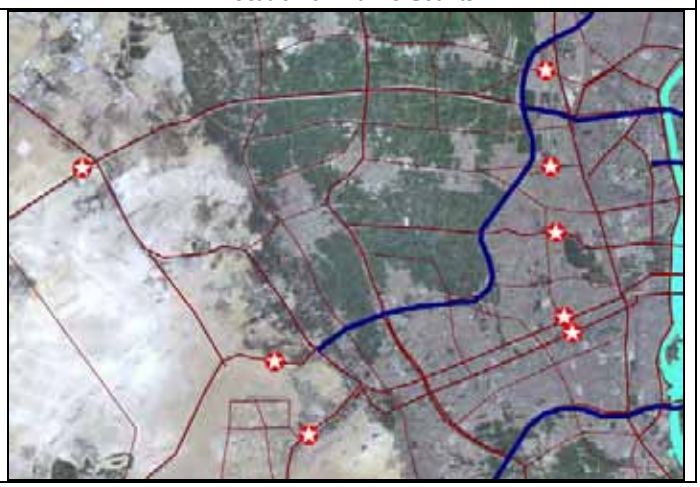
2 Future Traffic Demand of Western Development Corridor

2.1 A traffic survey was conducted to collect current travel characteristics of residents in 6th of October NUC. The purpose of this survey was to determine the daily traffic volumes on the road network and the distribution of vehicle types in the traffic flow in order to update and supplement the origin and destination (OD) tables of CREATS (Transportation Master Plan and Feasibility Study of Urban Transport Projects in Greater Cairo Region) and the PPP study (Public-Private Partnership Program for Cairo Urban Toll Expressway Network Development).

2.2 A traffic counting survey was conducted at eight stations crossing the existing transport corridors, as shown in Figure 2.1. Counting methods included 16-hour traffic counting from 06:00 hrs till 22:00 hrs and manual counting of hourly traffic by direction and vehicle type. Traffic counting was conducted at all locations on a typical working day (Tuesday) in December.

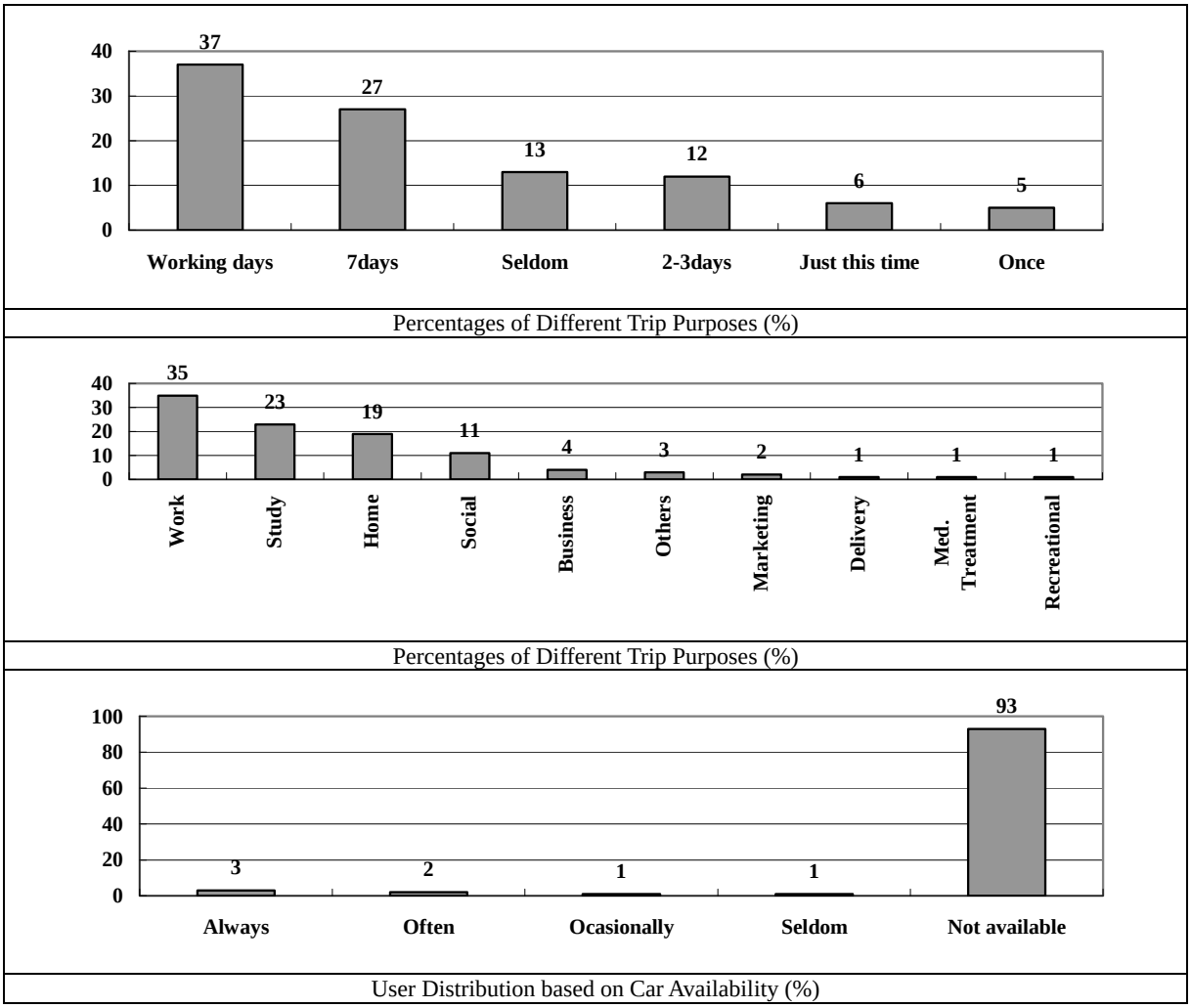
No	Name of Traffic Counting Station	Location of Traffic Counts
1	El- Barageel Street next to Imbaba airport.	
2	Nahya Street next to Boulaq terminal.	
3	26th of July corridor in the reach from Giza to Ring Road (near Ring Road).	
4	Faysal Street next to Sports Collage.	
5	Al-Haram (Pyramids) street next to Electricity Distribution Company Building.	
6	26th of July corridor between Ring Road and Shaikh Zayed entrance.	
7	The beginning of El-Wahat Road near the Ring Road.	
8	The beginning of Al Fayoum Road in front of the electricity station.	

Source: Traffic Survey for 2007, JICA Study Team

Figure 2.1 Locations of Traffic Counting Surveys

2.3 In addition, the Study Team conducted a Public Transport Passenger Survey (PTPS). The objective of the PTPS was to collect information on public transport passengers traveling between 6th of October NUC and Cairo / Giza. The survey targeted a total of 400 passengers who go to/from Cairo / Giza at the public transport terminals in 6th of October NUC.

2.4 Regarding the trip frequency, the survey results showed that the majority of users were going to/coming from 6th October City on working days only (37%), while the second highest number of users (27%) were undertaking the trip 7 days per week. As for the trip purpose, the analysis showed that the majority was for work (35%). Trips for education represented about 23%, while the homeward trip constituted about 19%. As for car availability, the majority of the interviewed persons do not have a car (93%).



Source: Traffic Survey, 2007, JICA Study Team

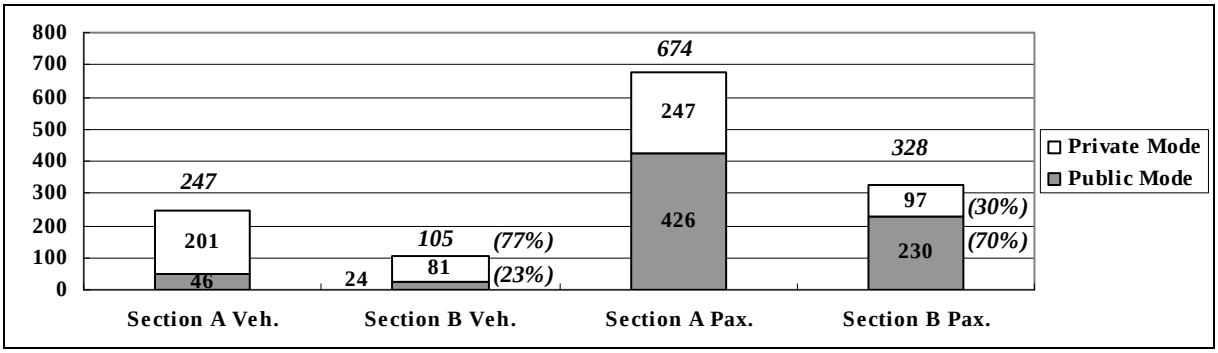
Figure 2.2 Outputs from the Public Transport Passenger Survey

2.5 The survey results also showed that the average total travel time between the origin and destination was about 98 minutes, while the minimum and maximum trip time was about 45 min. and seven hours, respectively. The long travel time belongs to those trips coming from or going to other governorates. As for the components of travel time, an average in-vehicle time is about 74 minutes, 5 minutes of walking time to the first station, 13.2 minutes of waiting time at the station and about 10 minutes for changing the travel mode.

2.6 Concerning the "willingness to pay" for the three scenarios of trip time savings, the survey results showed:

- For a 10% trip time saving, the majority of the users (50%) were willing to pay a fare of LE2.5.
- For a 25% trip time saving, the majority of the users (34%) were willing to pay a fare of LE2.75.
- For a 50% trip time saving, the majority of the users (50%) were willing to pay a fare of LE3.0.

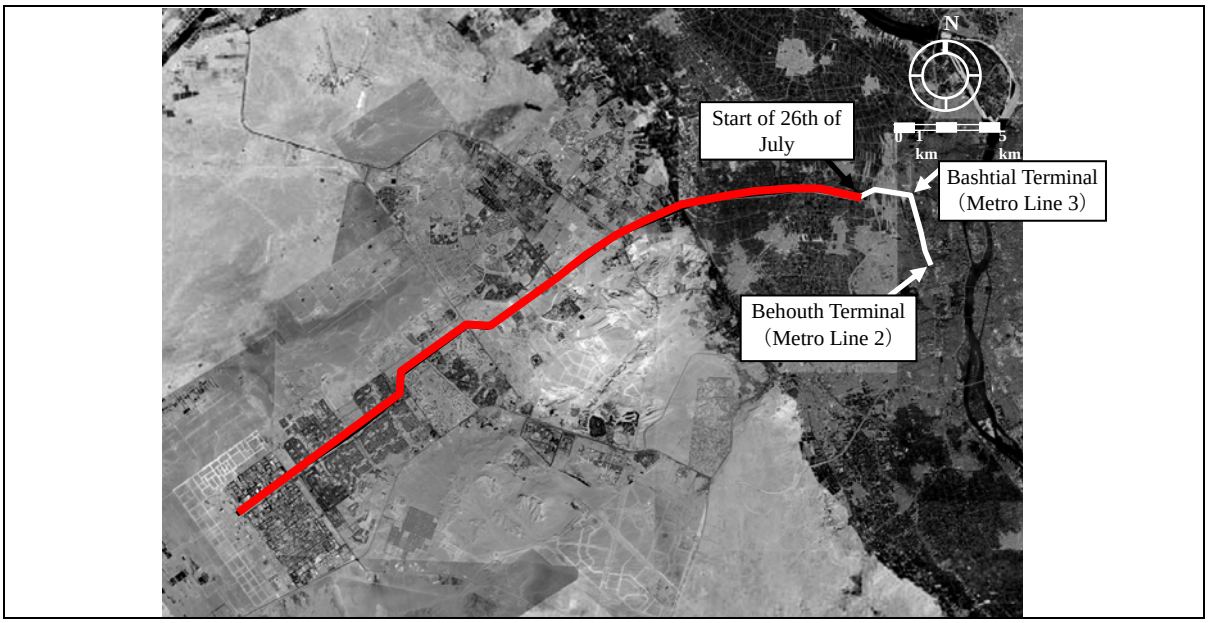
2.7 In order to estimate the total number of vehicle movements between Cairo / Giza and 6th October NUC, two cross sections were set up: "Section A" across Ring Road and "Section B" across Alexandria Desert Road. Figure 2.3 shows the total number of vehicles and passengers estimated by applying the average numbers of passengers by vehicle type of CREATS. Comparing the volumes of Section A and B, the volumes on Section A are more than double that of Section B in vehicle and passenger numbers.



Source: Traffic Survey, 2007, JICA Study Team

Figure 2.3 Total Volume of Vehicles and Passengers (1,000) at Cross Sections

2.7 As for the on-going transport network improvement projects, GOPP is considering implementation of a busway along the 26th of July Corridor. The busway services cannot be started from Cairo University Station to join the Metro Line 2, as proposed by the CREATS Study, since there is not enough land area. In this respect, an alternative is to start the busway near the Metro Line 2 Behouth Station. An underpass can be constructed between the existing Behouth Metro station and the proposed bus terminal. This will allow the metro and bus passengers to transfer without needing to use surface roads.



Source: JICA Study Team, based on consultation with GOPP representatives.

Figure 2.4 Overall Busway Alignment

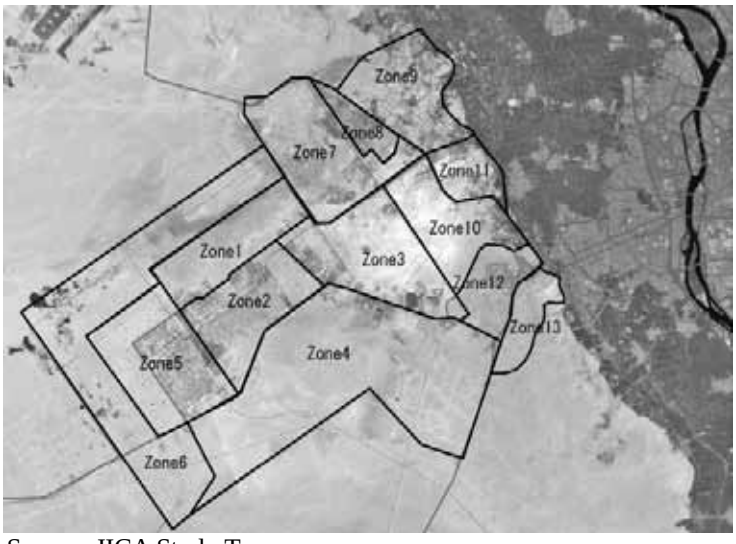
2.8 There are 16 other related transport projects as shown in Table 2.4. Of these, projects No. 5 through 9, No.10, 13, 15 and 16 are projects that directly relate to the western corridor.

Table 2.1 Overall Summary of Road Projects in the Greater Cairo Region, as of Year 2007

No	Project	Status	In Charge
East of Greater Cairo			
1	Intersection of Cairo-Ismailia Desert Road with RR	Approved	GOPP
2	Connection of the Entrances of Bader and Al Shoruk Cities with Cairo-Suez and Cairo-Ismailia Desert Roads	Approved	GOPP
North of Greater Cairo			
3	Construction of New Arterial Expressway (Moassat Al Zakah) to connect the East Arc of Ring Road from Cairo-Ismailia Desert Road till Cornish Al Nile at Shubra Al Khyma	Under Study	GOPP
4	Development of North Imbaba including Air Port Area	Under Study	GOPP
West of Greater Cairo			
5	Completion of the Ring Road	On-going	MOHUUD
6	Construction of Saft Al Labn Corridor	On-going	MOHUUD
7	Construction of Al Farag New Corridor	Under Study	GOPP
8	Improvement of Al-Ramayah Square	Approved	GOPP
9	Connection of Cairo-Alexandria Desert Road with RR at km 21	Approved	GOPP
Inside Greater Cairo			
10	Connection of 15th of May and 6th of October Bridges	Under Study	GOPP
11	Improvement of Ramses Square	Under Study	GOPP
12	Improvement of Giza Square and Murad Street	On-going	GOPP, MOHUUD
13	Development of 15th of May bridge	Under Study	GOPP
14	Construction of Intersection of Autostrade with Remises Extension	On-going	Cairo
Ring Roads			
15	Upgrading of Ring Road	Under Study	GARBLT
16	Construction of Regional Ring Road	Under Study and On-going	MOT

Source: GOPP

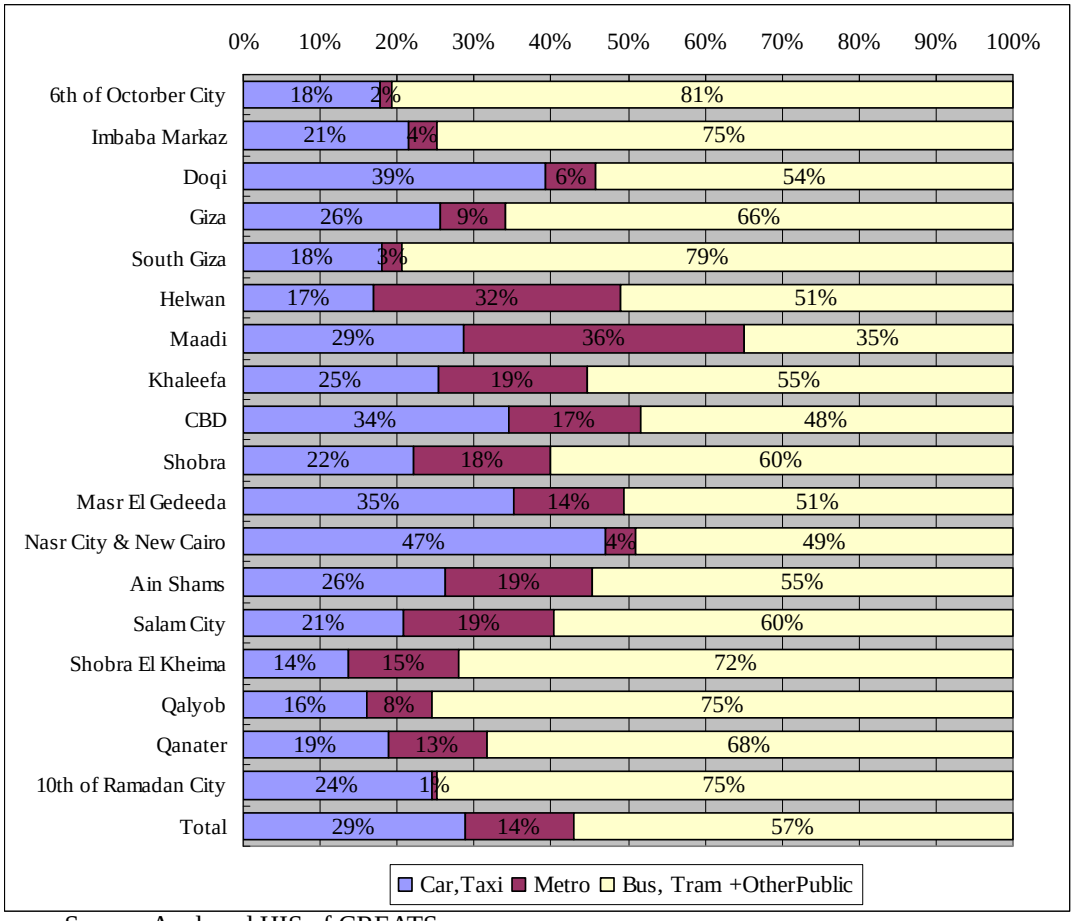
2.9 The future traffic demand was estimated by using the same traffic model as used in CREATS, but based on the future urban land use and population distribution predicted by the Study Team and transport characteristics determined from the surveys. For the convenience of the transportation study, the 6th of October NUC sector was divided into 13 traffic zones, as shown in Figure 2.5).



Source: JICA Study Team

Figure 2.5 Traffic Zones in 6th of October NUC

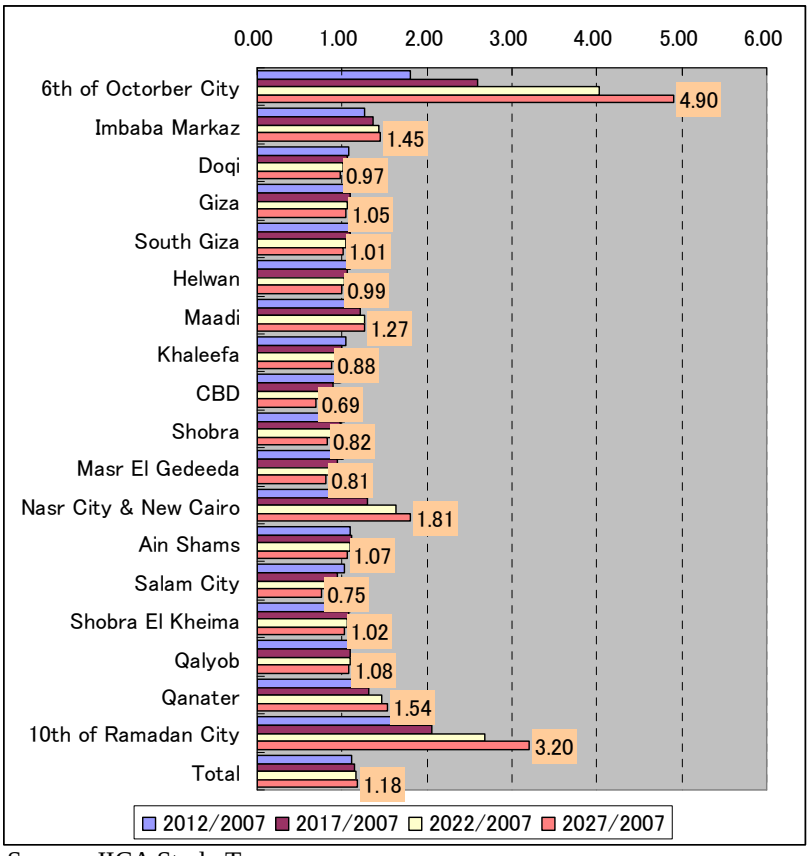
2.10 The modal share by sector zone was analyzed from the Household Interview Survey (HIS) done by CREATS in 2002. Although the person's transportation behavior changes gradually, the modal share shown in CREATS HIS is considered to be applicable to the Pre-F/S, as the five years time lapse probably does not greatly affect the citizens' modal share behavior. The Study Team used the CREATS HIS modal share data, based on this assumption. The result of the Study Team's analysis is summarized in Figure 2.6. In total, the modal share is roughly considered as Walking: 30%, Car and Taxi: 20%, Rail: 10%, and Bus: 40%. Looking closely at the Metro section receiving service, and the section between Helwan and Maadi in particular, 30-40% of trips used the Metro. The areas to be serviced by the Western Corridor project, i.e. 6th of October and Giza, showed a higher rate of bus use (70-80%) because no other public transport is currently available.



Source: Analyzed HIS of CREATS

Figure 2.6 Modal Share by Sector Zone in CREATS HIS 2002

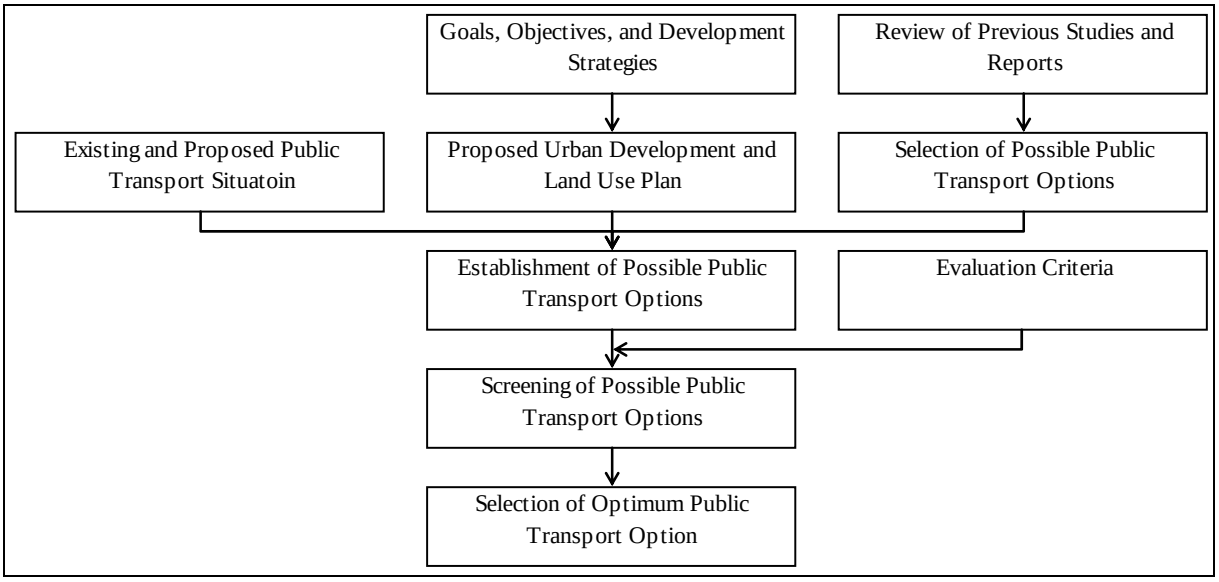
2.11 Public transport trip generation was estimated by sector zone. 6th of October NUC is predicted to show a remarkable growth ratio between 2007 and 2027, and 10th of Ramadan NUC will follow in significance, as shown in Figure 2.7. As for the current trip generation volume, Giza shows the largest volume with 1.5 million trips per day, followed by Masr El Gedeeda with 1.3 million trips and Imbaba Markaz with 1.2 million trips.



Source: JICA Study Team

Figure 2.7 Growth Rate of Public Transport Generation

2.12 Various studies and reports related to the introduction of public transport systems have already proposed different types, routes and origins of public transport systems for the corridor between Cairo and 6th of October NUC. A possible public transport solution has been established and the optimum public transport option has been selected in this Pre-F/S.



Source: JICA Study Team

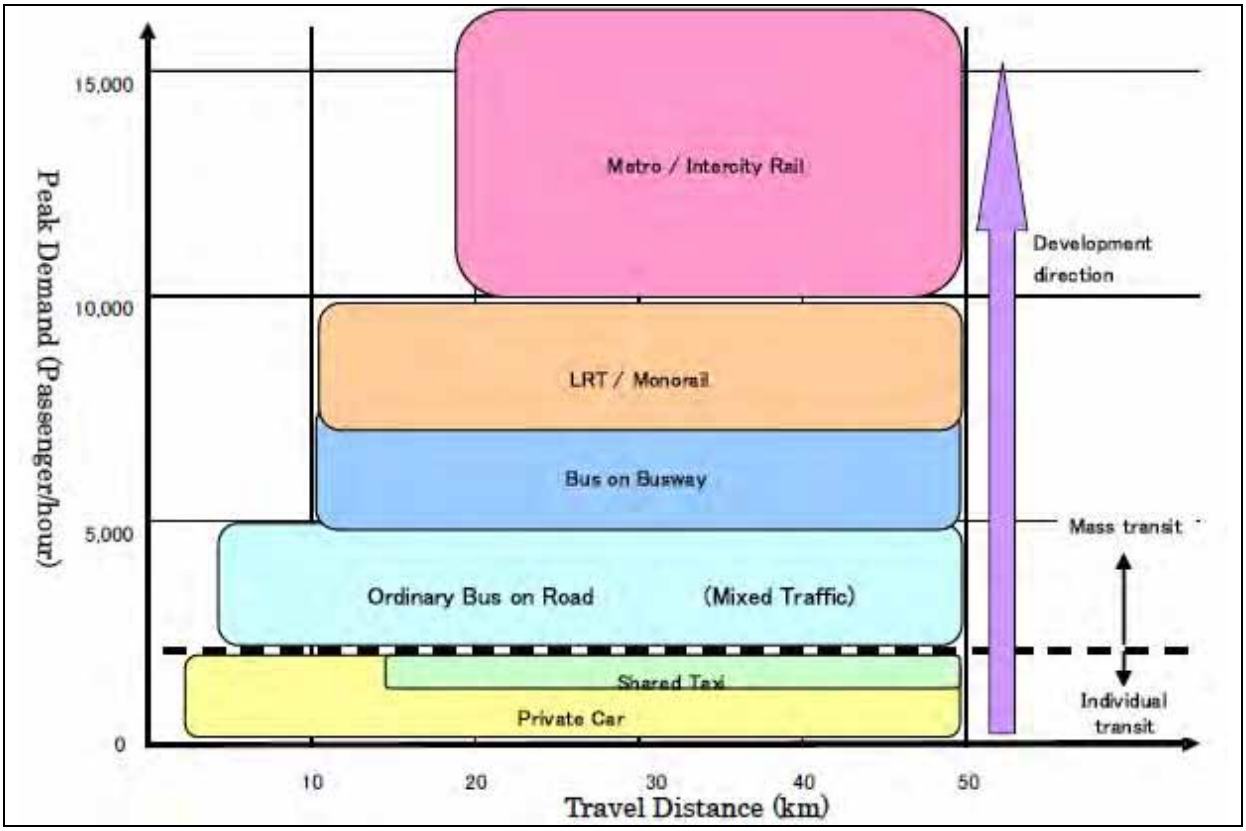
Figure 2.8 Study Approach for Planning and Selection of Public Transport Options

2.13 The transport capacity of applicable transport modes is summarized in Table 2.2. Figure 2.9 shows the relationship between traffic density and distance of various transport modes. Considering that the length of the Cairo – 6th of October NUC corridor is about 30 km, and through transport demand in the planning period is estimated reaching to 300,000 (daily) and 42,000 (peak hour), the development of transport system will be limited to a mixed strategy of an exclusive busway combined with an intercity railway.

Table 2.2 Transport Capacity by Transport Mode by Headway in Minutes

System		Capacity per Car (pax./car)	Congestion Rate (%)	Car/Set (Car/Train)	Transport Capacity by Headway in Minutes (pax./way/hour)				
					1	3	5	10	15
Bus	Ordinary	60	100	1	3,600	1,200	720	360	240
	Large	100	100	1	6,000	2,000	1,200	600	400
	Bi-Articulated	270	100	1	16,200	5,400	3,240	1,620	1,080
LRT		75	120	4	18,000	6,000	3,600	1,800	1,200
Monorail		100	120	6	-	12,000	7,200	3,600	2,400
MRT		140	150	6	-	16,800	10,080	5,040	3,360
		140	150	8	-	22,400	13,440	6,720	4,480

Source: JICA Study Team



Source: JICA Study Team

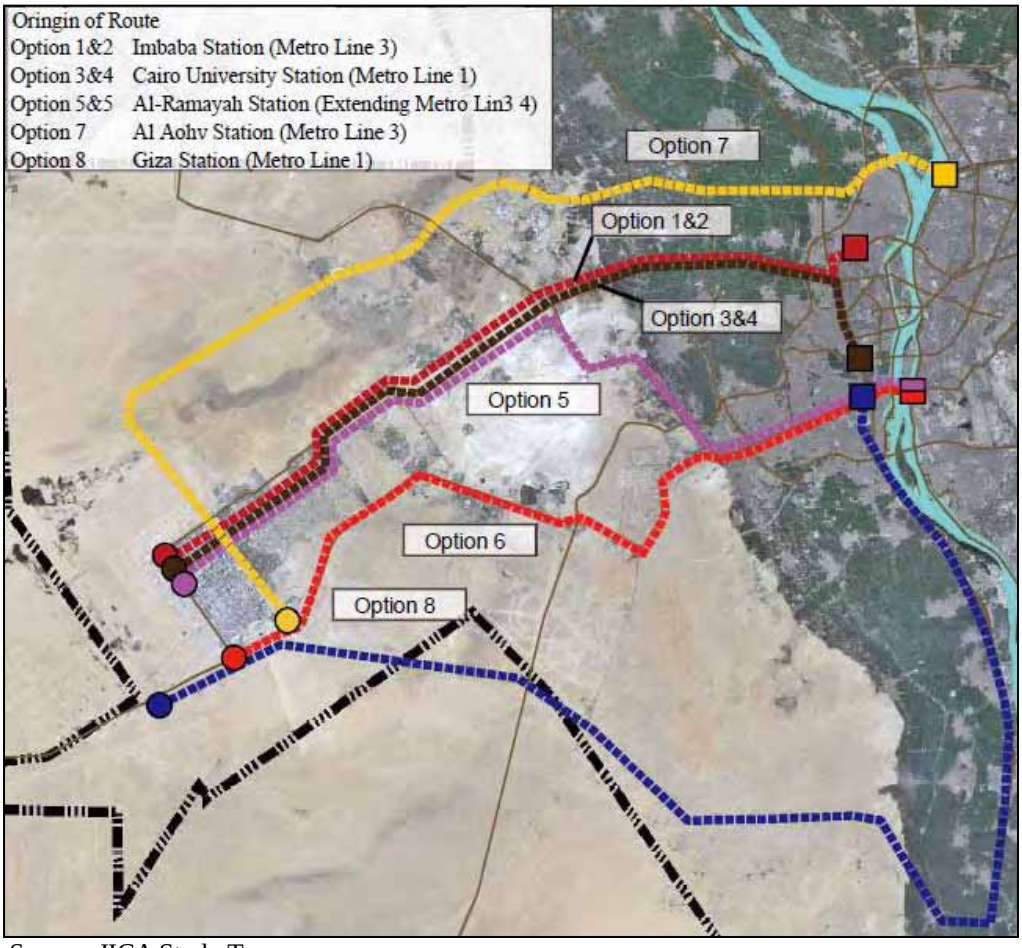
Figure 2.9 Transport Mode Selection by Traffic Demand and Travel Distance

2.14 Considering the nature of the transport mode mix, possible options and routes for a transport system were explored, as listed in Table 2.3 and illustrated in Figure 2.10.

Table 2.3 Possible Options for a Cairo – 6th of October Transport System

No	Name of Option	Candidate Location of Origin	Corridor	Length (km)	Mode	Connection to MRT
1	Bus Plan	Imbaba	26th of July Road	35.9	Bus	Metro Line 3 Imbaba Sta. (proposed)
2	Railway Plan on the Same Track of Option 1	Imbaba	26th of July Road	35.9	Rail	Metro Line 3 Imbaba Sta. (proposed)
3	Bus Plan	Cairo University	Ext of Sh. Abd. Hospt. / 26th of July Road	40.73	Bus	Metro Line 1 Cairo University Sta.
4	Railway Plan on the Same Track of Option 3	Cairo University	Ext of Sh. Abd. Hospt. / 26th of July Road	40.73	Rail	Metro Line 1 Cairo University Sta.
5	Extension of Metro 4 to 6th of October	Al-Ramayah	Alex Desert Road / 26th of July Road	35.19	Rail	Metro Line 4 Al-Ramayah Sq. Sta. (proposed)
6	Extension of Metro 4 to 6th of October	Al-Ramayah	Al Wahat Road	32.31	Rail	Metro Line 4 Al-Ramayah Sq. Sta. (proposed)
7	Railway Plan on Extension Road of North Expressway	Al Farag	Ext. of Ah.al Wahat	39.99	Rail	Metro Line 3 Al Aohv Sta. (proposed)
8	Utilization of Egypt Railway Plan	Giza Station	6th of October Railway Corridor	66.39	Rail	Metro Line 2 at Giza Station

Source: JICA Study Team based on the CREATS and McKinsey Study



Source: JICA Study Team

Figure 2.10 Possible Options for a Cairo – 6th of October Transport System

2.15 The evaluation factors shown in Table 2.4 were adopted for doing a comparative analysis of the possible transport systems. The conclusions of this analysis are summarized in Table 2.5.

Table 2.4 Evaluation Factors for Possible Transport System Options

Category	Factors
General	Location of origin and destination, length, mode of transport, and connection to Metro stations.
Traffic Functionality	Total number of passengers and peak hour passengers.
Urban Development and Land Use	Preference, from the viewpoint of land use and conformity to urban development directions.
Engineering Aspects	Engineering profile and rough cost estimates. The cost estimates refer to the cost estimates of pre-feasibility studies presented in Chapters 4 and 5 of the Main Report.
Socio Environmental Aspects	Necessity for land acquisition, number of families/persons affected by the project, and natural environment.
Economic Aspects	The integrated index of project costs and number of passengers.

Source: JICA Study Team

- The short term proposed plan for Option 3 (Busway) was determined to be the most preferable plan among the considered options. From the point of view of coordination and integration with the urbanization of the Western Corridor development, Option 5 (Railway) was superior to the other options. Considering the total transport demand, a transport mode mix concept comprising Option 3 (urgent, auxiliary transport mode in the short term) and Option 5 (long term, major transport mode) is advisable.

- 26th of July Road will already have been utilized for Option 3, so that excludes Option 2 or Option 4 from being selected. Option 7 and Option 8 attract only small demands. Option 6 might be the only rival plan to Option 5 when 6th of October City develops to the southward, but for the time being, Option 5 is considered better.

- Al Farag Road (Option 7) is an on-going project by GOPP. With regard to the road capacity, there will be a need for a new road connecting 6th of October NUC to Giza/Cairo. As this route runs through mostly agricultural areas, the route is not favorable for urban type of public transport. However, this route may be suitable for cargo transport as it connects to the industrial areas.

Table 2.5 Comparative Analysis of Alternative Routes

	Mode	Magnitude of Traffic Demand in 2027 ('000)	Urban Development Direction	Construction cost (US$ mil)	Socio-Environmental aspect	Investment per pass. (US$/Pa.)	Overall Evaluation
1	Bus	324	Point to point	545	A little	2,330	Not recommended
2	Rail	620	Point to point	977	Some	1,330	Not recommended
3	**Bus**	**318**	**Point to point**	**578**	**Little**	**2,510**	**Recommended as short term plan**
4	Rail	660	Point to point	969	Many	1,240	Not recommended
5	**Rail**	**666**	**Corridor development**	**1,605**	**A little**	**2,030**	**Recommended as medium & long term**
6	Rail	594	Corridor development	1,606	A little	2,270	Alternative to Option 5
7	Rail	324	Point to point	1,004	Some	2,600	Considered as a point-to-point route
8	Rail	74	Point to point	633	Little	7,190	Not recommended

Source: JICA Study Team based on the CREATS and McKinsey Study

2.16 The route and station locations need to be set in order to allow the forecast transport passenger volumes to be estimated. In this study, the Study Team assumed a railway route and stations of 6th of October Line and the 26th of July Busway. It is noted that for the convenience of understanding, the railway section between El-Malik El-Saleh and Al Wahat Road is called Metro Line 4, and the section between Al Wahat Road and Bank Street is named as 6th of October Line.

2.17 Future demands described in the former sections are summarized in Table 2.6. The share of railway users will comprise roughly 75% of these demands and busway users will comprise about is 25%. Considering the physical characteristics of the proposed busway as discussed in Chapter 3 of the Main Report, it is clear that the demand in 2022 of 120,700 passing through passengers per direction will already be beyond the capacity. This leads to the need to implement the 6th October Line in time to start operations before 2022.

Table 2.6 Summary of Future Demand of 6th of October Corridor and Necessary Improvement

Section	Year	No of Daily Passenger	Max. Passing through Volume per Direction	Improvement in 2008-2012 (Busway along 26th of July)
6th of October Line + Metro 4 Section 1	2017	425,800	144,800	
	2022*1	439,900	151,900	
	2022*2	677,600	201,400	
	2027	795,800	221,000	
Busway on 26th July Corridor	2012	100,800	40,400	
	2017	157,400	61,700	
	2022*1	313,800	**120,700**	
	2022*2	209,200	72,800	
	2027	229,700	80,700	
Total	2012	100,800	40,400	
	2017	583,200	206,500	
	2022*1	753,700	272,600	
	2022*2	886,800	274,200	
	2027	1,025,500	301,700	
Improvement in 2013-2017 (Metro Line 4 up to Pyramid Area)				Improvement in 2018-2022 (6th of October Line up to 6th of October NUC)
				

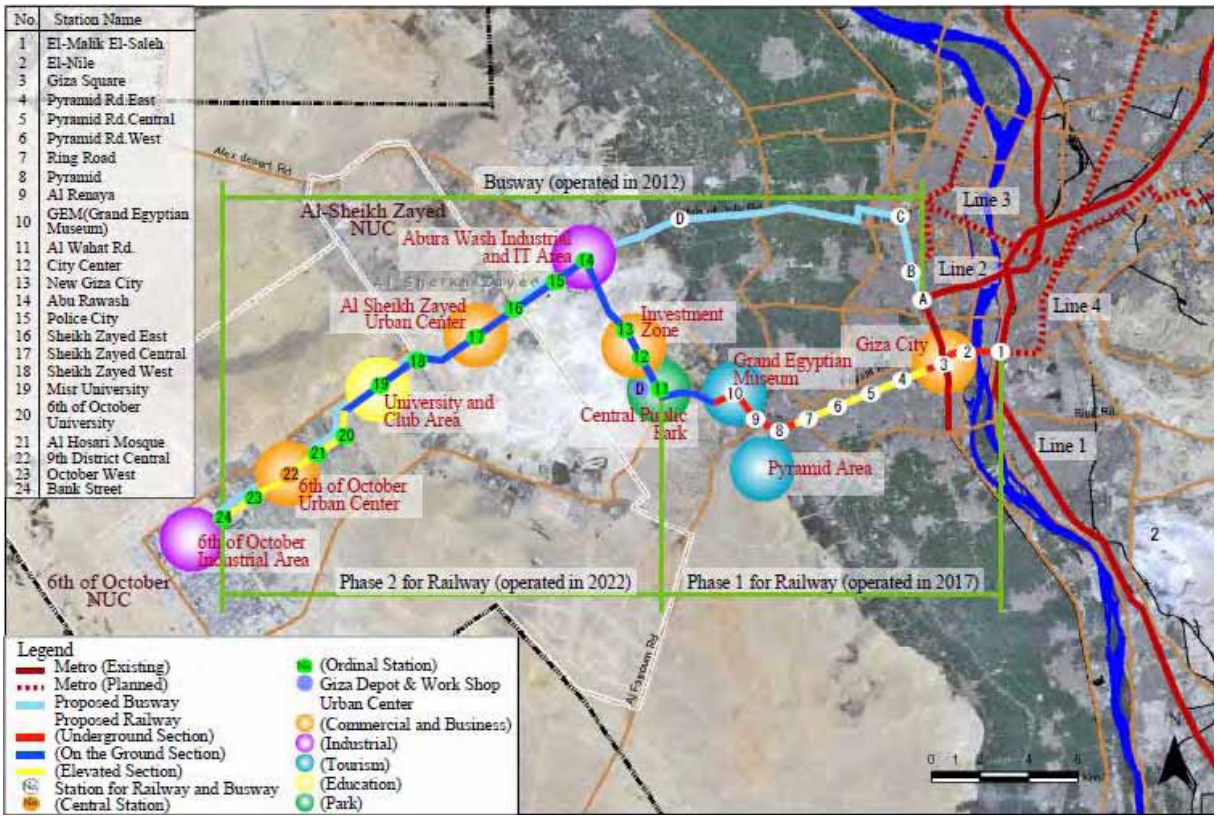
Source: JICA Study Team
Note: *1: A case *with* 6th of October Line
Note: *2: A case *without* 6th of October Line

3 6th of October Railway

3.1 The route for the proposed 6th of October Railway has been designed to run through the existing and planned urban areas as much as possible.

3.2 Selection of the station locations was carried out by firstly setting the average distance between consecutive stations to 1.7 km, taking into consideration the existing Metro. The proposed railway starts at El Malik El-Saleh Station (No.1) on Metro Line 1, and passes under the River Nile to the Giza the side. Then it will connect to Metro Line 2 at Giza Square Station (No.3). The new line will provide access to the Pyramids in Giza at Pyramid Station (No. 8), and also to the Grand Egyptian Museum (now under design) at GEM Station (No.10). Al Wahat Station (No. 11) will be the temporary terminal for the Phase I development. Phase II, comprising the remaining section (stations No.12 through 24), will be an extension of the railway to 6th of October NUC via the new development areas..

3.3 Selection of the structure types along the route is envisaged as shown in Figure 3.1. Between stations No.1 and 3, the line will be underground to pass under the River Nile. The section between stations No. 4 and 7 will be elevated to pass through the urbanized area of southern Giza. Between stations 8 and 10, it is planned to be underground, so as not to harm the landscape of the heritage area near the Pyramids in Giza. The section between stations 10 through 19 will basically be under development. As the roads are relatively wide in this section, the railway is planned at grade. The section between stations No. 20 through 24 is a relatively urbanized part of 6th of October NUC, so the line is planned to be elevated here.



Source: JICA Study Team

Figure 3.1 Route and Structure for the Proposed Railway

3.4 Selection of the type of rail transportation system was done comprehensively by assessing three aspects: (i) technical; (ii) O&M; and (iii) social characteristics. As an overall evaluation, it was concluded that conventional heavy rail was the optimum system. Linear motor systems have little merit due to the length of the underground section being too short. Monorail systems do not show good cost performance in the at-grade sections.

Table 3.1 Evaluation of Suitable Railway Systems

Evaluation Item	Heavy Rail	Linear Motor (LIM)	Monorail
Compatibility with Route Condition	Good for any alignment	Good for elevated /underground	Good for elevated
Transportation Capacity	Large capacity	Large but smaller than Heavy Rail	Large, but smaller than Heavy Rail
Easiness of Viaduct Const.	Girder type mitigates traffics	Girder type mitigates traffics	Easy construction
Operation	Travel distance within 100 km	Travel distance within 40 km	Travel distance within 30 km
Noise, Vibration and Scenery	Noisy, protection measure required	Smaller noise due to no traction gear	Smallest because rubber tires are use
Overall Evaluation	Most appropriate to 6th October Line	Second to Heavy Rail	Second to Heavy Rail

Source: JICA Study Team

3.5 The planned route, route conditions and track layout of stations are summarized below:

- Considering the traffic demand, the target years of the implementation are 2017 for Phase I (El Malek El Saleh – Al Wahat Road) and 2022 for Phase II (Al Wahat Road – Bank Street (6th of October), as shown in Table 3.2.
- Express train services are proposed for 6th of October. The express trains are planed to stop at eight stations: Giza Square, Pyramid Road, Central, Pyramid, Grand Egyptian Museum, Al Wahat Road, Sheikh Zayed Central, 6th of October University, and October West.

Table 3.2 Phase-wise Plan of Railway Implementation

Phase	Section	Distance (km)	Target Year
Phase I	El Malek El Saleh – Al Wahat Road	15.2	2017
	Under Ground Section	7.5	
	At Grade Section	1.5	
	Elevated Section	6.2	
Phase II	Al Wahat Road – Bank Street (6th of October)	25.3	2022
	At Grade Section	17.7	
	Elevated Section	7.6	

Source: JICA Study Team

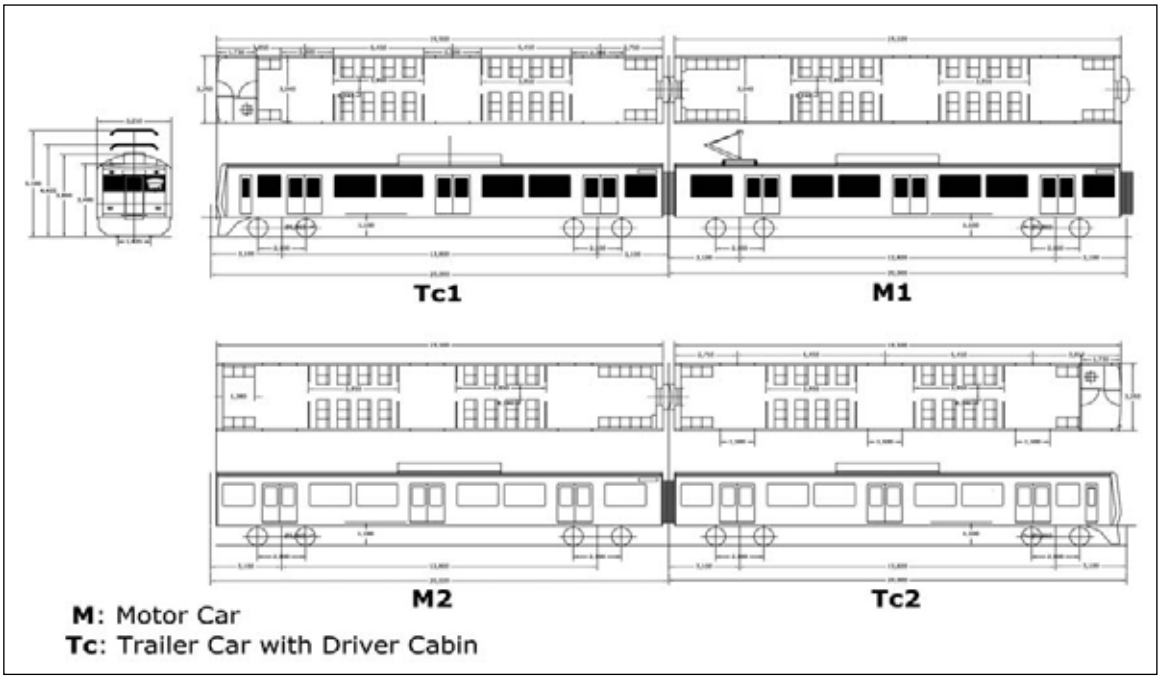
3.6 The proposed railway will follow the current Metro schedule. The morning peak hour will be between 8:00 am and 9:00 am during which the trains will operate at 175-190 % of the nominal boarding efficiency. The headway in track sections having a dense operation will be affected by the acceleration and deceleration characteristic of the trains, as well as the length of the train sets, the dwell times, and the set up of the signal equipment. The proposed train operation conditions are summarized in Table 3.3.

Table 3.3 Train Operation Conditions

Item	Unit	Phase I (2017)	Phase II 2022 (2027)
Volume of Sectional Transport (max.)	passengers/hour/way	20,272	28,200 (30,940)
Number of Cars per Train	car/train	6	8
Nominal Passengers per Train	person/train	942	1,266
Number of Trains at Peak Hour	train/hour/way	12	5 (Express: Bank Street) 4 (Ordinary: Bank Street) 4 (Ordinary: Al.Wahat)
Train Headway (peak hour)	minutes	5	4.5
Transport Capacity	persons/hour	20,300	31,000
Boarding Efficiency (congestion ratio)	%	180	175 (190)
Traveling Time	minutes	24.5	44.5 (Express)/61 (Ordinary)
Average Scheduled Speed	km/h	37.2	54.6 (Express)/39.8 (Ordinary)
Number of Trains	per day/direction	153	159
Required Reserve Train Sets	set	14 (2)	26 (3)
No. of Necessary Cars	car	84	208

Source: JICA Study Team

3.7 The basic train formation will be a four-car train pattern consisting of 2 motor cars and 2 trailer cars (2M2T). Two train sets can be added to create a six-car train formation for larger transport capacity in the future. The configuration of a typical car body is shown in Figure 3.2. The maximum speed will be 110 km/h. Because of the short distance between stations in the CBD area, the trains will be designed to provide fast acceleration and deceleration to reduce the transit time.



Source: East Japan Railway Company

Figure 3.2 Configuration of Car Body

3.8 The construction standards for the rail line, as listed in Table 3.4, are based on the contents of Section 4.4 “Premises of the Plan” in the Main Report. These will be in accordance with appropriate railways standards, such as STRASYA (Standard Urban Railway System for Asia).

Table 3.4 Construction Standards for Railway Lines

Item	Specification
Track gauge	1,435 mm
Design maximum speed	120 km/h
Operation maximum speed	110 km/h
Minimum radius of curve	
Main line	R= 600 m
Platform	R= 400 m
Side track, car depot	R= 100 m
Maximum gradient	
Car depot	35 ‰
Minimum vertical radius of curve	Level

Item	Specification
Distance between track centers	3,000 m
Track structure	More than 15'6" (4,724mm)
Main line (Viaduct)	Slab track
Main line (Ground level)	Ballast track
Side track, car depot	Ballast track
Rail	110 lb rail
Effective length of platform	170 m
Feeding line voltage	DC 1,500V
Power collection system	Overhead Catenary

Source: JICA Study Team

3.9 Preliminary construction costs for the railway development are estimated at USD2,101 million. The estimated cost includes the civil works, rolling stock, electrical facilities, car depot facilities, and others.

Table 3.5 Summary of Construction Cost (million USD)

Item	Phase I	Phase II	Total
Construction works			
Civil works	721.7	270.3	992.0
Electric and mechanical works incl. rolling stock	254.9	357.9	612.8
Sub-total	976.7	628.2	1,604.8
Engineering/administration/contingency/custom duties	301.8	194.1	495.9
Total	1,278.5	822.3	2,100.7

Source: JICA Study Team
Note 1) Price is as of the year 2007.
Note 2) 10 % customs duties are applied for the imported goods (or foreign currency portion).
Note 3) Construction cost of power generation plants is not included.

3.10 The implementation schedule up to the start of commercial operations for the line has been divided into two stages: Phase I, which will start operations in 2017, and Phase II, which will start operations in 2022, as illustrated in Table 3.6.

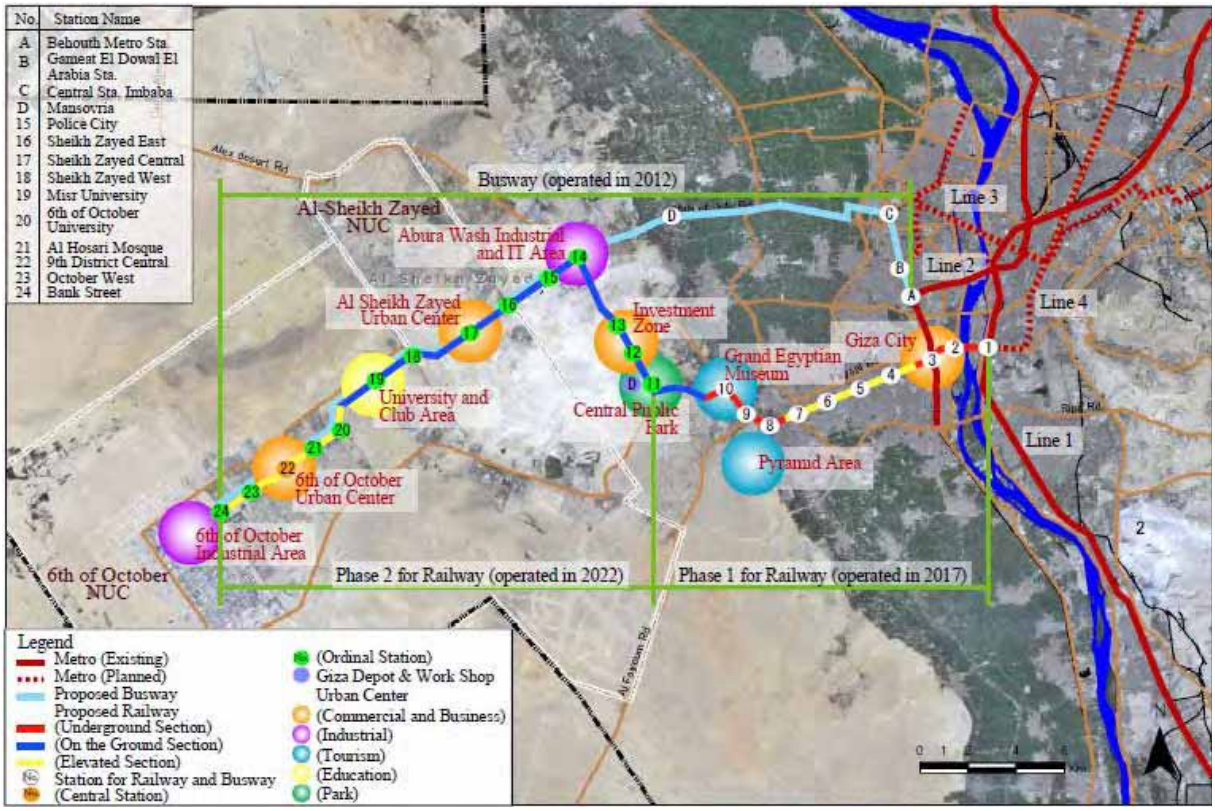
Table 3.6 Construction Schedule for Railway

Phase I	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Decision of project implementation															
Various formalities															
Basic design and bidding															
Civil and architectural works															
Eelectric and mechanical works															
Training & test															
Start of operation															
Phase II	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Decision of project implementation															
Various formalities															
Basic design and bidding															
Civil and architectural works															
Eelectric and mechanical works															
Training & test															
Start of operation															

Source: JICA Study Team

4 Exclusive Busway on 26th of July Road

4.1 The proposed exclusive busway service connects 6th of October NUC to the Metro Line 2 through 26th of July Road. The proposed route and location of stations are illustrated in Figure 4.1.



Source: JICA Study Team

Figure 4.1 Route and Station Location of 6th of October Line, Metro 4 Section 1 and 26th July Busway

4.2 The transport demand will be highly interrelated with the services of the busway and the 6th of October Line. The required points for coordination of the busway with the 6th of October Line are as follows:

- Busway services will start in 2012, while Phase I of the 6th of October Line will start operations in 2017 (up to Pyramid Area) and for Phase II in 2022 (up to Bank Street).
- Fare systems are presumed to be same as for the 6th of October Line.
- Bus stations will be located at the same place as railway stations in the section of the busway that is parallel to the railway, typically in 6th of October and Al Sheikh Zayed.

4.3 The system plan is mostly the same as the one proposed by CREATS, but some modification have been made in consideration of advice received from GOPP and from technical points of view. The major modifications from CREATS are as shown in Table 4.1

Table 4.1 Modification of CREATS Busway Plan

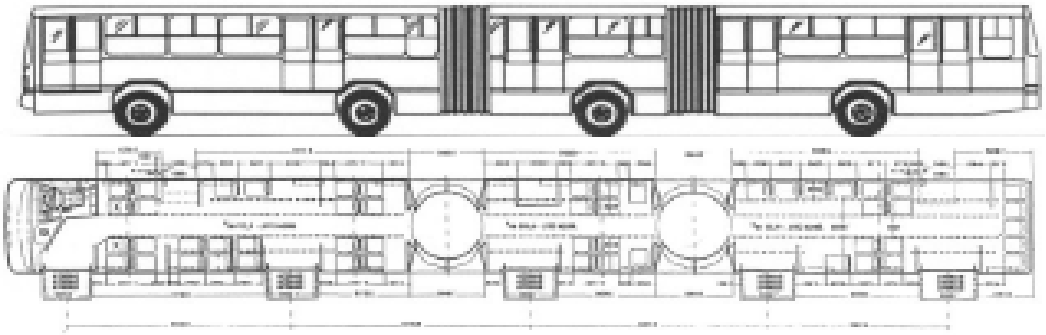
Proposed Busway Features	Modification Points from CREATS Plan
Cairo Univiversity-26th July	Move to west side of ENR track.
Connection with 26th July	Rerouting through agricultural land.
Alexandria Desert Road-6th October entrance	Move from median to outside lane.
Busway length	Shorten from 38.0 km to 35.6 km.
Cairo University terminal	Move to near Behouth Station.
6th of October Industrial terminal	Move to Bank Street.
Number of Bus stations	Increase from 3 to 14.
Number of station Plazas	Decrease from 6 to 5.

Source: JICA Study Team

4.4 Considering the large demand volume and a good driving conditions of the exclusive busway, the bus fleet will solely comprise bi-articulated buses, as shown in Table 4.2.

Table 4.2 Bus Capacity and Dimension of Bi-articulated

Type of Bus	Capacity			Dimension (m)			No. of Doors
	Seats	Standees	Total	Length	Width	Height	
Bi-articulated	57	213	270	24.52	2.50	3.42	5
Layout of Bi-Articulated Bus							



Source: CREATS Phase II Final Report, Vol. II

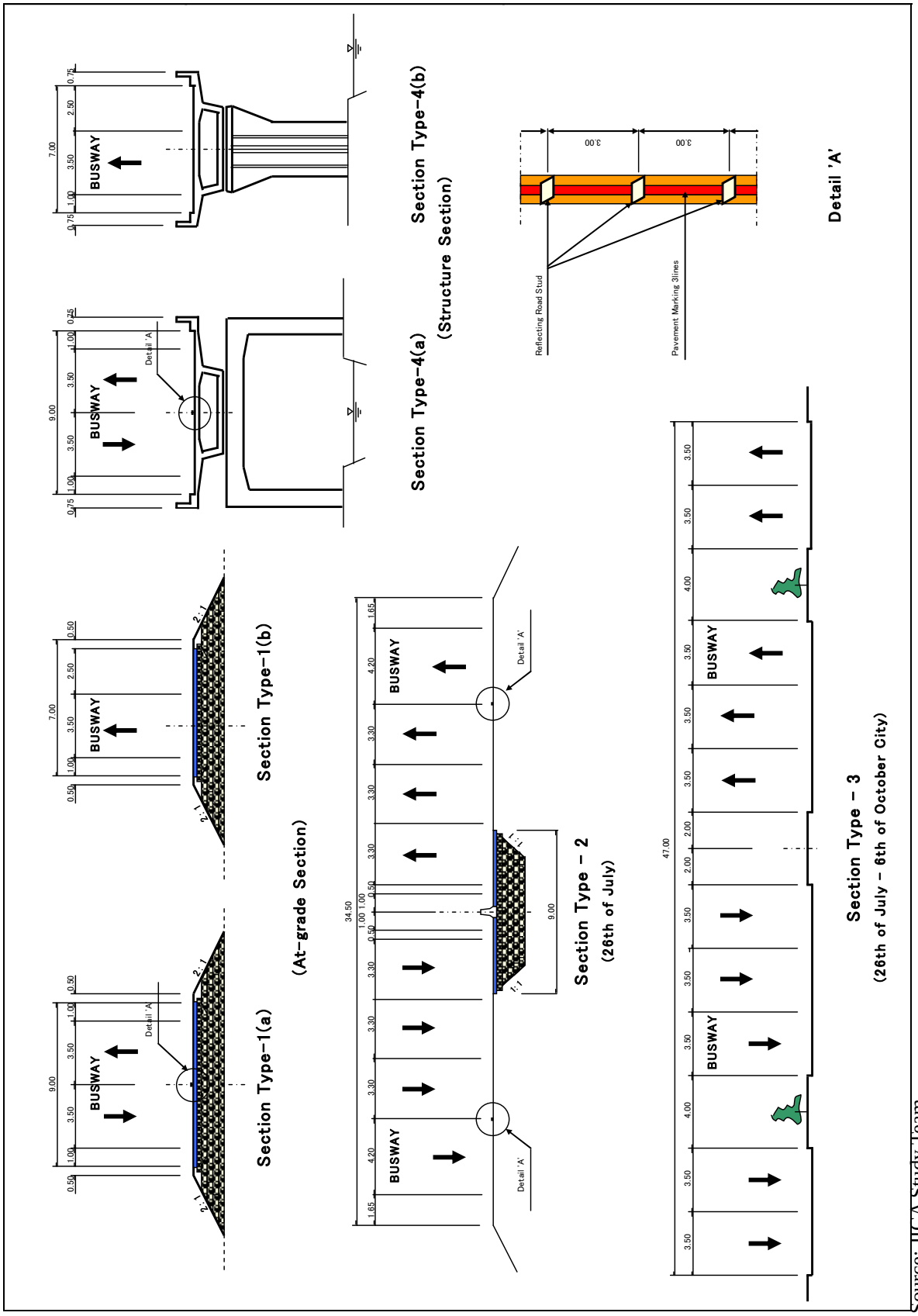
4.5 Assuming an average commercial speed of 40 km/h and the distance from the end to end of 35.6 km, the total travel time will become 53.4 minutes. Allowing 6.6 minutes waiting time for each bus trip, one trip is assumed to take one hour. Thus, the required number of buses will be equal to the number of services for both directions in one peak hour, plus a reserve fleet.

Table 4.3 Number of Buses Required in 2012-2027

Item	2012	2017	2022	2027
Buses in operation	34	52	62	68
Buses in reserve (20% of operating buses)	7	11	13	14
Total	41	63	75	82

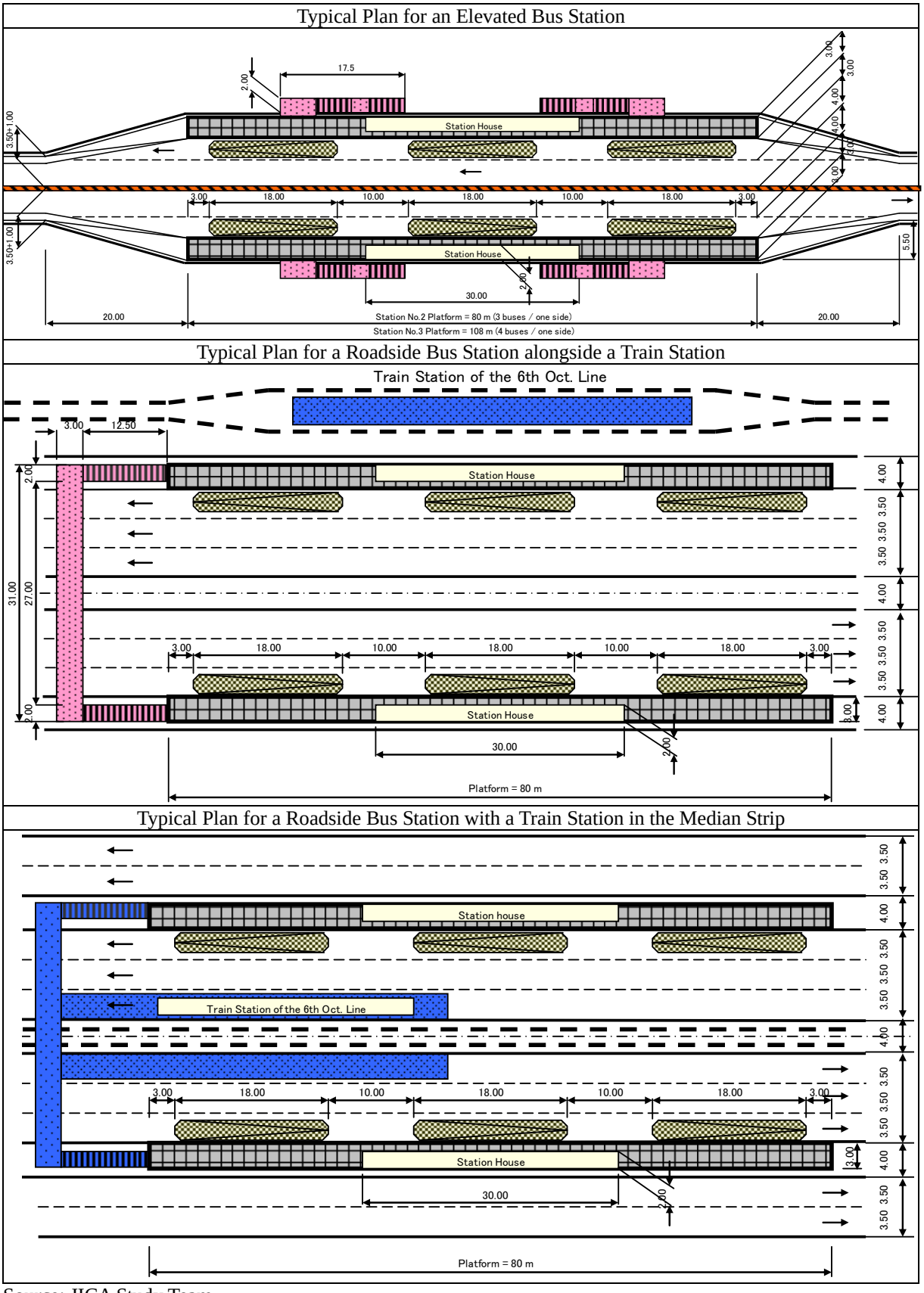
Source: JICA Study Team

4.6 Typical cross-sections for the busway will consist of different four types, including ones at-grade and elevated sections, as shown in Figure 4.2. Typical layouts for bus terminals and bus stations are shown in Figure 4.3.



Source: JICA Study Team

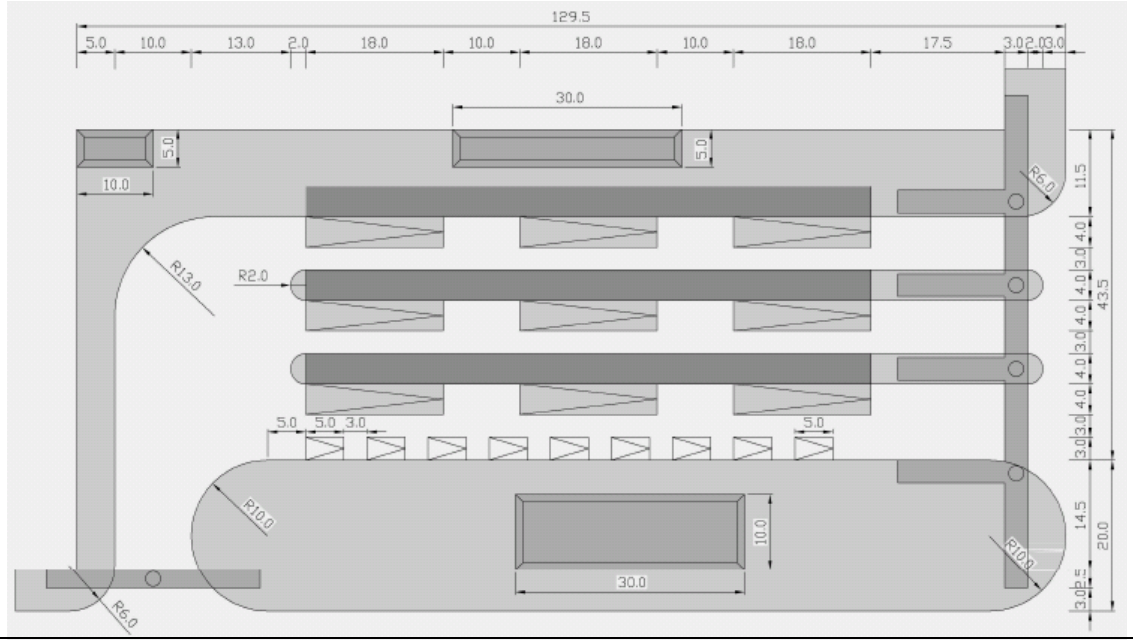
Figure 4.2 Typical Cross Section of the Busway Structure



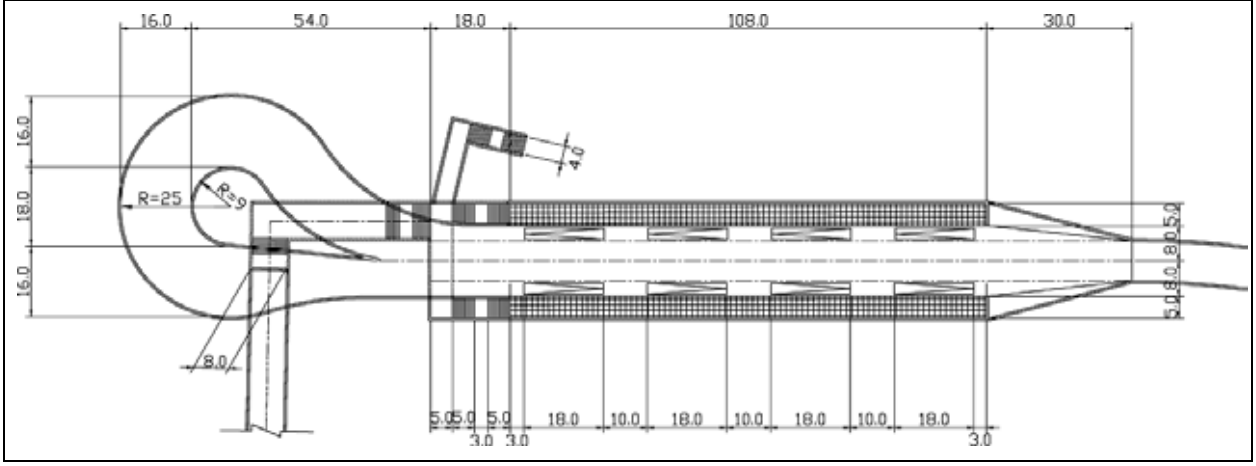
Source: JICA Study Team

Figure 4.3 Typical Layout of Bus Stations and Bus Terminals (1/2)

Preliminary Plan for the Bank Street Bus Terminal



Preliminary Configuration for Behouth Bus Terminal



Source: CREATS for the Bank Street Bus Terminal
Source: JICA Study Team for the Behouth Bus Terminal

Figure 4.3 Typical Layout of Bus Stations and Bus Terminals (2/2)

4.7 Preliminary construction costs for the busway, including the costs for procurement and management, are estimated at LE1,654.13 million as summarized in Table 4.4. A construction schedule that is formulated to allow operations to commence services in 2012 is shown in Table 4.5.

Table 4.4 Preliminary Construction Cost Estimate for Busway (mil. LE)

Item	Cost
Busway	328.72
Stations (At Grade and Elevated)	67.83
Intermediate Station	5.77
Station Plaza	47.71
Bus Terminal	130.11

Item	Cost
Depot and Workshop	46.85
Bus	908.00
Engineering, Management, Administration, and Contingency	119.13
Total	1654.13

Source: JICA Study Team

Table 4.5 Construction Schedule for Busway

Item	2009						2010												2011		
	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1-11		12
Detailed desing																					
Tendering																					
Land acquisition																					
Busway construction																					
Start of operation																					

Source: JICA Study Team

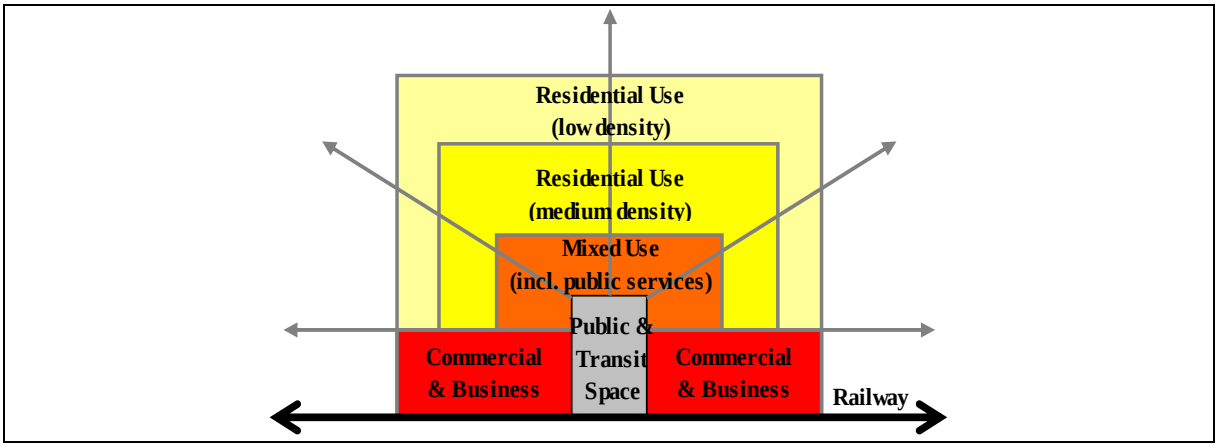
5 Urban Development Plan at Stations and Surrounding Areas

5.1 Development of the railway stations and surrounding areas is considered as one of the triggers for vitalizing new urbanization along the railway, and consolidating the new development with existing built-up areas. The railway stations and surrounding areas can become focal points, where different transportation modes comprising railway, buses, taxis and private cars, will be interlinked. These focal points will cater for a large number of passengers. Commercial facilities, such as general merchandise stores and various retail shops will be located at railway stations and surrounding areas. Convenient services will attract residents for shopping and the logistic to support this will be provided accordingly. Hence, the urban development plan for station squares and surrounding areas is an important issue to consider when creating new focal areas to vitalize urbanization and accelerate the shift of the population from the main agglomeration to the new development corridor.

5.2 The land use plan for station squares will follow the following planning criteria:

- To provide facilities for efficient and effective interlinking of different transportation modes, and
- To introduce functions to create a focal point in the surrounding urban areas.

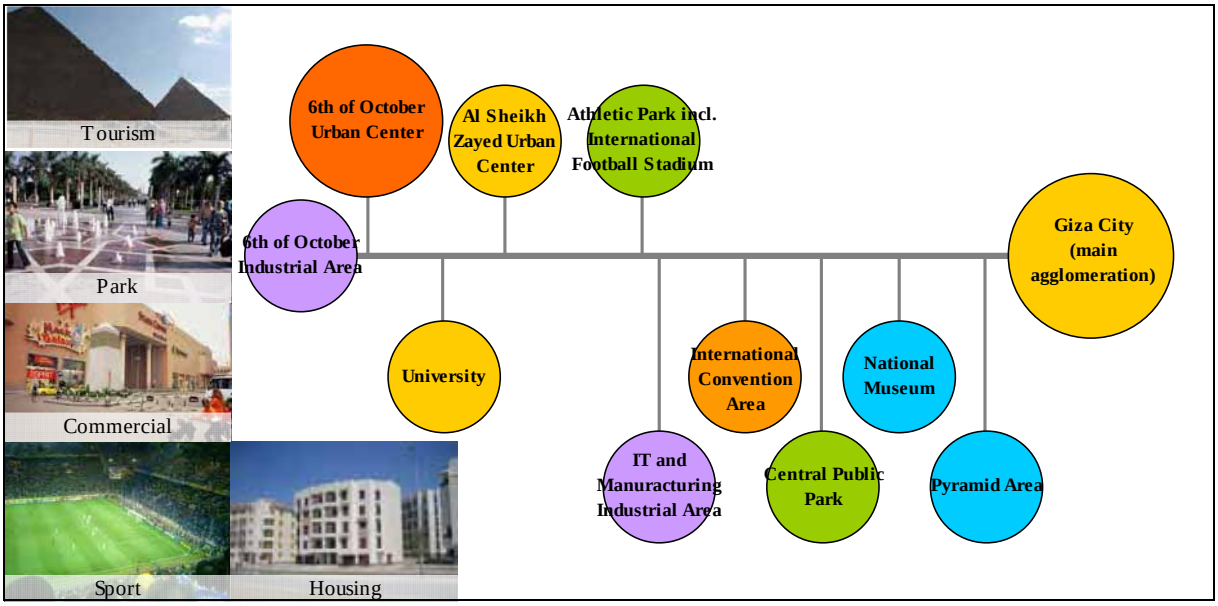
5.3 Since the station areas will be the natural focal area where a large number of passengers and residents will gather when they use public transport, the station and surrounding areas will need to allow for large scale buildings capable of accommodating the various activities for commercial, business, and services to create a transport-oriented development. Figure 5.1 illustrates the general concept of land use plans for transport-oriented development at stations.



Source: JICA Study Team

Figure 5.1 Concept of Land Use Plan for Transport-oriented Development at Stations

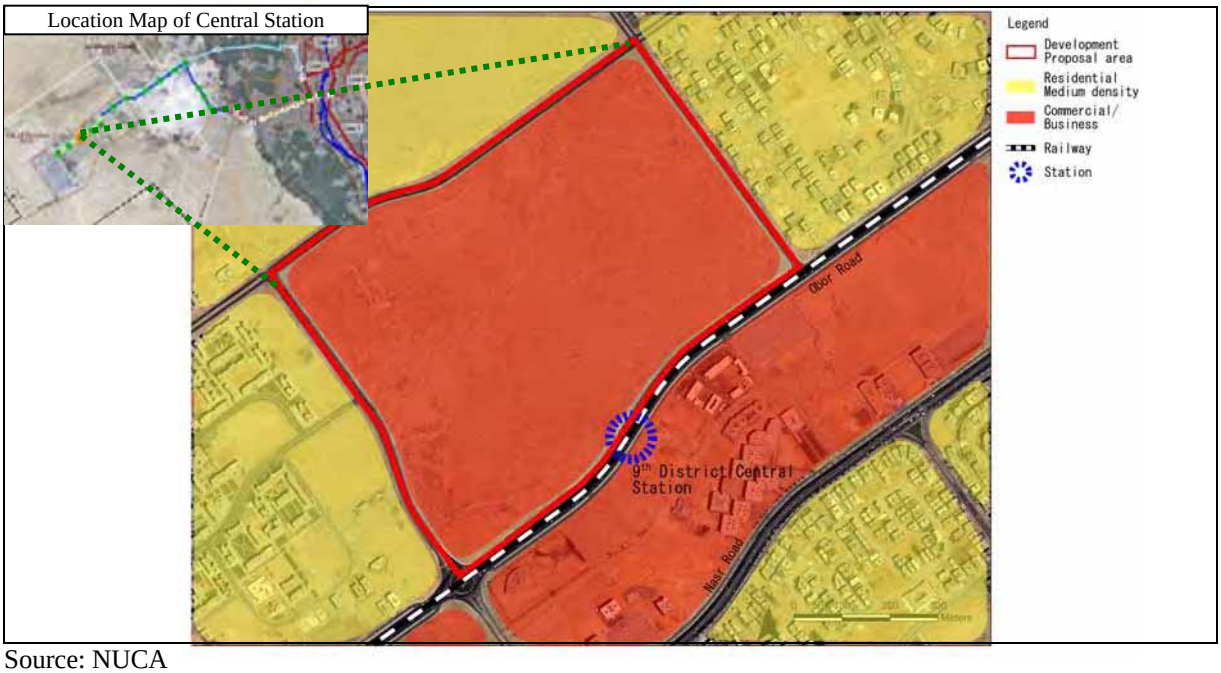
5.4 The railway of the Western Development Corridor will interlink various urban centers, which include the CBD of the main agglomeration and urban centers of NUCs. In addition, linkages will be provided to industrial areas, public parks that could include a new international football stadium, a new national museum (Greater Egyptian Museum), and a new international convention, area as depicted in Figure 5.2.



Source: JICA Study Team

Figure 5.2 Main Activities along the Railway

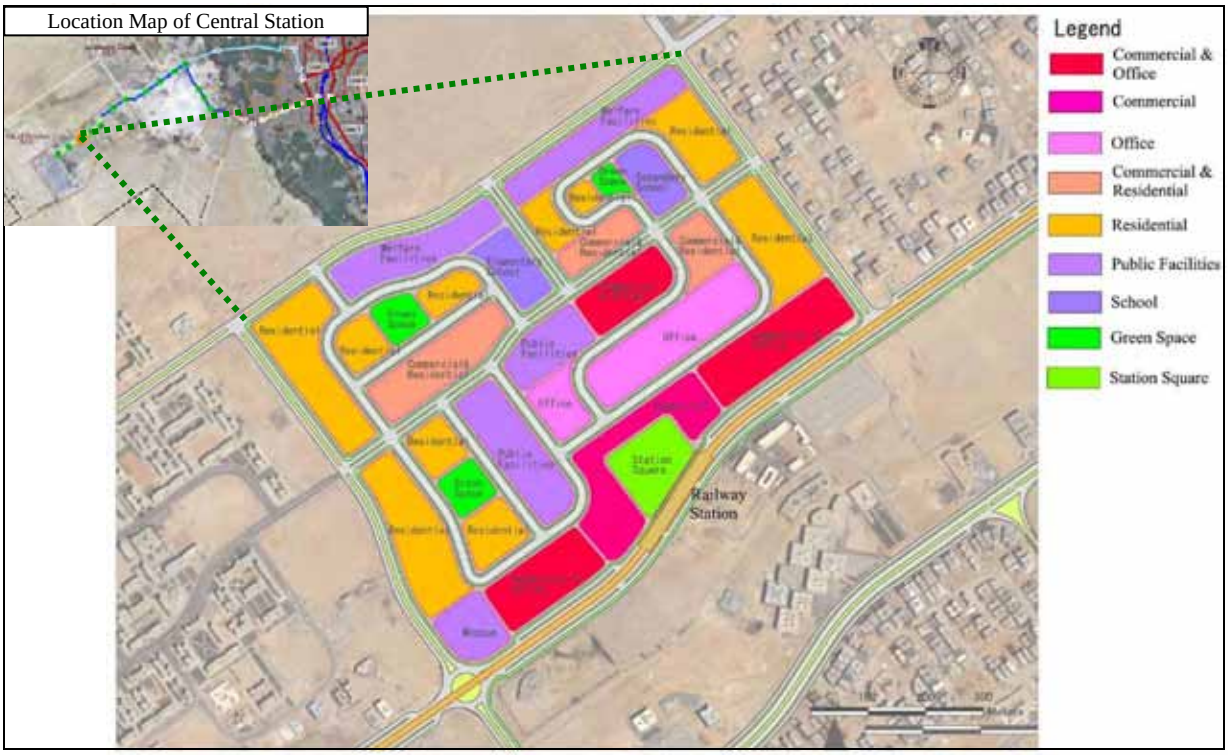
5.5 Proposed urban development plans have been prepared for two different types of stations, namely the central station and ordinary stations. The central station will constitute a new urban center, where the commercial and business activities at the regional level are concentrated. The central station is provisionally named "9th District Central Station" (No. 22) and it is located in the central part of 6th of October NUC. A proposed site of 56 ha is currently vacant and there are no existing physical plans for this site. It is also located adjacent to the main commercial areas, which run in an east-west direction in the central part of 6th of October. The proposed site is designated as a commercial area in the existing land use plan prepared by NUCA.



Source: NUCA

Figure 5.3 Existing Land Use Plan of the Central Station Area and Surrounding Areas

5.6 The central station area will provide an ideal site for business headquarters and branch offices for services, commercial, and finance to create a new sub-center in the development corridor. These activities will tend to be located within easy access of the transportation systems. Commercial facilities, such as restaurants and retail shops, will seek to locate along the main streets which will have a large number of people passing through. In addition, medium and high-rise housing units will be planned on the periphery of the station square area. A proposed land use plan is depicted in Figure 5.4. The required land area (m^2) by land use category has been estimated, as shown in Table 5.1.



Source: NUCA

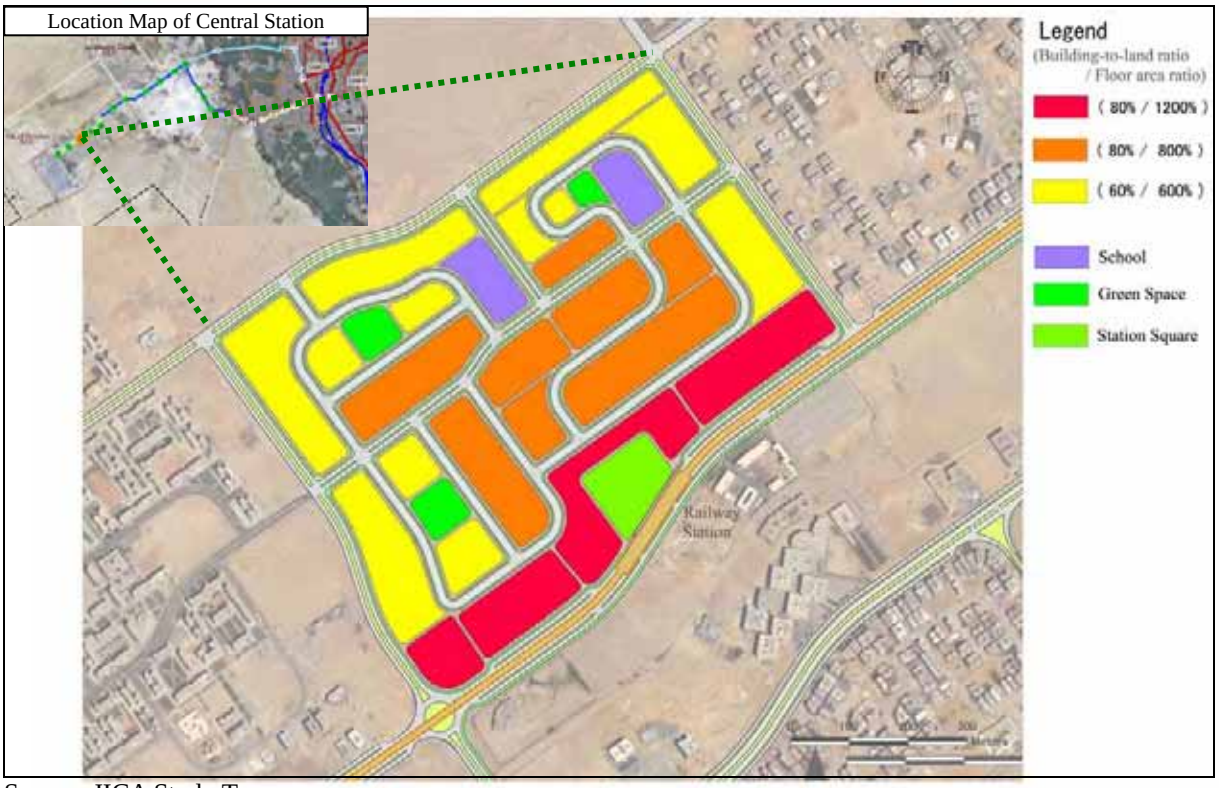
Figure 5.4 Proposed Land Use Plan of Central Station Area and Surrounding Areas

Table 5.1 Proposed Land Area Requirement by Land Use Category for the Central Station Area

Land Use Category			Land Area (m^2)	Share (%)
Land for Public Facilities	Roads		103,500	18.5
	Station Square		13,000	2.3
	Parks		18,000	3.2
	Sub-total		134,500	24.0
Land for Urban Development	Private-owned Land	Commercial	32,000	5.7
		Business	40,000	7.2
		Mixed Use (Commercial and Business)	63,000	11.3
		Mixed Use (Commercial and Housing)	41,000	7.3
		Housing	154,500	27.6
	Public-owned Land	Primary Schools	12,000	2.1
		Secondary Schools	12,000	2.1
		Other Public Facilities	71,000	12.7
	Sub-total		425,500	76.0
Total			560,000	100.0

Source: JICA Study Team

5.7 Two major control parameters for urban areas are the building coverage ratio (BCR) and total floor area ratio (FAR). The parameters that are used here for the central station are based on the direction of development and the land use plan, as shown in Figure 5.5. Areas around the station square will be the preferable location for commercial and business activities requiring a relatively large development in the sub-center. The proposed allowable capacity has been set at 80% for BCR and 1,200% for FAR. Buildings up to 15 stories high will be permissible in these areas. Areas behind the station square are planned for public facilities as well as for commercial and office buildings. Here, the proposed allowable capacity has been set at 80% for BCR and 800% for FAR. Other areas are planned for residential use, which need to provide amicable living conditions and open spaces.



Source: JICA Study Team

Figure 5.5 Proposed Building Coverage Ratio and Total Floor Area Ratio in the Central Station Area

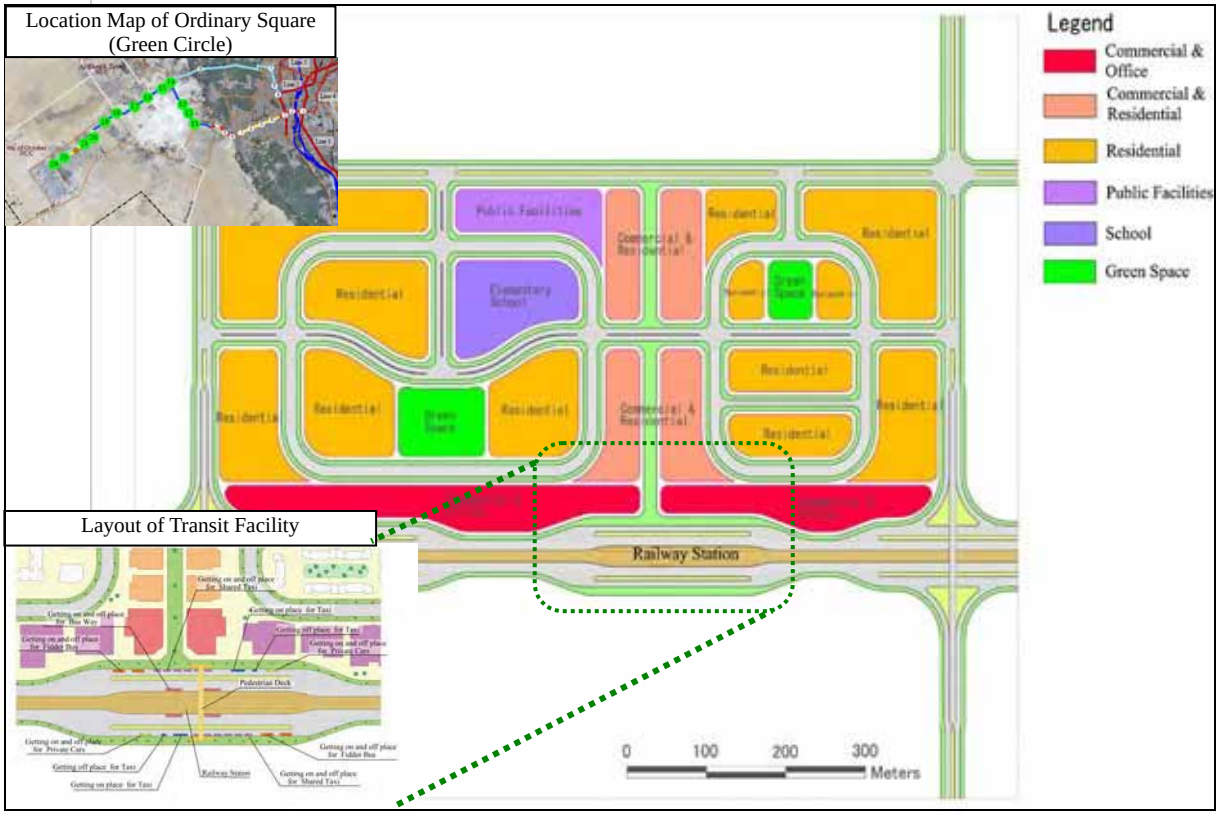
5.8 A station square needs to be located adjacent to the central station to ensure easy transfer between different transportation modes. The traffic direction in the station square will be controlled in a counterclockwise direction. There will be platforms for buses dedicated to the exclusive busway, feeder buses, shared taxies, ordinary taxies, and private cars. The platforms will be interlinked by elevated pedestrian decks to the railway station and the surrounding facilities, as shown in Figure 5.6. Based on the number of passengers at the central station, the required number of platforms has been estimated for each transport mode, allowing the size of station square to be planned. The proposed central station will require an area of 1.3 ha.

Source: JICA Study Team

Figure 5.6 Proposed Site Plan of the Central Station Square

5.9 The proposed plan for ordinary stations was prepared to show a typical land use plan which is an indicative sample that indicates technical requirements for stations other than the central station.

5.10 The urban development plan for ordinary station includes commercial, business, and residential areas on a lesser scale, compared to the central station area. Land plots will be divided to a relatively large parcels for the commercial area. In the residential areas, the road network will be planned to prevent through traffic for diminishing the living conditions of residents. Commercial and service facilities will be provided for neighboring residents and passengers who use the ordinary stations. The platforms in the station square will be planned to ensure effective and efficient transfer of passengers between different transportation modes. A typical land use plan for the ordinary station area is depicted in Figure 5.7. In the implementation stage, the proposed land use for specific stations will be adjusted so that it compliments the existing conditions at each station site.



Note: The land use plan that is depicted is considered as a typical example that needs to be adjusted to so that it compliments existing conditions at each station site.
Source: JICA Study Team

Figure 5.7 Proposed Typical Land Use Plan for a Ordinary Station

6 Environmental and Social Considerations

6.1 An Initial Environmental Examination (IEE) was conducted for the Western Development Corridor in the Master Plan phase. This was done in order to screen the potential impacts on the environment and provide recommendations for the forthcoming EIA or pre-EIA. The IEE focused on the Busway, the 6th October Railway and related urban development in and around the associated station areas. The IEE showed that the railway and busway transport projects both conform to the priority objectives of the transport modes having a good environmental performance in GCR. The planned development should have a very positive impact on ambient air and noise conditions, and traffic conditions in GCR. The project is expected to contribute to the reduction of the greenhouse gas (GHG) emissions in the transportation sector. Potential adverse impact of the project can be mitigated through the application of countermeasures.

6.2 The IEE showed that only a few aspects will need to be analyzed in the pre-EIA or EIA when the project reaches an advanced level of design. These aspects are mainly related to the selection of the railway and busway alignments, the design of the transportation structure, and the impact on social groups living along the alignments. Therefore, the IEE concluded that the project should definitely provide environmental benefits in GCR, but could also induce localized adverse impacts that need to be studied in an EIA or pre-EIA. It was recommended a pre-EIA study be conducted for the project to assess environmental and social considerations in the Pre-F/S. Since the project should not involve any large disruption of society or nature, but only cause localized and limited negative effects, the project is considered as a Category B project according to the JICA guidelines, and Category B (Grey List project) according to the Egyptian guidelines.

6.3 The pre-EIA Study was conducted during the Pre-F/S phase in order to more clearly identify the potential environmental issues related to implementation of the project, and to provide recommendations for the EIA. The pre-EIA has (i) identified the potential impacts of the project; (ii) proposed the measures that should be undertaken in case of adverse impacts; (iii) compared the environmental conditions *with* and *without* project; and (iv) determined the environmental benefits that are expected to result from implementation of the project.

6.4 The main adverse impacts induced by the railway project will be related to: (i) discharge of drainage water and wastewater; (ii) loss of trees and the possible damages to urban vegetation; (iii) emission of dust and vehicles exhaust air pollutants in the construction phase; (iv) temporary worsening of ambient noise levels; (v) generation and management of solid waste; (vi) handling and disposal of hazardous waste and substances; and (v) changes in the urban landscape and the living environment.

6.5 These adverse impacts are largely related to the construction phase of the project and can generally be mitigated by management measures. The most noticeable impacts are change in the urban landscape and the living environment of nearby residents, particularly along the Pyramids Road. The El Malik El Maleh – Giza Square section and the 6th of October section will mostly be affected by the nuisance of construction works.

6.6 The main adverse impacts that might be induced by the busway project would be related to: (i) relocation of the ENR settlements of Behouth; (ii) relocation of a single block of the market; (iii) generation and disposal of hazardous waste and substances; (iv) generation

and management of solid waste; (v) loss of agricultural land and trees, (vi) modification of the pedestrians crossway patterns; (vii) emission of dust related to demolition and construction; (viii) temporary worsening of ambient noise levels; and (ix) changes in the urban landscape and the living environment.

6.7 The adverse impacts that might be induced by the project would largely be related to the construction phase of the project and could be mitigated by practical measures to some extent. However, a few of the impacts are related to the relocation and design of the project. The relocation issue could have the most significant impact, but the area of effect is limited and it does not affect residential settlements. It is worthwhile to note that the location for the project was selected in order to avoid the need to relocate illegal residential and commercial settlements located in the railway corridor.

6.8 Proposed recommendations in the pre-EIA that need further study in the EIA include a soil survey of the ENR workshops of Behouth, and a social surveys in the sensitive areas of Behouth, Pyramids Road, and El Bashtir residential zone. In addition, mitigation or compensatory measures required for the potential adverse impacts of the project, and a few complementary measures that potentially will enhance the positive impacts of the project on the environment will also need to be studied.

6.9 A comparison of the air emissions induced by road traffic in the GCR *with* and *without* the railway project showed that the transport air pollutant emission savings due to the project will be significant in 2022. The potential reduction of pollution levels will be about 6% for NOx and suspended particulate matter (SPM), and between 2 and 3% for CO and SO_2. A comparison of the energy efficiency performance of the *with* / *without* railway project showed that the project will improve transportation energy efficiency in GCR. Energy savings will amount to about 2.4% compared with the no-project case in 2022. The net budget for emissions was compared for the *with* and *without* the railway project. The result for the *with* case was that CO_2 emissions reductions will amount to about 2%.

6.10 In the case of the busway project, the air pollutants emissions savings will be quite positive in 2017, in the range of 3 to 3.5% for NOx, which is the most important performance indicator. The busway project will produce a slight advantage in terms of energy savings, in comparison to no implementation. Analysis of the CO_2 emission budget for transportation *with* and *without* the project has shown no increase of emissions in the case of project implementation.

6.11 In conclusion, the pre-EIA confirmed that the proposed project will comply with the environmental requirements of Egyptian laws, regulations and policies, and with the JICA guidelines, after application of the proposed mitigation measures. This project will not impair the major environmental objectives of GCR, but very often will contribute to their achievement. The project may have some localized adverse impacts, such as the relocation of a few activities and change in the urban landscape and living environment. However, these impacts are not significant when compared to the environmental benefits, and should be acceptable to most residents. The project will contribute to achieving positive environmental and social benefits, such as the overall reduction of air pollutant emissions, improved mobility for the people, fuel and energy savings, and reduction of GHG emissions.

6.12 A no-action alternative to the proposed project would result in: (i) excessive pressure on the existing road transport network and traffic congestion; (ii) increasing air pollution and

GHG emissions; (iii) worsening of urban mobility; (iv) increasing social segregation of vulnerable groups due to limited access to transport; (v) loss of energy efficiency objectives in transport; and (vi) a general worsening of the living environment for citizens. The cumulative environmental impacts (pollution, nuisances, and health) make the no-action alternative unacceptable and inconsistent with the environmental policy objectives of GCR.

7 Economic and Financial Analysis

7.1 Economic costs and benefits for the urban and transport development have been estimated based upon the gap between the *with* and *without* project alternatives, as is normal practice. The *with* project alternative denotes how transport conditions and urbanization will change in the study area when both the busway and 6th of October Line (Metro) projects are implemented.

7.2 In the economic analysis, all costs were classified into the three classes: (i) traded goods (or foreign currency portion); (ii) non-traded goods (or local currency portion); and (iii) transfer item (or taxes). A standard conversion factor (SCF) of 0.84 was applied as an index which converted the domestic price of non-traded goods to international prices. Following this, the economic costs for the total amount of the traded goods and the SCF-converted non-traded goods is calculated.

7.3 The economic costs for the 6th of October Line were estimated at LE9,124 million. The economic costs included the economic construction costs and the economic operation and maintenance costs, as shown in Table 7.1. Economic benefits for the 6th of October Line counted the cost savings in travel time and vehicle operation. Passengers on the 6th of October Line who are diverted from other modes of transport will obtain a time saving (valued at LE4,238 million) and reduced private vehicle mileage (valued at LE2,274 million), as shown in Table 7.2. Thus, the total annual cost saving produced by the 6th of October Line has been estimated at LE6,512 million in 2027. The analysis yielded an EIRR (Economic Internal Rate of Return) of 14% and NPV (Net Present Value) of LE1,360 million as the base. A sensitivity analysis indicated that the project will generally be feasible, excluding the worst situation where Costs are +20% and Benefits are -20%, as shown in Table 7.3.

Table 7.1 Economic Cost for the 6th of October Line

Item	Unit	Phase I (2010-2016)	Phase II (2017-2021)	Total
Economic Construction Cost	mil. LE	5,540.7	3,458.6	8,999.4
Economic O&M Cost	mil. LE/Year	48.0	124.7	-

Source: JICA Study Team
Note: Economic construction costs include costs for civil works, E&M works, engineering services, and administration. Economic O&M costs include economic cost for administration, operation, and maintenance.

Table 7.2 Economic Benefits by Cost Saving of Travel Time and Vehicle Operating for the 6th of October Line

Year	Travel Time Saving (mil. LE per year)			Vehicle Operating Cost Saving (mil. LE per year)		
	Public Transport	Private Transport	Total	Public Transport	Private Transport	Total
2017	337	48	385	503	7	510
2022	2,291	401	2,692	1,789	19	1,808
2027	3,309	929	4,238	2,248	26	2,274

Source: JICA Study Team

Table 7.3 Sensitivity Analysis for the 6th of October Line

Item			Benefit		
			-20%	Base	+20%
Cost	-20%	EIRR (%)	14.05	16.11	17.89
		NPV(LE Million)	1,088	2,376	3,664
		B/C	1.27	1.59	1.91
	Base	EIRR (%)	12.12	14.05	15.72
		NPV(LE Million)	72	1,360	2,648
		B/C	1.01	1.27	1.52
	+20%	EIRR (%)	10.62	12.46	14.05
		NPV(LE Million)	(944)	344	1,632
		B/C	0.85	1.06	1.27

Source: JICA Study Team
Note: Discount rate set at 12% per year and Project evaluation period for 30 years after operation.

7.4 In the financial analysis, costs for the 6th of October Line covered the costs of construction and O&M. The construction costs were estimated at LE 11,554 million, of which LE7,031 million would be for Phase I and LE4,523 million is for Phase II. The O&M costs will amount to LE8 million per year in Phase I and LE19 million in Phase II, respectively. Revenue for the 6th of October Line will accrue from fare incomes and ancillary sources, such as advertising fees. Two options for the fare system were set up: (i) Option 1 for a distance-based fare; and (ii) Option 2 for a fixed fare. Since the total distance of the new line will be more than 40 km long, Option 1 is analyzed as the base (or preferred option), and Option 2 was used for comparison in the sensitivity analysis. The Metro fare increased by 10.1% per year in the period between 2000 and 2006, while the inflation rate was 5.0% per year in the same period. The real fare inflation rate was therefore set at 5.1% per year as, shown in Table 7.4. Table 7.5 shows the conditions set for the financial analysis, which consisted of three cases that varied in the percentage of government contribution to the construction cost: (i) 0% for Case 1; (ii) 57.1% for Case 2 (all civil work costs); and (iii) 100% for Case 3.

Table 7.4 Proposed Fare System for the Metro 6th of October Line

Item	Unit	2008	2012	2017	2022	2027
Option 1: Distance-based fare						
Base fare	LE	0.60	0.70	0.81	0.93	1.08
Distance-based fare	LE/km	0.03	0.03	0.04	0.05	0.05
Option 2: Fixed Fare	LE/time	1.00	1.20	1.40	1.60	1.90

Source: JICA Study Team

Table7.5 Financial Analysis Conditions by Government Support Case for the 6th of October Line

Item		Case 1	Case 2	Case 3
Fare Setting		Distance-based fare system		
Total Fare Revenue (2017-2046)	million LE			27,843
Total Capital Expenditure	million LE			11,554
Construction subsidy	million LE	0	6.601	11,554
Government Contribution	%	0	57.1	100.0

Source: JICA Study Team

7.5 The financial analysis of the 6th of October Line (distance based fare option) revealed that Case 3 (100% subsidy) will be the only case that is financially feasible. In Case 2, the FIRR will be 12.0%, which is equal to the assumed opportunity rate of capital in Egypt, and is thus only marginally feasible. Since the project is justified as being worthwhile from the

national economic point of view, this means that the government will need to support the project financially by providing a subsidy or low interest rate capital loan to ensure successful business management. For the fixed fare option (Option 2), the financial situation will be slightly worse than that for Option 1.

Table 7.6 Results of Financial Analysis by Fare Option for the 6th of October Line

Fare Option	Case	Net Present Value (million LE)	Revenue / Expenditure Ratio	Financial Rate of Return (%)
Option 1 (Distance based fare)	Case 1	(968)	0.65	8.04
	Case 2	5	1.00	12.03
	Case 3	1,300	3.52	n.a.
Option 2 (Fixed fare)	Case 1	(1,548)	0.54	6.31
	Case 2	(380)	0.83	9.94
	Case 3	1,174	2.83	n.a.

Source: JICA Study Team
Note: In Case 3, revenue exceeds expenditure at any discount rate. FIRR of Case 3 can not be computed due to the definition of equation of FIRR.

7.6 Economic costs for the busway consist of the construction costs (LE446.1 million) and the O&M costs (LE47.4 million in 2017). Economic benefits resulting from the cost savings in the travel time and vehicle operation will amount to LE1,493 million per year in 2027. The analysis yields an EIRR of 21% and NPV of LE1,017 million as the base. A sensitivity analysis indicated that the project will be feasible, even in the worst situation where Costs are +20% and Benefits are -20%.

Table 7.7 Economic Benefits by Cost Saving of Travel Time and Vehicle Operation for the Busway Project

Year	Travel Time Saving (mil. LE per year)			Vehicle Operating Cost Saving (mil. LE per year)		
	Public Transport	Private Transport	Total	Public Transport	Private Transport	Total
2012	258	13	270	185	28	213
2017	332	21	353	641	30	671
2022	419	248	668	179	28	207
2027	727	452	1,179	269	45	314

Source: JICA Study Team

Table 7.8 Sensitivity Analysis Regarding Costs and Benefits for the Busway Project

Item			Benefits		
			-20%	Base	+20%
Costs	-20%	EIRR (%)	21.32	25.55	29.34
		NPV (LE Million)	813	1,293	1,773
		B/C	1.73	2.17	2.60
	Base	EIRR (%)	17.41	21.32	24.75
		NPV (LE Million)	536	1,017	1,497
		B/C	1.39	1.73	2.08
	+20%	EIRR (%)	14.3	18.11	21.32
		NPV (LE Million)	260	740	1,220
		B/C	1.16	1.45	1.73

Source: JICA Study Team
Note: The discount rate set at 12% per year and Project evaluation period for 30years after operation.

7.7 The financial analysis costs for the busway project cover the cost of construction and O&M. The construction cost is estimated at LE1,654 million, of which LE690 million is for

civil works, LE56 million is for the depot and workshop, and LE908 million is for buses. The O&M cost, including the running costs and personnel costs, will amount to LE37 million per year in 2027. The revenue for the busway follows the concepts applied to the 6th of October Line (Metro). The busway revenue comprises the fare incomes and ancillary sources, including advertising fees. Two options for the fare system were set up: (i) Option 1 for a distance-based fare; and (ii) Option 2 for a fixed fare. Option 1 is analyzed as the base (or preferred option), and Option 2 was used for comparison in the sensitivity analysis. Table 7.9 shows the conditions that were set for the financial analysis, which consisted of two cases for different proportions of government contribution to the cost of civil works: 0% for Case 1 and 100% for Case 2.

Table 7.9 Conditions of Financial Analysis by Government Support Case for the Busway Project

Item		Case 1	Case 2
Fare Setting Option		Distance based fare system	
Total Fare Revenue (2012-2041)	million LE	4,954.1	
Total Capital Expenditure	million LE	1,654.1	
Government contribution to construction costs for civil works	million LE	0	690.4
Government Contribution to Total Capital Expenditure*1	%	0	41.7

Source: JICA Study Team
Note:*1: The subsidy is set to 100% contribution of the civil works cost.

7.8 The financial analysis revealed that both Case 1 and Case 2 will be financially feasible for either the distance based or fixed fare option. However, looking more closely, Case 1 is not as resilient as Case 2 if the cost increases and revenue decreases. Since the busway project is justified as being viable from the national economic view point, the government needs to support the busway project to make the project financially robust.

Table 7.10 Results of Financial Analysis by Fare Option for the Busway Project

Fare Option	Case	Net Present Value (million LE)	Revenue / Expenditure Ratio	Financial Rate of Return (%)
Option 1 (Distance based fare)	Case 1	186	1.313	18.46
	Case 2	438	2.260	35.7
Option 2 (Fixed fare)	Case 1	93	1.156	15.4
	Case 2	345	1.993	31.3

Source: JICA Study Team

7.9 As for the economic analysis of urban development, the economic benefits for urban development were assessed as the incremental value added by the economic activities. The total incremental value added between *with* and *without* project alternatives was estimated by multiplying the unit value added by the incremental number of employment. The annual economic benefits amounted to LE4,894million per year in 2027, while the project cost was estimated to be LE 37,714 million in total, including the costs for housing, industrial related facilities, and public facilities to be developed for the incremental population in the *with* project alternative. As a result, the analysis yielded an EIRR of 17.45% as the base for the urban development alone.

Table 7.11 Economic Benefits and Project Costs for Urban Development

Item		Amount
Annual Economic Benefit in 2027 (million LE at current prices)	Secondary	2,765
	Tertiary	2,129
	Total	4,894
Project Cost (million LE at current prices)	Construction	29,092
	Design and Management	4,507
	Operation and Maintenance	4,115
	Total	37,714

Source: JICA Study Team
Note: Construction costs include the cost for housing, industry related facilities, and public facilities based on the incremental population, workers, and students from the *without* project alternative.

Table 7.12 Sensitivity Analysis for Urban Development

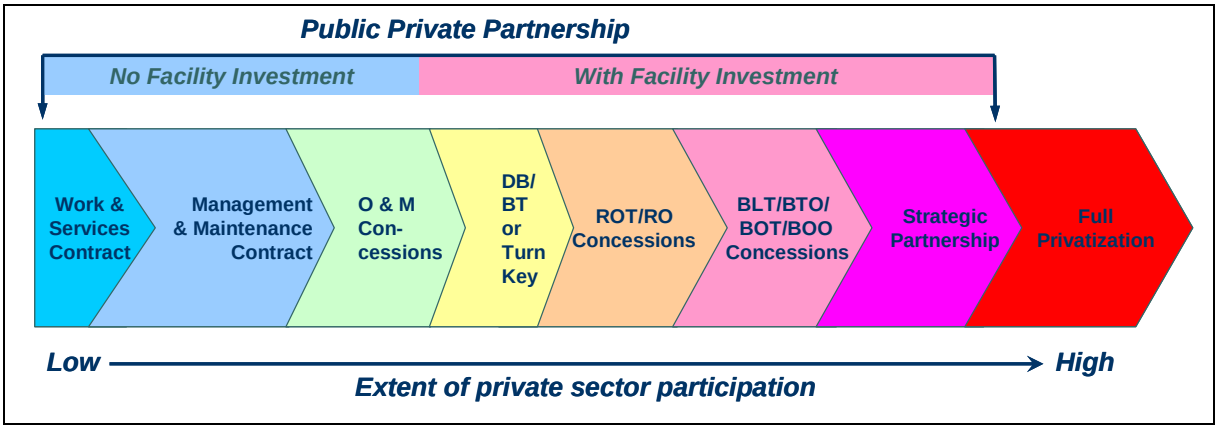
Item			Benefit		
			Base	-10%	-20%
Cost	Base	EIRR (%)	17.45	15.19	12.96
		NPV(LE Million)	2,285	937	(411)
		B/C	1.20	1.08	0.96
	+10%	EIRR (%)	15.39	13.36	11.36
		NPV(LE Million)	1,165	(183)	(1,530)
		B/C	1.09	0.99	0.88
	+20%	EIRR (%)	13.70	11.86	10.01
		NPV(LE Million)	45	(1,302)	(2,650)
		B/C	1.00	0.90	0.80

Source: JICA Study Team
Note: The discount rate is set at 12% per year. The project evaluation period is from 2008 to 2046.

7.10 Taking into account the integrated economic benefits and costs for the proposed railway and busway, as well as the resultant urban development, the overall EIRR was calculated at 16.48% with a NPV of LE3,057 million. The analysis justifies the Western Development Corridor as a whole from the national economy point of view.

8 PPP Study on the Exclusive Busway

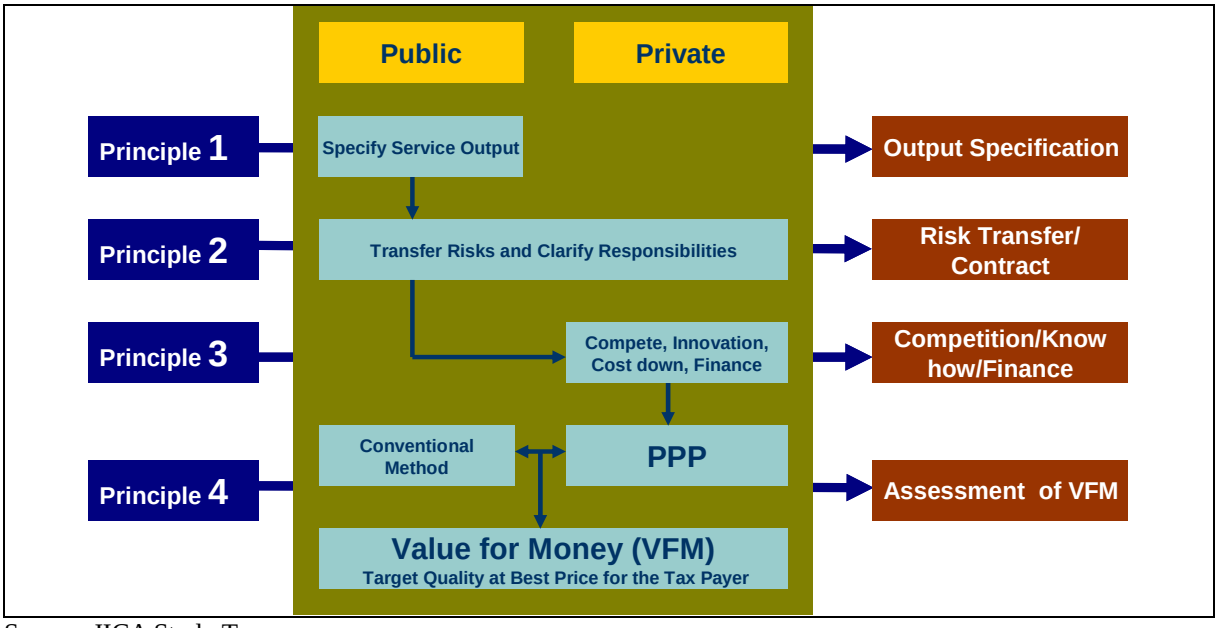
8.1 Public-Private Partnership (PPP) has broad implementation modalities ranging from the contracting out of simple services through to fully fledged privatization of public service entities, as illustrated in Figure 8.1. The difference between each mode stems from the varying extent of private sector participation. When looking at these various modalities, special attention should be given to whether or not the responsibility for facility investment is borne by the private sector, as this is the point that determines whether long-term financing by the private sector will be required for the project.



Source: JICA Study Team

Figure 8.1 Broad Implementation Modalities of PPP

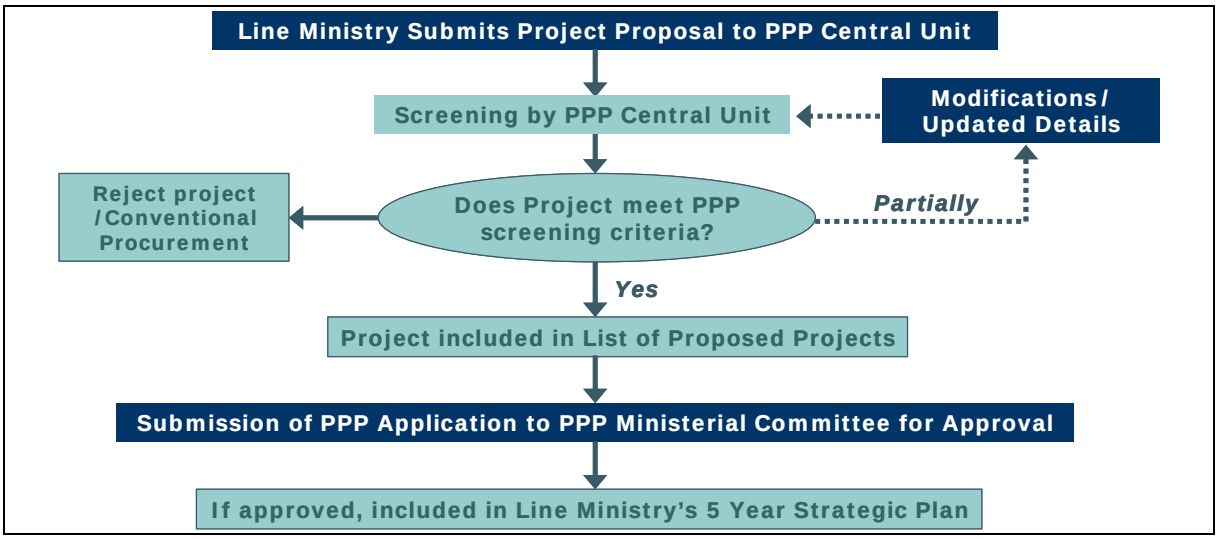
8.2 There are four (4) basic structural elements that are applied to PPP projects: (i) output specification; (ii) risk transfer based on contract; (iii) competition; and (iv) assessment of value for money. These four structural elements are illustrated in Figure 8.2.



Source: JICA Study Team

Figure 8.2 Value for Money Mechanism – How to Structure a PPP Project

8.3 In Egypt, a PPP law has been drafted and is still under examination in the Egyptian Parliament. The law basically relates to new rules for public procurement, as is now stipulated in Law 89 for Public Procurement[2]. Figure 8.3 illustrates the PPP draft institutional setup, for which the Ministry of Finance took the initiative in cooperation of Ministry of Investment and Ministry of Planning. Here, the PPP Central Unit in the Ministry of Finance will play a pivotal role in providing required knowledge and in streamlining and screening the line Ministries' PPP projects. A satellite PPP unit has been established in each line Ministry to facilitate the implementation of PPP projects.



Source: Ministry of Finance, PPP Central Unit

Figure 8.3 Function of the PPP Central Unit and the PPP Approval Process

8.4 One of the important effects of adopting a PPP approach for urban and transportation planning projects is to shift the government policy away from the current trend of a "supply driven planning approach" to a "market driven planning approach". Potential PPP project components in the SDMP may be found in the following sectors: (i) public transport; (ii) toll roads; and (iii) urban development.

8.5 While potential PPP opportunities may exist in the public transport, toll roads and urban development sectors, it is unlikely that many PPP projects could be formulated that will generate revenue in hard currency. The market for long term financing in local currency is still developing and uncertain in Egypt. Therefore, medium term financing of PPP projects such as the metro line and urban toll road with local currency revenue may be dependent on either long term financing in hard currency provided by both international and selected domestic financial institutions, or on short term financing in local currency. In the former case, the foreign exchange risk of the project will either be shared amongst the stakeholders or be borne solely by a particular member of the PPP. In the latter case, the project sponsor may need to take on board the risks of interest fluctuation and of rolling over the short term loan. Either of these considerations will tend to discourage the sound formation of a PPP project. General options for utilizing PPP in the SDMP are illustrated in Table 8.1.

[2] Based on an interview at the PPP Central Unit of the Ministry of Finance.

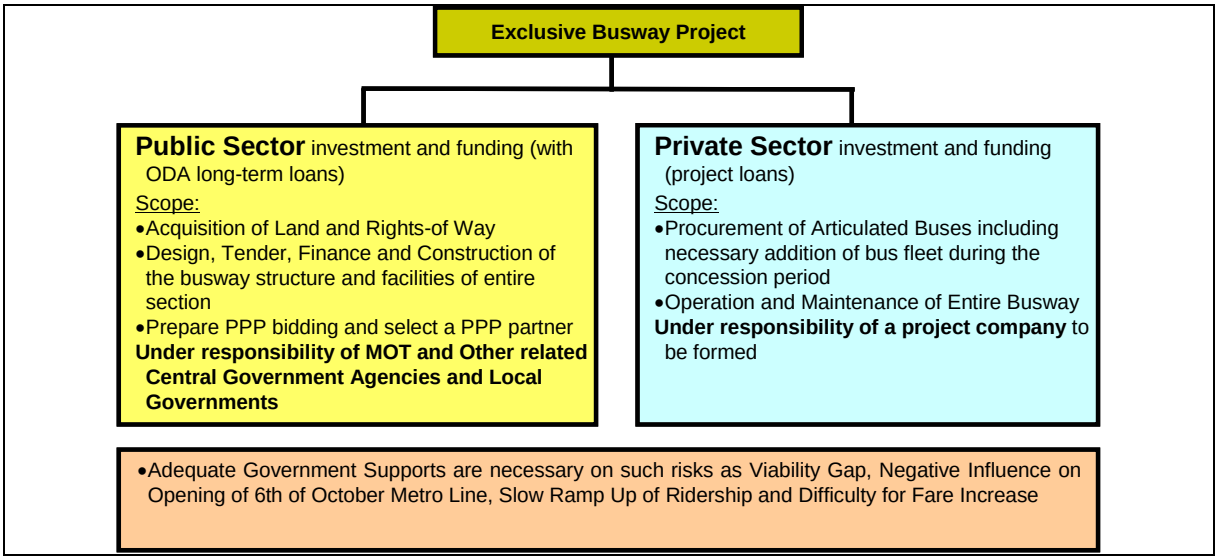
Table 8.1 General Options for Utilizing PPP in the SDMP

Extent of Private Sector Participation (Low → High)		Implementation/Funding Alternatives	Public Transport	Road	Urban Development
	1. Conventional	(1) Budget Allocation from MOF	◎	◎	◎
		(2) Grant/Loan from National Development Bank	△	△	△
		(3) Loan/Grant from Foreign Donors	◎	◎	◎
		(4) Bond Issues	△	△	△
	2. Public-Private Partnership	(1) Service Contracting Out	◎	◎	○
		(2) Management Contract	◎	◎	○
		(3) Operating/Retail Concession	◎	◎	○
		(4) Design Build/ Build Transfer (BT)	◎	◎	△
		(5) Leasing Concession (BLT)	◎	◎	△
		(6) BOT/BTO/Other PPP (Viability Gap Funding, Service Purchase Model, etc.)	○	○	◎
		(7) Development Benefit - Development Charge - Developer Contribution - Special Assessment District - Land readjustment/ Urban Redevelopment - Land Auction/Sale of LUR/Land Lease	○	○	◎
		(8) Strategic Partnership/ JV	△	△	◎
		(9) Commercial Corporatization	○	○	△
		(10) Full Privatization/ Open Market	○	○	△

Notes: ◎: High Potential, ○: Medium Potential, △: Low Potential
Source: JICA Study Team

8.6 As mentioned above, it is difficult for a PPP project requiring a large capital investment to procure long term project financing at a moment. Lack of legal and regulatory frameworks for providing various public support, such as viability-gap funding, may also be a constraint on forming an appropriate PPP structure in some cases. Therefore, it seems that it will be difficult to structure a fully fledged PPP public transport sector project at the moment. The main funding for these types of projects will be based on conventional sources, such as budget allocation from the Ministry of Finance, grants/loans from the National Development Bank, and the loans/grants from the foreign donors. However, despite some constraints on the formation of fully fledged PPP projects in Egypt, it is important to initiate the PPP practice by utilizing a modality that is practicable to implement.

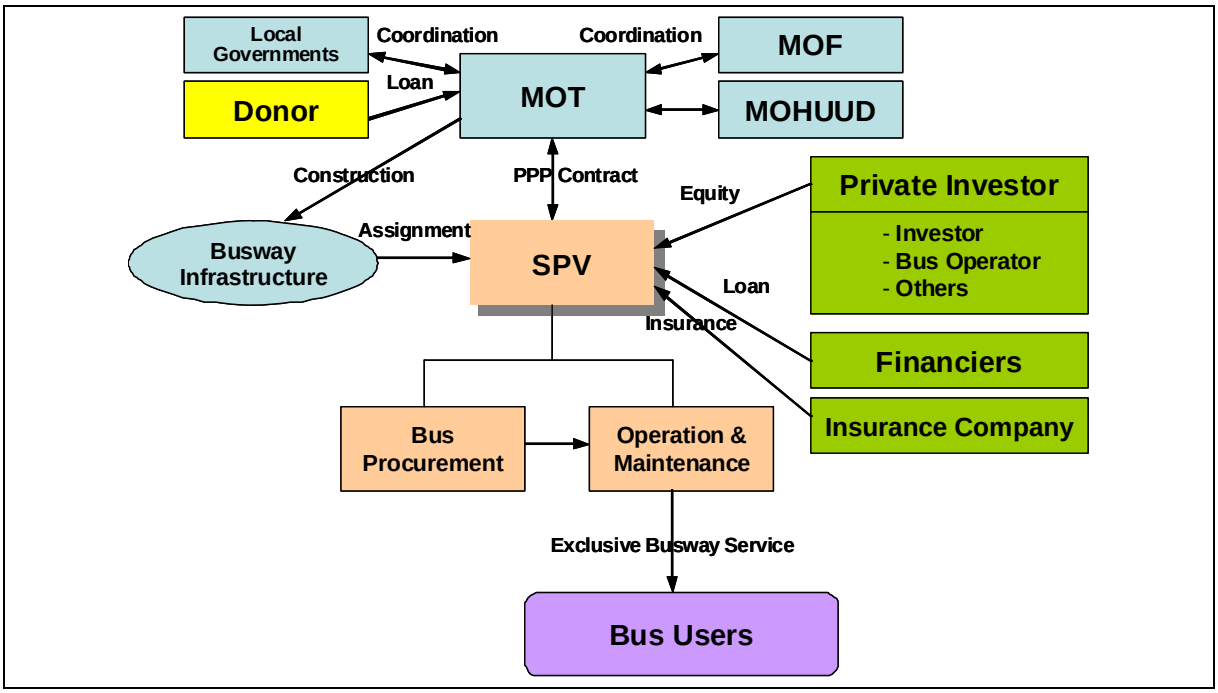
8.7 Figure 8.4 shows a schematic view of funding arrangements proposed for the exclusive busway. For this proposal, the public sector will retain responsibility for providing infrastructure, while the private sector will retain responsibility for providing operation and maintenance of the exclusive busway and for procuring the articulated bus fleet. The probability of getting long term project financing for the articulated bus fleet would be relatively high. However, in order to materialize private sector participation and the project financing mechanism, adequate government support to mitigate critical project risks (viability-gap risk, impact of opening of the 6th of October Line, slow ramp up of ridership, and slow rate of fare increase) are essential.



Source: JICA Study Team

Figure 8.4 Proposed Funding Arrangements for the Exclusive Busway

8.8 Figure 8.5 shows the contractual structure for implementation of the proposed PPP for the exclusive busway project. With the government support indicated above, the project would have sufficient level of IRR on equity (about 20%) to attract the private sector.



Source: JICA Study Team

Figure 8.5 Contractual Structure of the PPP Project Implementation for the Exclusive Busway

9 Recommendations and the Way Forward

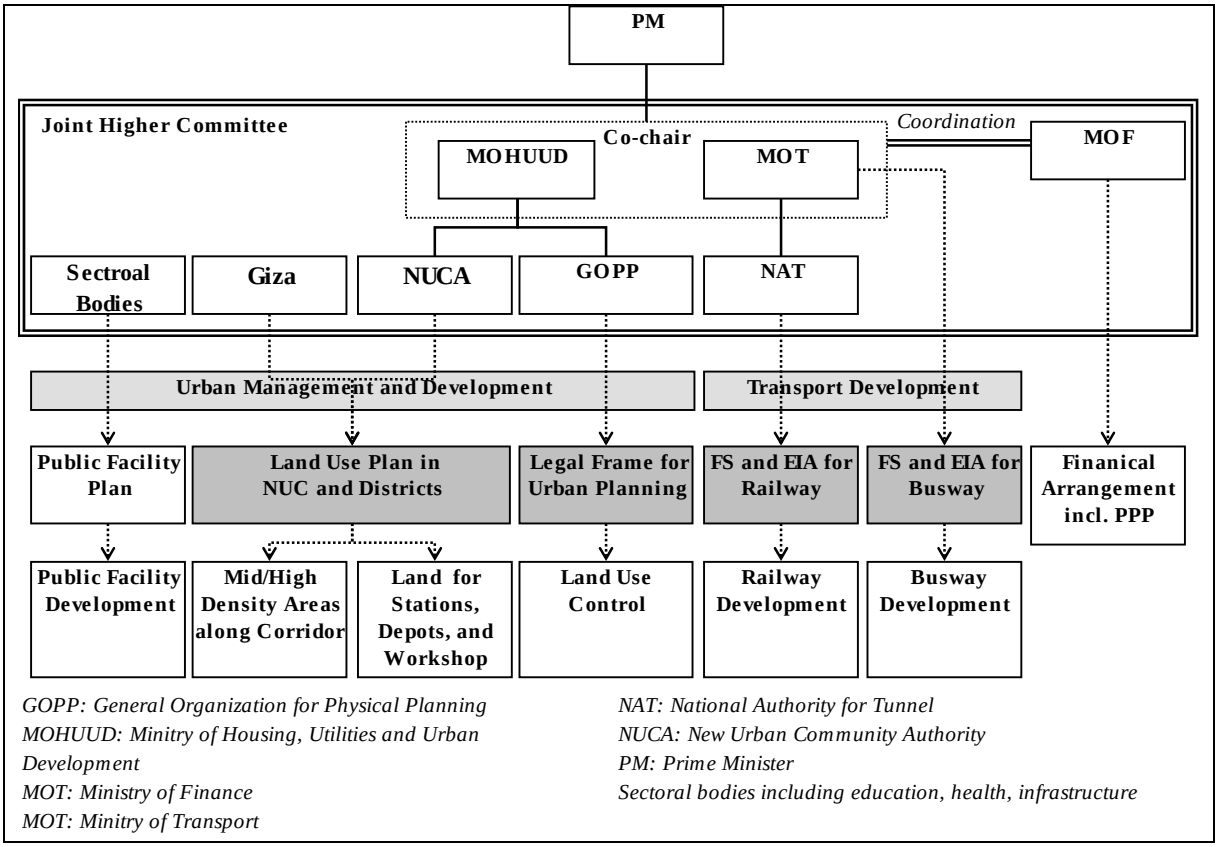
9.1 The essential factor for successfully implementing the Western Development Corridor is to maintain the momentum of development by carrying out necessary actions in sequence. For the next step, the main tasks to be undertaken for implementation in the urban and transport sectors after completion of the SDMP Study are as follows:

1) A new coordinating body should be established to manage and coordinate the activities of relevant authorities in the urban planning and transport sectors.

2) The urban planning sector should begin detailed development planning for 6th of October, Al Sheikh Zayed, and areas along the development corridor. The detailed plans should designate medium and high density areas along the corridor, and assign sites to be used for priority areas, including a central station, terminal stations, depots and workshops. Capacity development for the establishment of an appropriate legal framework and better enforcement of urban planning controls will also be necessary. In addition, the required public facilities should be developed within the Western Development Corridor, including utilities related to education, health, water supply, wastewater and solid waste.

3) The transport sector should conduct a feasibility study (FS) and environmental impact assessment (EIA) for the railway and busway development. The FS should review the designs, fare system, the financial and business model, and construction methods to mitigate the potential negative affect on the traffic during the construction stage. The EIA should evaluate the relocation of existing residents and countermeasures to mitigate the potential adverse impacts that may be induced by the project.

To achieve the proposed activities for the next step, the authorities will need to establish a joint high coordinating committee to oversee the transport development and urban development in an integrated viewpoint. The committee will be co-chaired by the Minister of Transport and Minister of Housing, Utilities and Urban Development. Figure 9.1 depicts a proposed implementation scheme for actions that need to be taken by various organizations.



Source: JICA Study Team

Figure 9.1 Proposed Implementation Scheme for the Western Development Corridor