85.7%	89.1%

Peak Hour	Qalaa St.	Abdel Mageed El Labban St.	Sad El Barany St.	Salah Salem St.	
	Hara El Kebera - Nouman Mosque St.	Mohamed Aly Preparatry School - Lasheen El Seify Mosque	Momtaz St. - Hareery St.	Manyal St. - Malek El Saleh St.	Mahmoud Fahmy St. - Neel St.
09-10	85.1%	69.1%	74.2%	46.4%	92.0%
13-14	97.7%	86.8%	84.3%	64.3%	85.1%
17-18	93.1%	76.5%	92.1%	35.7%	63.2%

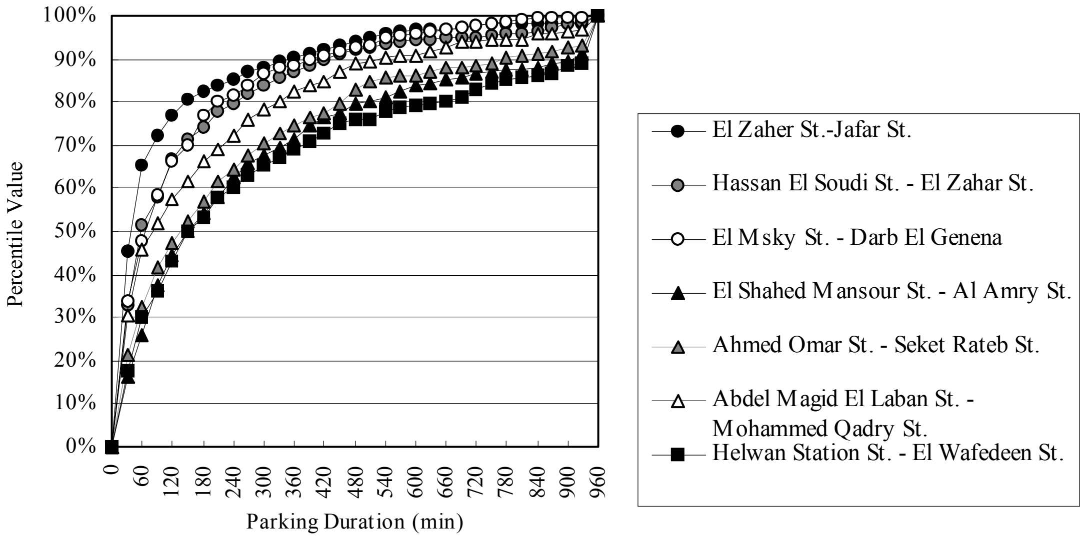
Peak Hour	Malek Feisal St.				
	Abdel Naser St. - Nady St.	Shorbagy St. - Naser El Thawra St.	Hassan Metwaly St. - Kafr Tohormos Road	Matbaa St. - Diaa St.	Tereat El Maryoteya - Qahwagy Butchery Shop
09-10	59.0%	64.6%	79.0%	82.4%	89.2%
13-14	75.9%	81.3%	76.5%	78.4%	91.9%
17-18	78.3%	79.2%	93.8%	89.2%	83.8%

Source: JICA Study Team

2) Parking Duration

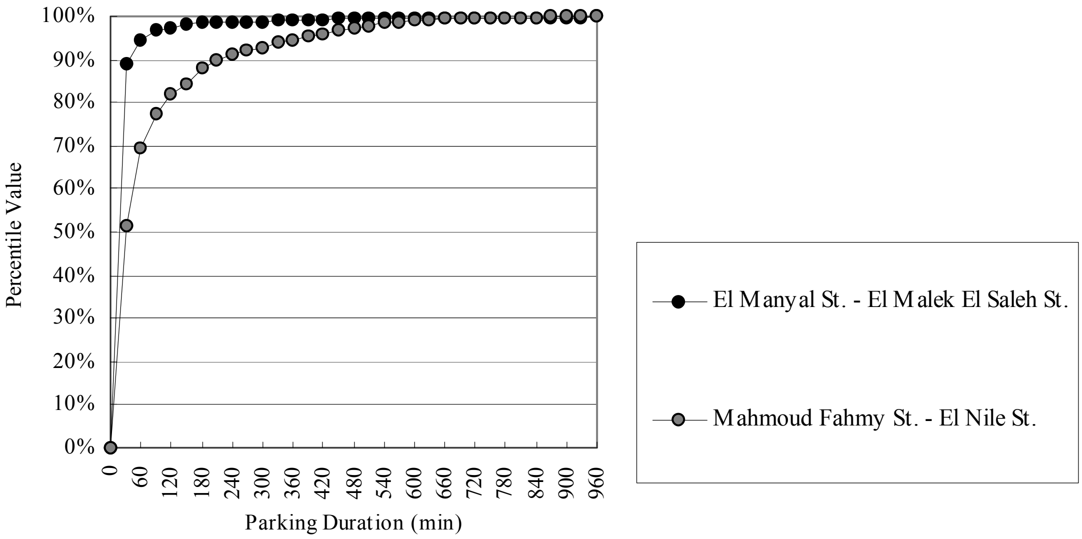
The average parking durations, for the each section on Metro 4 Corridor, are shown in Table 4.2.8. The average parking duration on the entire Metro 4 Corridor was about 167 min (2hrs 47min). The average parking duration, by section, on Metro 4 Corridor are; Port Said St., 127–316 min (2hrs 7min-5hrs 16min), Qalaa St., 271 min (4hrs 31min), Sad El Barany St., 203 min (3hrs 23min), Salah Salem St., 44-96 min (44min-1hr 36min), and Malek Feisal St., 88–186 min (1hr 28min-3hrs 6min).

On the entire sections of Port Said St., 42.3% of total parked vehicles on street and parked for less than 1 hour, 15.6% for 1-2 hours, 9.0% for 2-3 hours and 33.1% parked for more than 3 hours. Such shares by parking duration in each section are nearly the same as that of the whole sections of Port Said St. However, the shares on Salah Salem St. range: 69.4-94.3% of total cars parked for less than 1 hour, 3.2–12.4% for 1-2 hours, 1.3–6.0% for 2-3 hours and 1.3–12.2% parked for more than 3 hours. The longer parking duration of more than 3 hours was seen on Salah Salem St. and Malek Feisal St.. Long parking durations of more than 8 hours are: 12.0% on Port Said St., 2.2% on Salah Salem St. and 6.1% on Malek Feisal St.



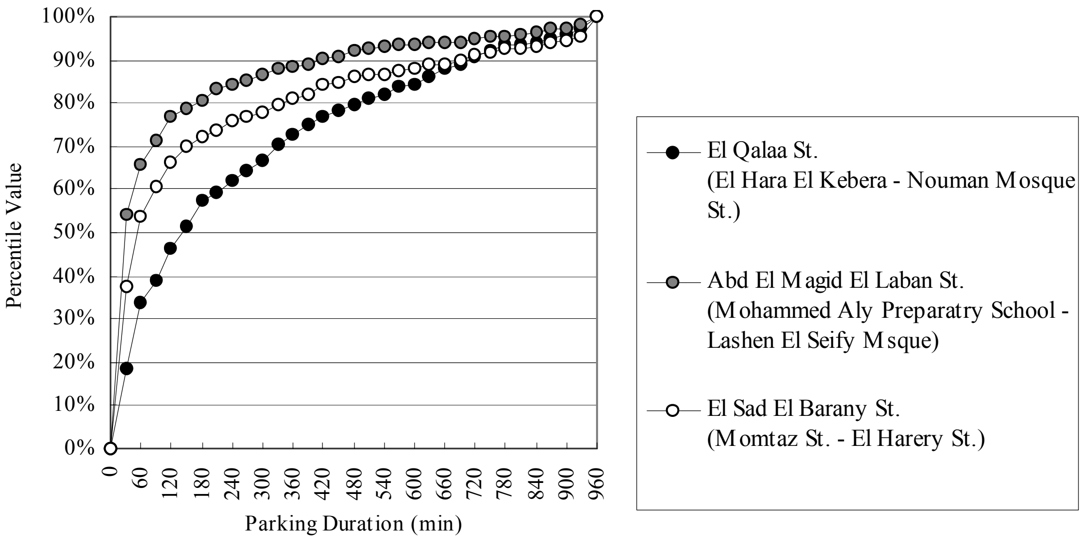
Source: JICA Study Team

Figure 4.2.2 Cumulative Parking Duration Distribution by Sections (Port Said St.)



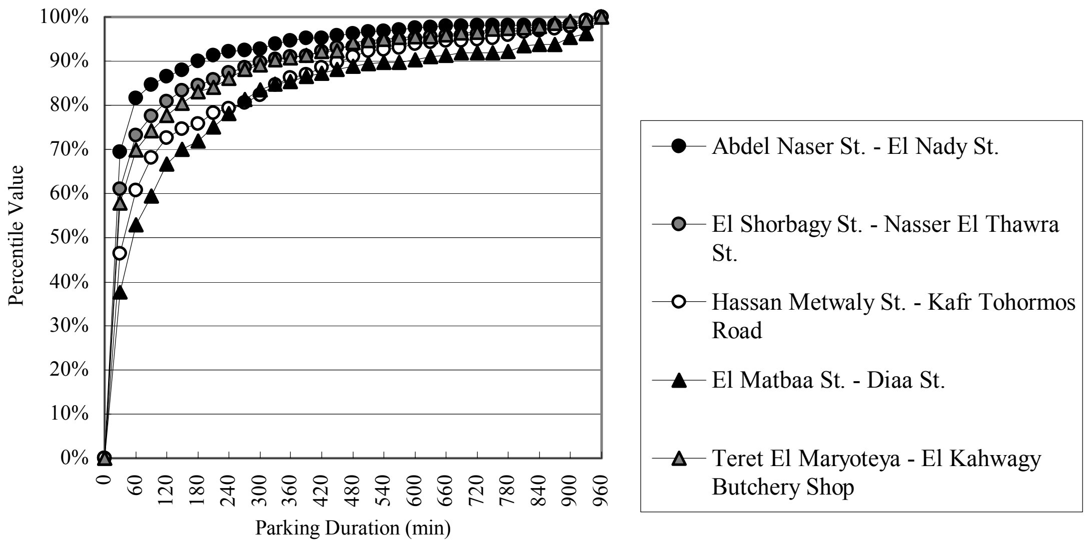
Source: JICA Study Team

Figure 4.2.3 Cumulative Parking Duration Distribution by Sections (Around Sayeda Zeinab Sq.)



Source: JICA Study Team

Figure 4.2.4 Cumulative Parking Duration Distribution by Sections (Salah Salem St.)



Source: JICA Study Team

Figure 4.2.5 Cumulative Parking Duration Distribution by Sections (Malek Feisal St.)

3) Turnover Rate

Table 4.2.8 shows the parking turnover rate on-street, by sections and by streets. The entire average is in the range of 2.68 and 7.16 times. Ahram St. has the highest rate of 5.88 times, while other high rates were on Malek Feisal St. at 5.88 times and Abdel Mageed El Labban St. at 4.90 times. The lowest rate of 3.09 was observed on Qalaa St.

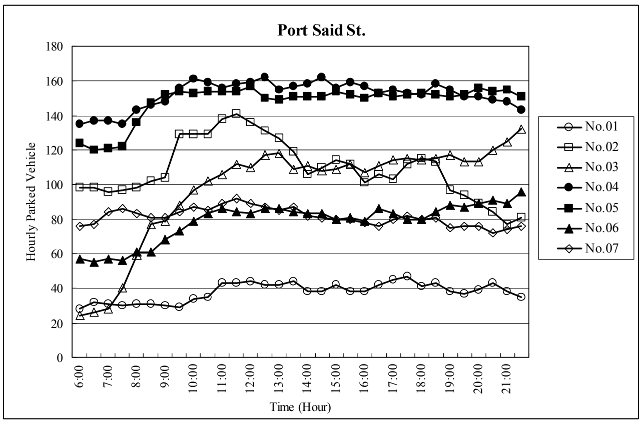
Table 4.2.8 On-Street Parking Duration by Sections on Metro 4 Corridor

Street	Parked Vehicles (Vehicles)	Parking Capacity (PCU)	Ave. Parking Duration (hours)	Ave. Parking Turn-over Rate
1. Port Said St.	3,165	845	3.64	3.75
2. Qalaa St.	269	87	4.51	3.09
3. Abdel Mageed El Labban St.	333	68	2.35	4.90
4. Sad El Barany St.	357	89	3.38	4.01
5. Salah Salem St.	911	115	1.30	7.90*
6. Malek Feisal St.	2,398	408	2.24	5.88

Source: JICA Study Team
*Note: * On-street parking vehicles in section Manyal St.-Malek El Saleh St. were controlled by policemen.*

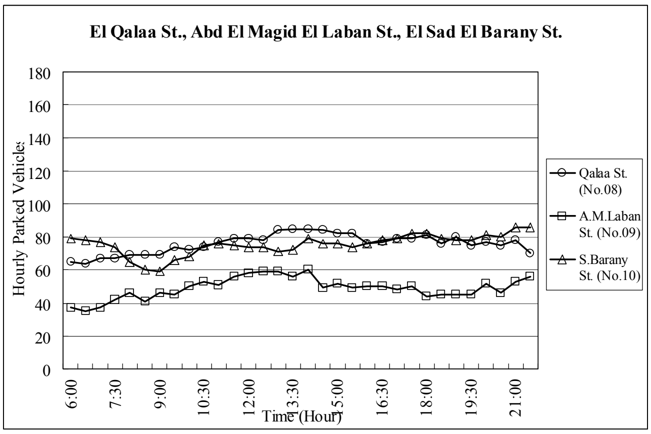
4) Hourly Fluctuation of Parked Vehicles

The peak periods were generally 11:00-14:00 in the midday and 16:00-20:00 in the evening. On Port Said St. and Salah Salem St., the number of parked vehicles sharply increases from 7:00 to 12:00, while it gradually decreases thereafter to 19:00. The number of parked vehicles on Malek Feisal St. stays nearly constant all day long. The hourly fluctuation of parked vehicles by street is shown in Figures 4.2.6 (1) (2) (3) (4).



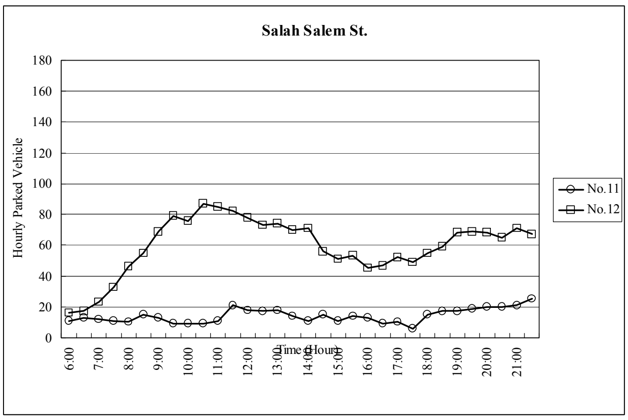
Source: JICA Study Team

Figure 4.2.6 (1) Hourly Fluctuation of Parked Vehicles on Port Said St.



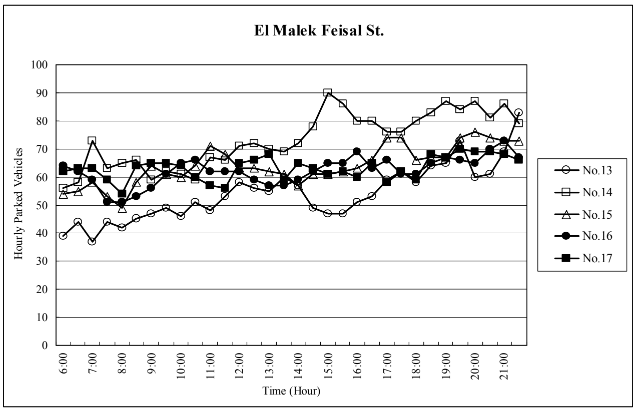
Source: JICA Study Team

Figure 4.2.6 (2) Hourly Fluctuation of Parked Vehicles on Qalaa St., Abdel Mageed El Labban St. and Sad El Barany St.



Source: JICA Study Team

Figure 4.2.6 (3) Hourly Fluctuation of Parked Vehicles on Salah Salem St.



Source: JICA Study Team

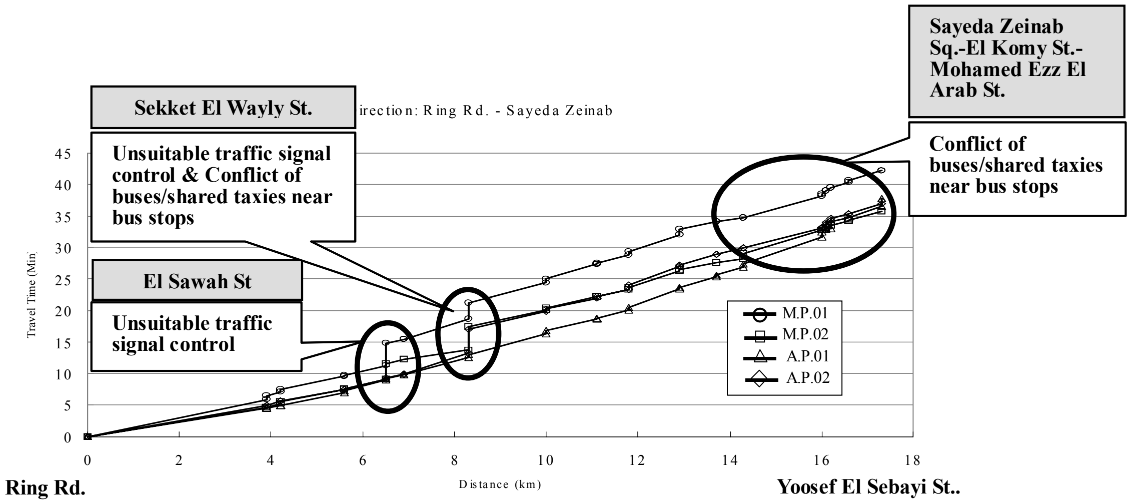
Figure 4.2.6 (4) Hourly Fluctuation of Parked Vehicles on Malek Feisal St.

(4) Travel Time Survey

Information regarding the average travel speed, with stopping time by reasons, on Metro 4 Corridor was obtained from the travel time survey. The travel time survey was carried out during the morning peak period and the afternoon peak period. The two peak periods are defined as: during 7:00-9:00 in the morning and 14:00-16:00 in the afternoon. Figure 4.2.7 (1) (2) (3) (4) (5) shows the travel time and distance diagram on Metro 4 Corridor. This figure shows the running time and the stopping time in relation to the distance, in order to understand the bottleneck points and the causes in the context of traffic engineering. In this analysis, the bottleneck point in the context of traffic engineering is defined as:

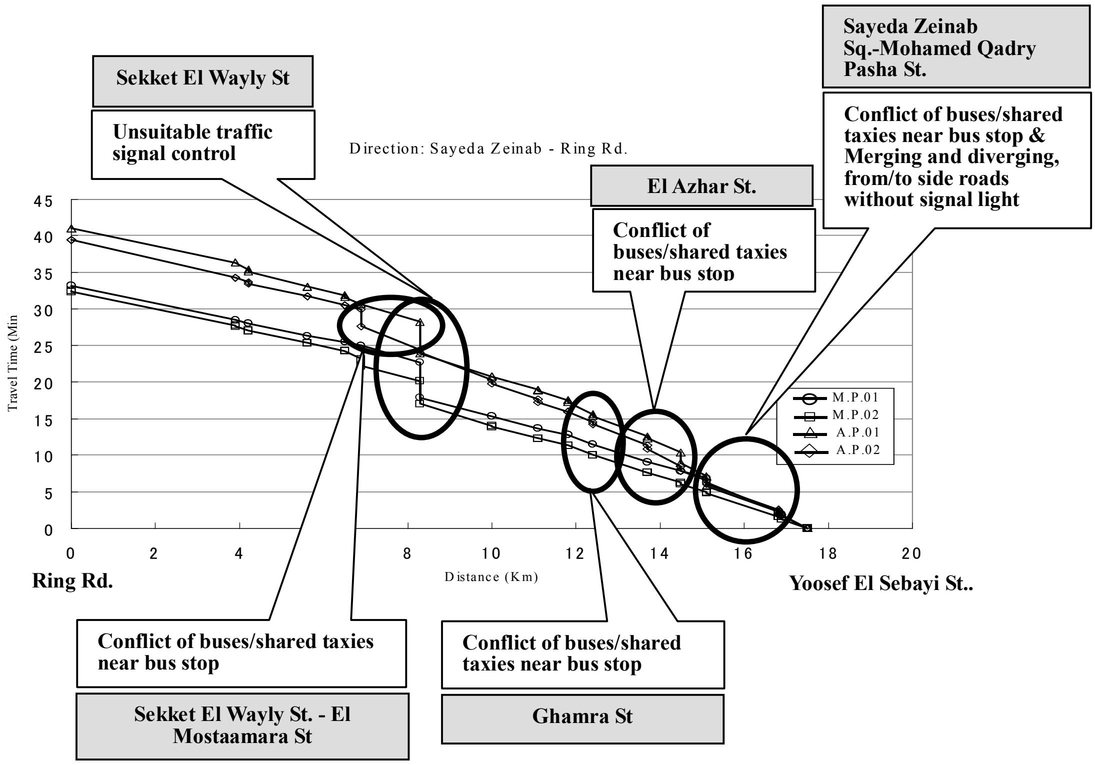
- Delayed time: travel speed under 10km/h or
- Ratio of total stopping time to total travel time: ratio above 50%.

The major causes of traffic congestion, characterized by low travel speed of 10km/h or less during the peak hour, are unsuitable traffic signal control systems, merging and diverging, from/to side roads without signal light (including U-turn point), and conflict of buses/shared taxies near bus stops. The average speed and the causes of time delay, by peak period, are shown below:



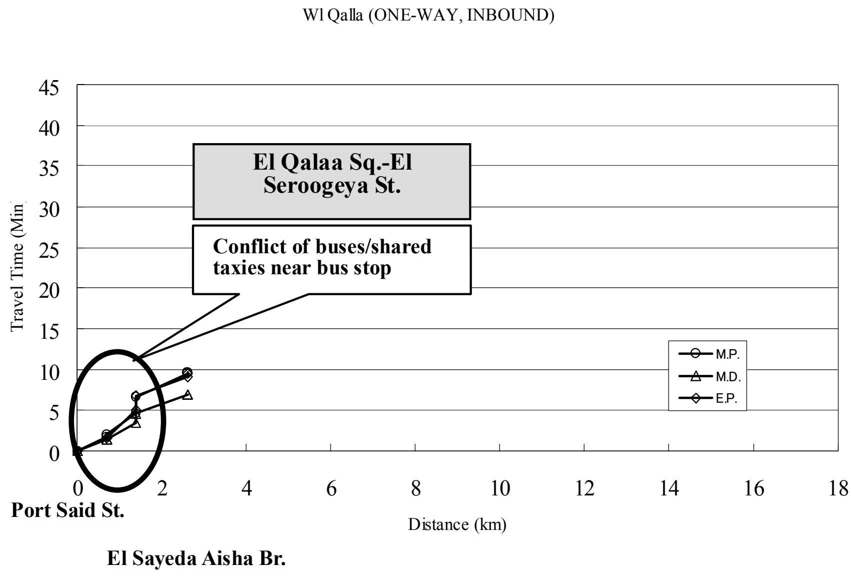
Source: JICA Study Team

Figure 4.2.7 (1) Travel Time and Distance Diagram from Ring Road to Yoosef El Sebaey St. on Port Said St.



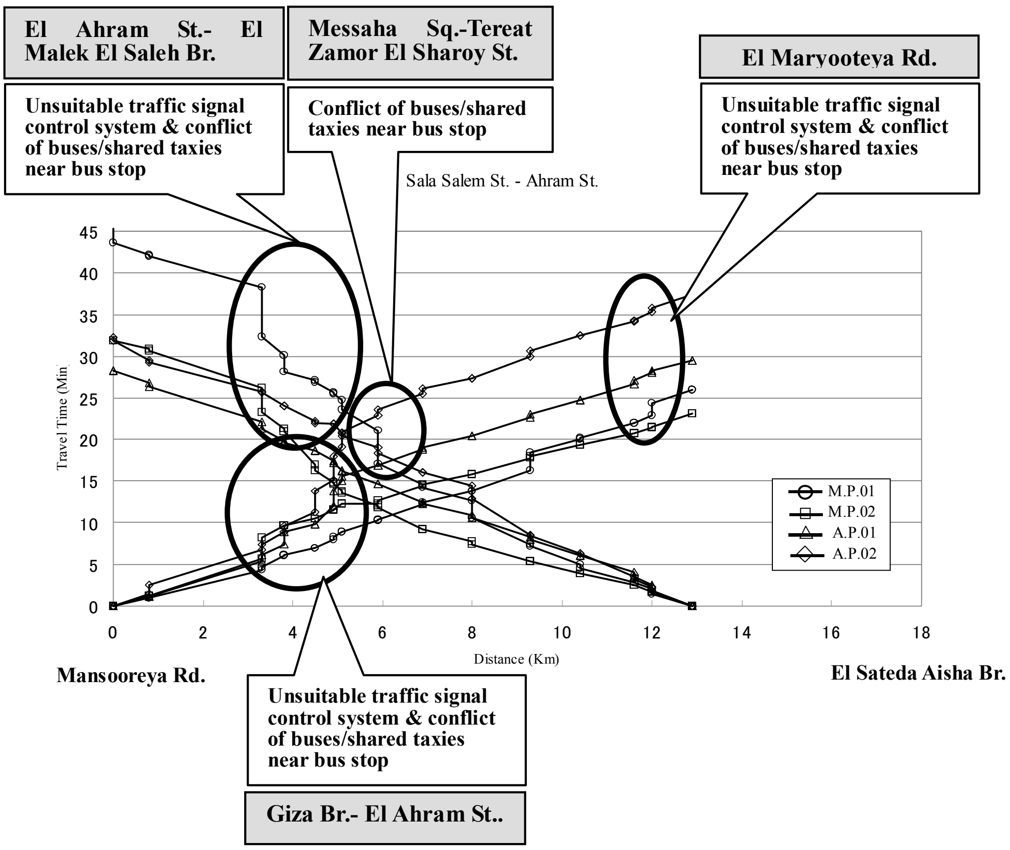
Source: JICA Study Team

Figure 4.2.7 (2) Travel Time and Distance Diagram from Sekket El Wayly St. to Ring Road on Port Said St.



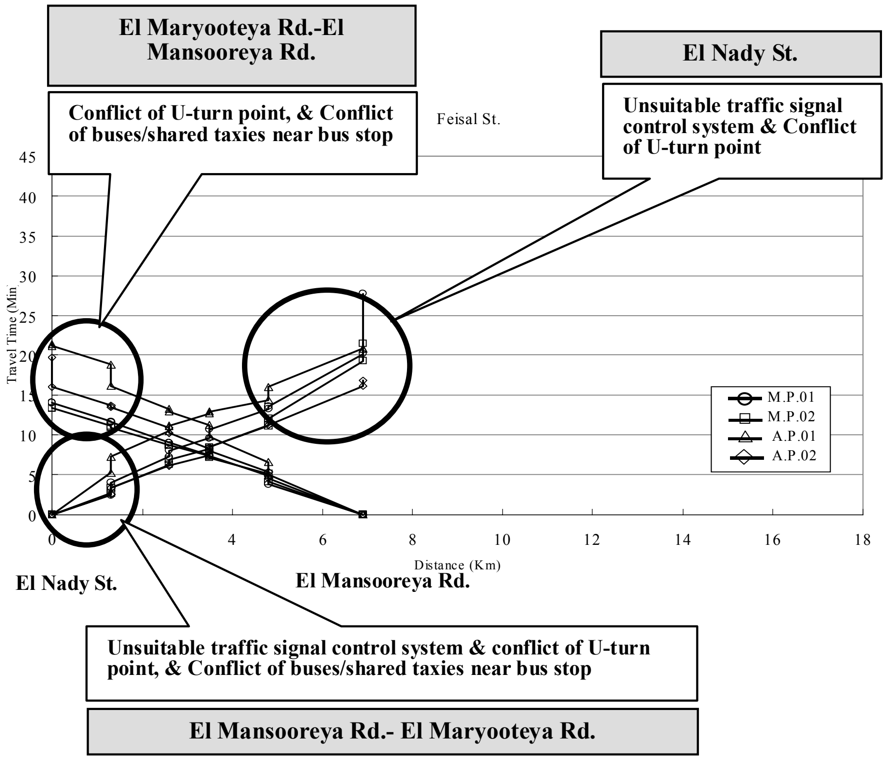
Source: JICA Study Team

Figure 4.2.7 (3) Travel Time and Distance Diagram from Sayeda Aisha Br. to Port Said St. on Qalaa St.



Source: JICA Study Team

Figure 4.2.7 (4) Travel Time and Distance Diagram from Sayeda Aisha Br. to Mansooreya Rd. on Salah Salem St.-Ahram St.



Source: JICA Study Team

Figure 4.2.7 (5) Travel Time and Distance Diagram from Mansooreya Rd. to Nady St. on Malek Feisal St.

1) Morning Peak Period (7:00-9:00)

Table 4.2.9 shows the average speed and causes of time delay on Metro 4 Corridor during the morning peak period. Sections with travel speed of 10km/h or less, indicating serious traffic congestion, were concentrated on major intersections on Metro 4 Corridor, toward the Cairo CBD area and Central Giza, such as Sawah St., Sekket El Wayly St. and around Sayeda Zeinab Sq. on Port Said St., Malek El Saleh Br. on Salah Salem St., Maryoteya Rd. on Ahram St., and Nady St. on Malek Feisal St. The major causes of traffic congestion are unsuitable traffic signal control systems, conflict from buses/shared taxies near bus stops and U-turn conflict points.

Table 4.2.9 Average Speed, Causes of Delay Time in Morning Peak Period

(a) Inbound Direction

Street	Section	Average Speed (km/h)	Ratio of Total Stopping Time (%)	Causes
Port Said St.	Tereat El Ismailia Br.-Sawah St.	10.0km/h	68%	- Unsuitable traffic signal control system - Conflict of buses/shared taxies near bus stops
	Sayeda Zeinab Sq.-Komy St.	10.0km/h	80%	
Qalaa St.	Qalaa Sq.-Seroogeya St.	8.9km/h	44%	- Conflict of buses/shared taxies near bus stops
Salah Salem St.	Ahram St.-Giza Sq.	10.0km/h	80%	- Conflict of buses/shared taxies near bus stops
	Giza Sq,-Bahey El Deen Barakat	10.0km/h	30%	- Conflict of buses/shared taxies near bus stops
	Bahey El Deen Barakat-Giza Br.	9.7km/h	66%	- Unsuitable traffic signal control system
	Giza Br.- Malek El Saleh Br.	3.7-6.1 km/h	73-60%	- Unsuitable traffic signal control system
Ahram St	Mesaha Sq.-Tereat EL Zomor El Sharqy St.	9.1km/h	57%	- Conflict of buses/shared taxies near bus stops
Malek Feisal St.	Tareeq Kafr Tohormos St.-Nady St.	8.9km/h	53%	- Unsuitable traffic signal control system - Conflict of U-turn point

(b) Outbound Direction

Street	Section	Average Speed (km/h)	Ratio of Total Stopping Time (%)	Causes
Ahram St	Mostashfa St.-Maryoteya Rd.	5.7km/h	61%	- Unsuitable traffic signal control system - Conflict of buses/shared taxies near bus stops

Source: JICA Study Team

2) Afternoon Peak Period (14:00-16:00)

Table 4.2.10 shows the average speed and causes of time delay on Metro 4 Corridor during the afternoon peak period. Sections with travel speed of 10km/h or less, indicating serious traffic congestion, were observed at major intersections on Metro 4 Corridor, going outbound from the city center such as Sekket El Wayly St. and around Sayeda Zeinab Sq. on Port Said St., Giza Br. and Giza Sq. on Salah Salem St., Maryoteya Rd. on Ahram St., and Maryoteya Rd. on Malek Feisal St. The major causes of traffic congestion are unsuitable traffic signal control systems, conflict from buses/shared taxies near bus stops, U-turn conflict points, and merging and diverging, from/to side roads without signal lights.

Table 4.2.10 Average Speed, Causes of Delay Time in Afternoon Peak Period

(a) Inbound Direction

Street	Section	Average Speed (km/h)	Ratio of Total Stopping Time (%)	Causes
Port Said St.	Mostaamara St.-Sekket El Wayly St.	10.4km/h	53%	- Unsuitable traffic signal control system - Conflict of buses/shared taxies near bus stops
	Sayeda Zeinab Sq.-Komy St.	7.2km/h	41%	- Conflict of buses/shared taxies near bus stops
	Komy St.-Mohamed Ezz El Arab St.	5.4km/h	98%	- Conflict of buses/shared taxies near bus stops
Qalaa St.	Qalaa Sq.-Seroogeya St.	8.2km/h	33%	- Conflict of buses/shared taxies near bus stops
Salah Salem St.	Ahram St.-Giza Sq.	10.3-10.6 km/h	80%	- Conflict of buses/shared taxies near bus stops
Malek Feisal St.	Mansooreya Rd.- Maryoteya Rd.	10.1km/h	29%	- Unsuitable traffic signal control system - Conflict of U-turn point - Conflict of buses/shared taxies near bus stop

(b) Outbound Direction

Street	Section	Average Speed (km/h)	Ratio of Total Stopping Time (%)	Causes
Port Said St.	Sayeda Zeinab Sq.-Mohamed Qadry Pasha St.	10.3km/h	80%	- Merging and diverging, from/to side roads without signal light - Conflict of buses/shared taxies near bus stops
	Ahmed Maher Pasha Sq.-Azhar St.	10.2km/h	46%	- Conflict of buses/shared taxies near bus stops
	Daher St.-6th of October Br.	10.0km/h	50%	- Conflict of buses/shared taxies near bus stops
	Farz St.-Sekket El Wayly St.	13.7km/h	55%	- Unsuitable traffic signal control system
	Sekket El Wayly St.-Mostaamara Sr.	15.1km/h	51%	- Conflict of buses/shared taxies near bus stops
Salah Salem St.	Giza Br.-Bahey El Deen Barakat St.	10.1km/h	58%	- Unsuitable traffic signal control system
	Bahey El Deen Barakat Sq.-Giza Sq.	5.6-6.1km/h	43-83%	- Unsuitable traffic signal control system
	Giza Sq.-Ahram St.	4.3-6.6km/h	31-62%	- Conflict of buses/shared taxies near bus stops

Street	Section	Average Speed (km/h)	Ratio of Total Stopping Time (%)	Causes
Ahram St.	Mostashfa St.-Maryoteya Rd.	7.0-7.3km/h	17-33%	- Unsuitable traffic signal control system - Conflict of buses/shared taxies near bus stops
Malek Feisal St.	Maryoteya Rd.- Mansooreya Rd.	10.0km/h	60%	- Conflict of U-turn point - Conflict of buses/shared taxies near bus stops

Source: JICA Study Team

4.3 BASIC PLANNING POLICY AND STRATEGIES

4.3.1 Current Issues and Basic Planning Policy

As previously pointed out in the analysis of the current traffic status on Metro 4 Corridor, the traffic congested sections/or intersections and the causes in the context of traffic engineering were verified by the traffic investments. Major current traffic congestion is caused by inadequate road capacity including the lack of a well-developed traffic management and control system. Such major causes of traffic congestion along Metro 4 Corridor are as follows:

- Unsuitable traffic signal control system at intersections;
- Conflict from buses and shared taxies near bus stops;
- U-Turn conflict points;
- Merging and diverging, from/to side roads without signal light, and
- High occupancy of on-street parking.

Owing to the density of buildings along Metro 4 Corridor, it will be difficult to improve the road capacity to meet the demands of an ever-increasing volume of traffic, even with unlimited investment in new road construction. The traffic management program along Metro 4 Corridor is proposed as a series of short-term measures for the next five years. With a view to achieving a smooth traffic flow along Metro 4 Corridor, the goal of this plan is to induce commuters to shift from private vehicles to public transportation, and to mitigate traffic congestion at bottlenecks. In addition, the plan must consider how to create an attractive urban environment that is amenable to pedestrians as well as for public transport. The time has come to start regulating the inflow of private vehicles with a public transport priority system and by increasing the use of public transport facilities.

From the standpoint of a traffic management and control program, and a public transport priority system, the three basic planning policies can be envisioned.

- To promote the service level of bus transport system;
- To mitigate traffic congestion, and
- To create pedestrian-friendliness.

4.3.2 Strategies for Program of Metro 4 Corridor

A traffic management program that takes into account the following basic strategies, based on the above issues, is envisioned for Metro 4 Corridor. The strategies are as follows:

a. Public transportation facilities will be improved in order to induce commuters to shift from private vehicles to public transportation. The function of a bus priority system will be clarified; therefore, the bus lane facilities should be segregated by introducing a Median Bus Lane System. The conflict between buses and shared taxies near bus stops can be improved by the installation of a bus platform on a median bus lane.

b. In addition to the proposed median bus lane system on Metro 4 Corridor, bus stops/or terminals, for transfer purposes, will be established along the bus routes. At present, bus passengers who transfer are seen at long distance bus stops near Ring Rd. and Ghamra Station on Port Said St., where are the bottleneck points. An Improvement of Bus Stops/or Terminals is necessary for transfer purposes.

c. The signal control system can only be effectively operated when the traffic shows a stable fluctuation pattern. The technical improvement of the signal control system at the bottlenecks will be necessary by the introduction of a Synchronized System, a Traffic Signal Phase System and a Bus Priority System for traffic signal lights, instead of manual operation by traffic police. In order to succeed in the implementation of the given improvement of signal control system on Metro 4 Corridor, the tickets for slow vehicles should be executed carefully. It is necessary that such slow vehicles will be controlled by traffic regulation for passing through the arterial roads. During peak periods, the Slow Vehicles Ban System on the Metro 4 Corridor will be considered. Besides, introduction of a specified detour system for slow vehicles will be necessary.

d. Traffic to and from side roads without traffic lights disturbs the main traffic flows. These non-signalized intersections will be considered for the Installation of Traffic Signal Lights, in order to control both motor vehicles and pedestrian traffic.

e. The conflict of vehicles at U-turn points was seen on Metro 4 Corridor. Such U-turn points should be considered for the Installation of Traffic Signal Lights, as intersections for the synchronized system, or such type of intersection will be improved with a more adequate design.

f. In accordance with the above-mentioned installation of traffic signal lights at intersections and U-turn points, it is highly recommended that the Intersection Improvement should be done by introducing the traffic channelization system, in order to reduce traffic accidents, and where the shape of intersection will change due to the widening of the approach.

g. Based on the analysis of traffic capacity at each bottleneck, either the improvement of signal phases or the widening of approaches will be selected. In those cases where these improvements are considered to be impracticable, then a Grade-Separated Intersection should be planned.

h. In principle, the Metro 4 Corridor parking should be restricted in order to enlarge the road capacity. Two kinds of prohibition measures will be recommended; one is the Prohibition of On-street Parking during 8:00-20:00 along Metro 4 Corridor, and the other is the Prohibition of On-street Parking Charge along secondary streets by introducing a parking ticket system. This is to manage parking duration on street in order to increase the parking turnover rate, and to deter vehicles from long-term parking on street.

i. The traffic safety facilities, such as pedestrian crossings (including bridges) are not sufficient in number. More friendly pedestrian facilities will be provided by introducing a Pedestrian Crossing with Traffic Signal Light, in order to ensure a safe pedestrian environment on Metro 4 Corridor.

j. Since there is no space in the built-up area between Sayeda Zeinab Sq. and Qalaa Sq., in the short-term, it is very difficult to construct the widening of existing and new roads. Accordingly, it is necessary to increase road traffic capacity through the maximum use of the existing road facilities. It is highly recommended that a Traffic Circulation System be introduced for one-way regulation (one-way from Sayeda Zeunab Sq. to Qalaa St. on Mohamed Qadry Pasha St.; and one-way from Mohamed Qadry Pasha St. to Port Said St.) in association with a signal control system and bus priority lane system, in order to support commercial/business activities and to create an attractive urban environment that is amenable for pedestrians as well as for public transport. This strategy is discussed in detail in Section 4.4.6.

4.3.3 Basic Concept of Traffic Management Program Along Metro 4 Corridor

In order to address the strategies and measures of the traffic management program along Metro 4 Corridor, presented in the previous sections, the basic concept is formulated as follows:

(1) Plan Location by Type of Measures

As shown in Figure 4.3.1 (1) (2) (3) and Table 4.3.1 (1) (2) (3) (4) (5), the traffic management program will deal with Metro 4 Corridor, based on the bottleneck sections/or points and their causes in the context of traffic engineering.

Table 4.3.1 (1) Plan Location by Measures on Port Said St.

Measures	Action plan	Sections	Intersections/or Points
1. Bus priority System	1. Median Bus Lane System	1. Long distance transfer point-Bab El Shaareya Sq. 2. Bab El Shaareya Sq.-Mosheer Ahmed Sq. 3. Ahmed Maher Pasha Sq.-Sayeda Zeinab Sq.	- - -
	2. Improvement plan of bus stop/or terminal for transferring	- -	1. Long distance bus stop 2. Ghamra Sta. of Metro 1
2. Improvement of Traffic Signal Control System	1. Improvement of traffic signal phase system at bottlenecks	- -	1. Sawah St. 2. Sekket El Wayly St.
	2. Installation of traffic signal light at intersection (including bus stop of Median Bus Lane System)	- - - - - - - - - - - - - - - -	1. Monstaamara St. 2. Madinet El Ashraf St. 3. Garag El Baladeya St. 4. Farz St. 5. Maamal El Saboon St. 6. Ghamra Station of Metro 1. 7. Daher St. 8. Mosheer Ahmed Ismail Sq. 9. Bab El Shaareya Sq. 10. Azhar St. 11. Sheikh Rehan St. 12. Magles El Shaab St. 13. Sayeda Zeinab Sq. 14. Saad El Deen St. 15. Yoosef El Sebaey St.
	4. Bus priority signal light system		Same as locations of the installation of traffic signal light at intersection
	5. Synchronized traffic signal light system	1. Sawah St.- Sayeda Zeinab Sq. 2. Saad El Deen St.- Yoosef El Sebaey St.	- -
3. Improvement of Intersection	1. Traffic channerization system & widening of approach	-	Same as locations of the improvement of traffic signal control system
	2. Grade-separated intersection	-	1. Bab El Shaareya Sq.
4. Parking System	1. Prohibition of on-street parking	1. Sawah St.- Sayeda Zeinab Sq.	-
	2. Prohibition of on-street parking charge system	1. Daher St.- Yoosef El Sebaey St. on secondary St.	-
5. Pedestrian Friendly System	1. Pedestrian crossing with traffic signal light	-	Same as locations of the improvement of traffic signal control system

Source: JICA Study Team

Table 4.3.1 (2) Plan Location by Measures around Qalaa St.

Measures	Action plan	Sections	Intersections/or Points
1. Traffic Circulation System	1. Bus transit mall system during peak periods	1. Qalaa Sq.- Ahmed Maher Pasha Sq. on Qalaa St. 2. Sheikh Abdel Megeed El Labban St.-Saleeba St.-Shaykhoon St.	- - -
	2. One-way regulation system	Above-mentioned sections, counter-clockwise direction	-
2. Improvement of Traffic Signal Control System	1. Installation of traffic signal light at intersection	-	1. Seroogeya St. 2. Qalaa Sq. 3. Qalaa St.- Salah Salem St.
	2. Synchronized traffic signal light system	1. Qalaa Sq.-Seroogeya St.- Ahmed Maher Pasha Sq.	
3. Improvement of Intersection	1. Traffic channerization system & widening of approach	-	Same as locations of the improvement of traffic signal control system
4. Parking System	1. Prohibition of on-street parking	1. Qalaa Sq.- Ahmed Maher Pasha Sq. on Qalaa St. 2. Sheikh Abdel Megeed El Labban St.-Saleeba St.-Shaykhoon St.	- -
	2. Prohibition of on-street parking charge system	Above-mentioned sections on secondary St.	-
5. Pedestrian Friendly System	1. Pedestrian crossing with traffic signal light	-	Same as locations of the improvement of traffic signal control system

Source: JICA Study Team

Table 4.3.1 (3) Plan Location by Measures on Salah Salem St.

Measures	Action plan	Sections	Intersections/or Points
1. Bus priority System	1. Median Bus Lane System	1. Sayeda Aisha Br.-Fostat St. 2. Malek Saleh Br.- Bahr El Aazam St.	- -
2. Improvement of Traffic Signal Control System	1. Improvement of traffic signal phase system at bottlenecks	- -	1. Qayrawan Sq. 2. Giza Br.
	2. Installation of traffic signal light at intersection (including bus stop of Median Bus Lane System)	- - - - -	1. Sayeda Aisha Br. 2. Fostat St. 3. Malek El Saleh Br. 4. Giza Sq 5. Ahram St.
	3. Bus priority signal light system	- - - -	Same as locations of the installation of traffic signal light at intersection
	4. Synchronized traffic signal light system	1. Malek El Saleh Br.-Ahram St.	-
3. Improvement of Intersection	1. Traffic channerization system & widening of approach	-	Same as locations of the improvement of traffic signal control system
	2. Grade-separated intersection	-	1. Bahary El Oyoon St.
4. Parking System	1. Prohibition of on-street parking	1. Sayeda Aisha Br.- Ahram St.	-
	2. Prohibition of on-street parking charge system	1. Malek El Saleh Br.-Ahram St. on secondary St.	-
5. Pedestrian Friendly System	1. Pedestrian crossing with traffic signal light	-	Same as locations of the improvement of traffic signal control system

Source: JICA Study Team

Table 4.3.1 (4) Plan Location by Measures on Ahram St.

Measures	Action plan	Sections	Intersections/or Points
1. Bus priority System	1. Median Bus Lane System	1. Tereat El Zomor El Sharqy St.-Mansooreya Rd.	-
2. Improvement of Traffic Signal Control System	1. Improvement of traffic signal phase system at bottlenecks	-	1. Maryoteya Rd. 2. Mansooreya Rd.
	2. Installation of traffic signal light at intersection (including bus stop of Median Bus Lane System)	- - - - -	1. Tereat El Zomor Sharqy St. 2. Samy El Baroody St. 3. Naser El Thawra St. 4. Ossmam Moharam St. 5. Sahl Hamza St.
	3. Installation of traffic signal light at U-turn points (including bus stop of Median Bus Lane System)	- - - - -	1. Mesaha Sq. 2. Madkoor Sq. 3. Nabarawy St. 4. Sheikh El Sherbeeny St. 5. Taawon Sq.
	4. Bus priority signal light system		Same as locations of the installation of traffic signal light at intersection & U-turn point
	5. Synchronized traffic signal light system	1. Mesaha Sq.-Mansooreya Rd.	-
3. Improvement of Intersection	1. Traffic channerization system & widening of approach	-	Same as locations of the improvement of traffic signal control system
	2. Grade-separated intersection	-	1. Maryoteya Rd.
4. Parking System	1. Prohibition of on-street parking	1. Tereat El Zomor El Sharqy St.- Mansooreya Rd.	-
5. Pedestrian Friendly System	1. Pedestrian crossing with traffic signal light	-	Same as locations of the improvement of traffic signal control system

Source: JICA Study Team

Table 4.3.1 (5) Plan Location by Measures on Malek Feisal St.

Measures	Action plan	Sections	Intersections/or Points
1. Bus priority System	1. Improvement of traffic signal control system*	1. Mansooreya Rd.-Nady St.	-
2. Improvement of Traffic Signal Control System	1. Improvement of traffic signal phase system at bottlenecks	-	1. Nady St.
	2. Installation of traffic signal light at intersection	- - - - - -	1. Mansooreya Rd. 2. Maryoteya Rd. 3. Safa Wel Marwa St. 4. Osman Moharam St. 5. Madkoor St. 6. Saad Ebn Aby Waqqas St.
	3. Installation of traffic signal light at U-turn points	- - - -	1. Abu Bakr El Sadeeq St. 2. Sheikh El Sherbeeny St. 3. Hassan Mohamed St. 4. Nassar El Thawra St.
	4. Synchronized traffic signal light system	1. Mansooreya Rd. –Nady St.	
3. Improvement of Intersection	1. Traffic channerization system & widening of approach	-	Same as locations of the improvement of traffic signal control system
	2. Grade-separated intersection	-	1. Maryoteya Rd.
4. Pedestrian Friendly System	1. Pedestrian crossing with traffic signal light	-	Same as locations of the improvement of traffic signal control system

Source: JICA Study Team
*Note: * Due to difficulty of installation of the median bus lane system, the improvement of traffic signal control system should be proposed, in order to achieve a smooth traffic flow.*

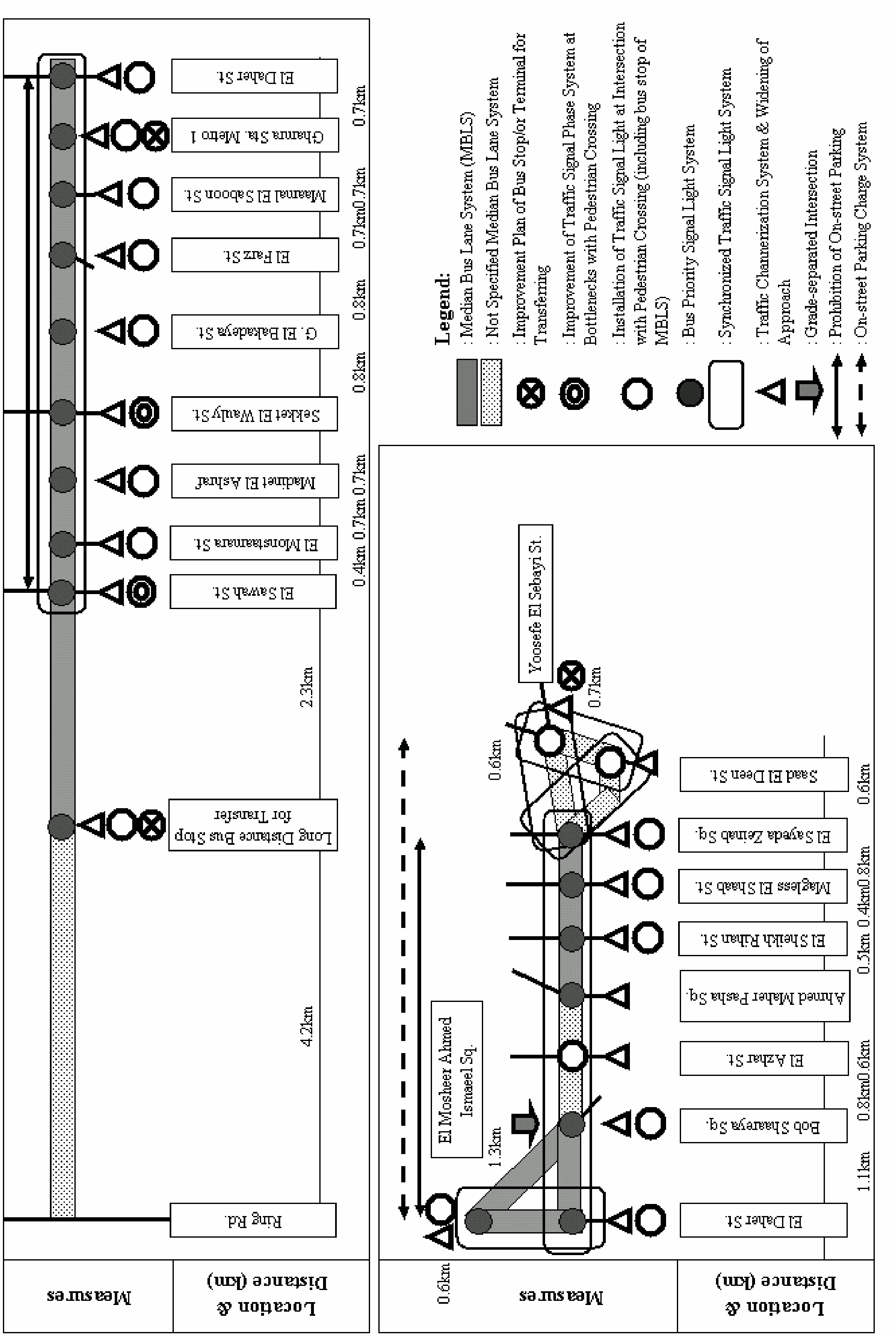


Figure 4.3.1 (1) Plan Location by Measures on Metro 4 Corridor – –Port Said St.

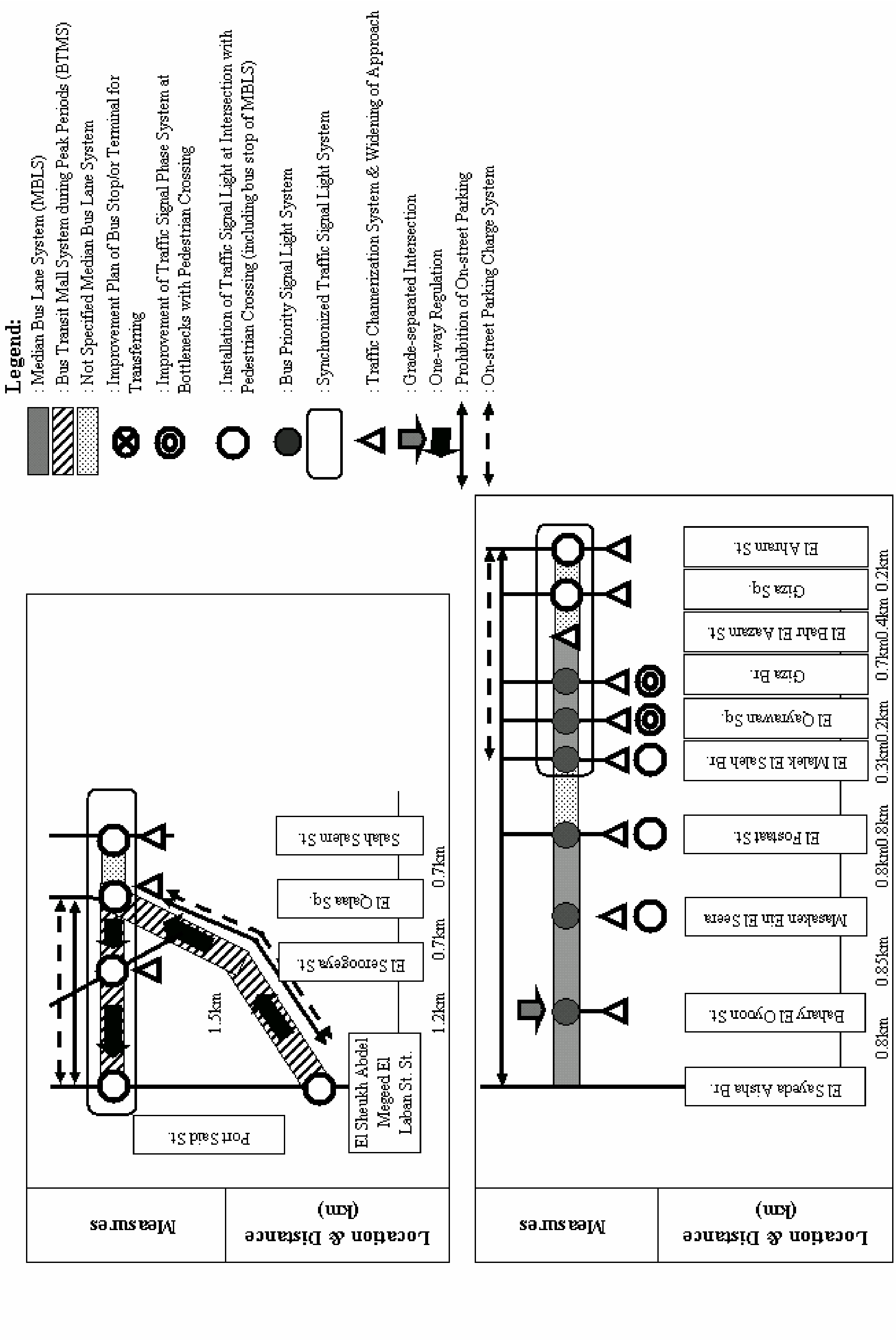


Figure 4.3.1 (2) Plan Location by Measures on Metro 4 Corridor – Qalaa St., Salah Salem St.

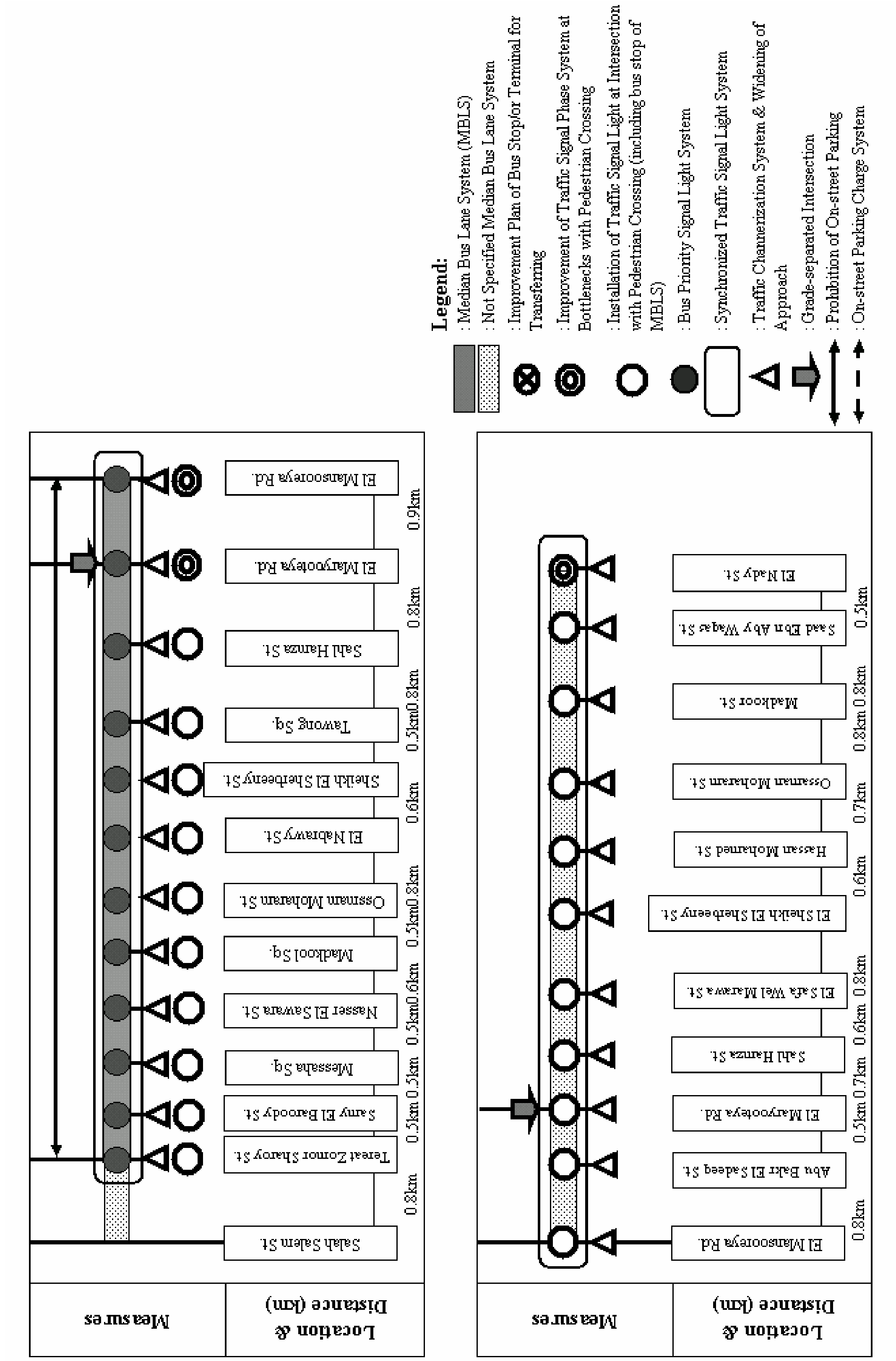


Figure 4.3.1 (3) Plan Location by Measures on Metro 4 Corridor – Ahram St., Malek Feisal St.