CHAPTER 3
COLLECTION OF RELEVANT DATA ABOUT EXISTING AND PROPOSED PUBLIC UTILITIES AND OTHER POTENSIAL CONFLICTING INFRASTRUCTURE

CHAPTER 3 COLLECTION OF RELEVANT DATA ABOUT EXISTING AND PROPOSED PUBLIC UTILITIES AND OTHER POTENTIAL CONFLICTING INFRASTRUCTURE

3.1 Wastewater Tunnel under Port Said Street and its Branch Sewage Tunnels

The spine wastewater tunnel is located under Port Said Street at a depth of 10 to 15 m from ground level (Figure 3-1). It is an obstacle and a problem for the plan and design of the Phase 2 section of Metro Line 4. From documents published by the Egyptian Tunnelling Society and the International Tunnelling Association, it is found that the branch sewerage tunnels which were connected to the spine wastewater tunnel had been constructed in the 1990s. It is assumed that these branch tunnels are connected under the road intersections. Therefore, it is important to obtain the diameter and location of these tunnels for the plan and design of Metro Line 4.

Source: Tunnel & Tunnelling Int. Sep. 1999

Figure 3-1 Location of Spine Wastewater Tunnel and its Branch Sewerage Tunnels

3.2 El Azhar Road Tunnel

The El Azhar Road Tunnel crosses under Port Said Street and is located beneath the spine wastewater tunnel at its intersection (Figure 3-2). If Metro Line 4 would be constructed under the El Azhar Road Tunnel, the depth of the metro tunnel will be 45 m or deeper and the neighbouring station will encounter a problem for passenger access and convenience. Therefore, in order to collect horizontal and vertical location data, the design and as-built drawings of the El Azhar Road Tunnel were collected from the General Authority for Roads, Bridges and Land Transport (GARBLT). The location and construction method of the Metro Line 4 will thus be studied, taking into consideration the drawings of the road and sewerage tunnels.

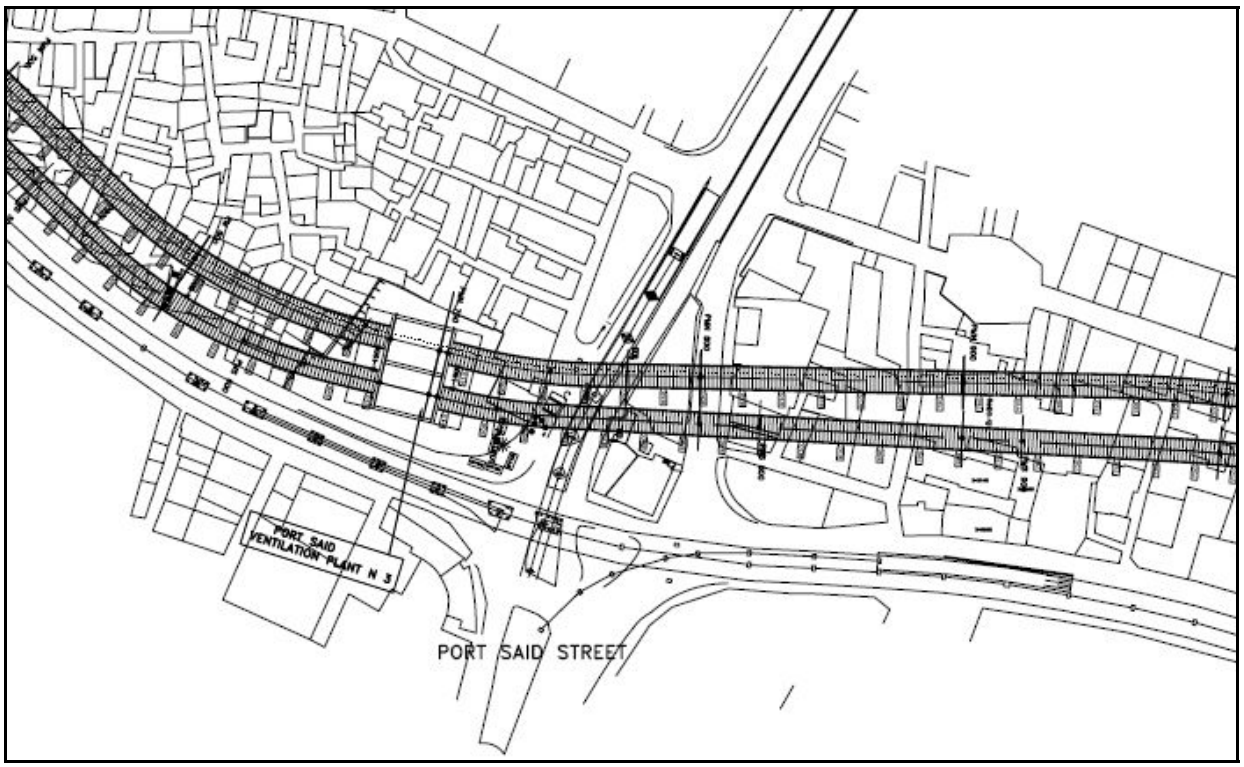


Figure 3-2 Plan of El Azhar Tunnel at intersection of Port Said Street

3.3 Other Sewerage Tunnels

There is information that new sewerage tunnels are constructed or planned in other areas of Greater Cairo. Therefore, the location of the construction and plan of the sewerage tunnels should be known in order to confirm their impact on Metro Line 4. A questionnaire for this purpose was submitted to the Ministry of Housing, Utilities and Urban Development.

3.4 Other Utilities

Interviews were arranged with the following organizations for the purpose of collecting data on the location of other utilities, such as electric power lines, gas pipes, potable water pipes, telephone cables, etc.:

- Cairo Utility Data Center (CUDC)
- Giza Utility Data Center (GUDC)

Based on the interviews, it was found that utility surveys are controlled and executed by these organizations and a subcontract with the organization will be required if the JICA Study Team should assemble the desired information. The subcontract will include a site visit survey, data collection for each utility and preparation of plan and cross-sectional drawings. The basic unit costs for the survey, excluding supervision during construction stage, are as follows:

- LE 1,280/500 m^2, CUDC
- LE 990/500 m^2, GUDC

3.5 Other Potential Conflicting Infrastructures

Information on other potential conflicting infrastructures (hard points), such as Ghamra Bridge, El Azhar Bridge, Al Haram & El Malek El Saleh Subways, etc. will be incorporated in Volume 2.

CHAPTER 4
COLLECTION OF RELEVANT SOCIO-ECONOMIC DATA

CHAPTER 4 COLLECTION OF RELEVANT SOCIO-ECONOMIC DATA

4.1 Data Required for the Environmental Plan

4.1.1 Relevant Legislation

Table 4-1 lists the legislations that apply to Environmental Impact Assessment (EIA) studies in Egypt.

Table 4-1 List of Relevant Legislations

	Name	Description
1	Egyptian Constitution	
2	Law No. 31/1976	Public cleanliness (control of solid waste management, amends Law No. 38 of 1967)
3	Law No. 27/1978	Public water sources
4	Law No. 137/1981	Labour (control of work place safety and environment)
5	Law No. 48/1982	Protection of Nile and its waterways
6	Law No. 102/1983	Natural protection
7	Law No. 117/1983	Cultural heritage
8	Law No. 4/1994	Protection of environment
9	Law No. 12/2003	Labour
10	Law No. 9/2009	Amendment of some parts of Law No. 4/1994

Source: JICA Study Team

4.1.2 EIA System in Egypt

Law No. 4/1994 on the Environment and the amended executive regulations issued by Decree 1741 of year 2005, and subsequently by Law No. 9/2009, state that new establishments or projects as well as expansions or modifications of existing establishments must be subject to an EIA before any construction works are initiated or a license is issued. The EIA report should be submitted through the Competent Administrative Authority (CAA) to the Egyptian Environmental Affairs Agency (EEAA). EEAA will review the study and prepare an opinion indicating if the project can be approved.

According to the EIA guidelines issued in January 2009, there are three categories of projects that require an EIA, as follows:

(1) Category A Projects

This class includes establishments/projects with minor environmental impacts. The project proponent has to fill in the Environmental Screening Form "A". The list includes establishments which may be approved based on fundamental information only.

(2) Category B Projects

The list includes establishments to be screened for major environmental impacts. The establishments are categorized by activities, quantity of production and project size. In case of establishments with no mentioned production capacity limits, all sizes are included, which is currently the case in the present list. The proponent has to fill out an Environmental Screening Form "B". The procedure consists of two stages, namely: (a) screening (filling out Form “B”) possibly followed by (b) scoped EIA on certain identified

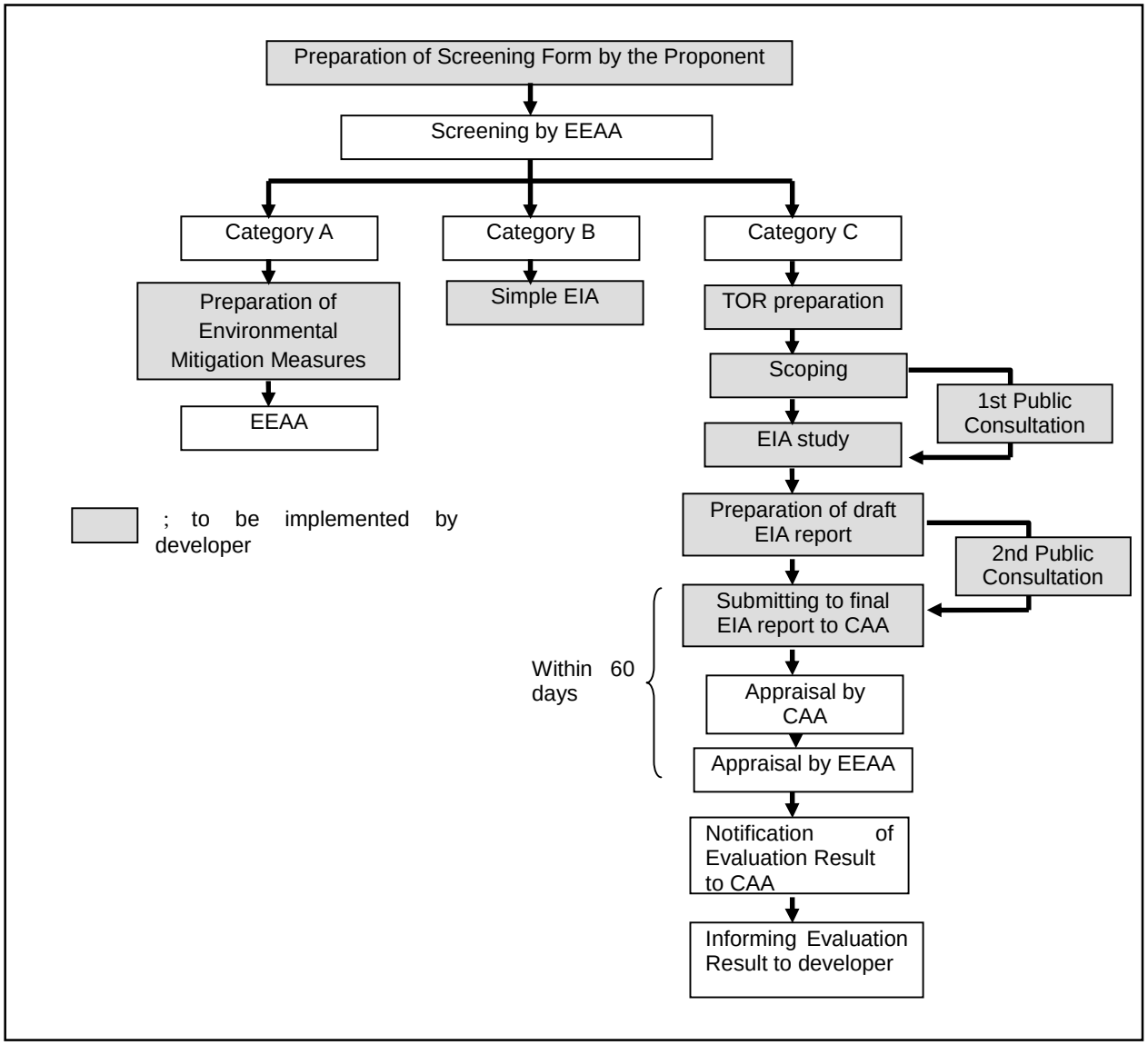
impacts/processes if EEAA requests this.

(3) Category C Projects

This category includes establishments/projects which, due to their potential substantial environmental impacts, need a full EIA study.

- The establishments are screened by activities, quantity of production and project size. In case of establishments with no mentioned production capacity limits, all sizes are included, which is currently the case in the present list as provided in the annex of the latest guidebook. Determining the classification of the project may be conducted in consultation with EEAA if not clearly found on the list of C-listed projects.
- The developer applies to the CAA with a letter of intent to undertake a certain project classified as a Category C project. The developer attaches three copies of the full EIA study on the project in accordance with the relevant sector guidelines.
- The CAA registers the documents and checks whether the selected category is correct and whether the information included in the EIA study complies with the required information according to relevant sector guidelines.
- The CAA checks the documents and formally submits the applicant's documents to EEAA for review and evaluation.
- EEAA evaluates the documents and submits to the CAA its opinion and possible proposals for measures to be taken in order to ensure the protection of the environment within 60 days of EEAA's receipt of the completed documents. Failure to do so shall be considered as an approval of the assessment.
- EEAA registers the documents, its opinion and proposals in the EIA register at EEAA.
- The CAA officially notifies the developer, by registered letter with an acknowledgment of receipt, about the final result of the evaluation.
- The CAA forwards a copy of its decision to EEAA, which registers it in the EIA register.
- The CAA ensures implementation of the decision.
- The developer can appeal the decisions to the Permanent Appeals.
- Committee in writing within 30 days of receipt.
- Required documents include the relevant sector guidelines available at the CAA.

Figure 4-1 shows the flow of the EIA approval process.



Source: Prepared by JICA Study Team based on Egyptian EIA Guidelines

Figure 4-1 Flow of EIA Approval

4.1.3 Contents of EIA Report

EIA studies of Category A and Category B projects are guided by the forms for these projects, which require completion of the following fundamental components:

- Project description
- Relevant provisions of environmental laws and decrees
- Description of surrounding environment
- Impact Assessment, including the impact of the environment on the project
- Environmental Management Plan, including mitigation measures, monitoring, as well as a contingency plan in accordance with Labour Law No. 12/2003

EIA studies of Category C projects are outlined as follows, and must be prepared by an environmental consultant or an environmental consultancy firm:

- Executive Summary (non-technical)
- Legal and Institutional Framework
- Project Description
- Description of Surrounding Environment
- Impact Assessment and Analysis
- Assessment of Alternatives
- Public Consultation
- Environmental Management Plan
- List of References
- Annexes, which shall include the following documents, among others:
  - List of Consultants and their Roles in the EIA Study
  - Attendance List of the Public Consultation/Hearing Session(s)
  - Agendas of Meetings and Public Consultation Sessions.

4.1.4 Appeal System

The decision taken by the authorities regarding the assessment and/or the proposals required to be implemented can be appealed to the Permanent Appeals Committee by the developer within 30 days after receiving such decision. The classification according to environmental impacts of the projects ("A", "B" or "C") cannot be appealed.

4.1.5 Public Consultation

Public consultation is required for EIA studies of Category C Projects, and it is noted that political and economic aspects are not to be discussed. Invitees include the public and private sector, academia, civil society, representatives from neighbouring communities or establishments, and any other stakeholder.

Public consultation is to be conducted twice, i.e., once during scoping and the second time after preparing the draft EIA study. International lenders, such as the World Bank, might require the further conduct of regular ongoing public consultations throughout both phases of the project building and throughout operation. The method of conducting public consultation can be flexible, e.g., either through a single session with all stakeholders or through individual meetings.

Depending on the nature of the project, the EEAA may call for the second public consultation on the draft EIA study through announcement in the local newspapers or by invitation. The non-technical executive summary, in Arabic language, should be made available to the public at least two weeks before the public consultation. In case of public objections during consultation, the EEAA will evaluate the need to provide scientifically justified responses from the project proponent.

After completion of the EIA study, it will be kept in the central library of the EEAA or the

respective Regional Branch Office (RBO). The executive summary will be made available on the EEAA website, with the possible exclusion of confidential information.

4.1.6 Baseline Information

(1) Environmental Standard

a) Air Quality

According to Law No. 4/1994, the standard for ambient air quality is regulated as shown in Table 4-2.

Table 4-2 Maximum Limits of Outdoor Air Pollutants (Microgram per Cubic Meter)

Pollutant	Maximum Limit	Period Of Exposure
Sulphur Dioxide	350 150 60	1 hr 24 hrs 1 year
Carbon Monoxide	30 mill gram /m^3 10 mill gram /m^3	1 hr 8 hrs
Nitrogen Dioxide	400 150	1 hr 24 hrs
Ozone	200 120	1 hr 8 hrs
Suspending Particles (Measured as black smoke)	150 60	24 hrs 1 year
Total Suspending Particles	230 90	24 hrs 1 year
Chest Particles (PM 10)	150 70	24 hrs 1 year
Lead	0.5 1.5	An average of 24 hours over 1 year in the urban areas An average of 24 hours over 6 months in the industrial zones

Source: Law No. 4/1994

The air quality standard for indoor public and closed spaces according to Law No. 4/1994 is shown in Table 4-3.

Table 4-3 Quantities of External Air Necessary for Ventilating Public and Closed Places

Quantity Of External Air (*) m^3/minute/person	Type of Place and Activity
0.14 – 0.28	Place with high ceiling, bank, lecture hall, worship place, **large public place,** theatre, room without smoking.
0.28 – 0.42	Apartment, hairdresser's, beauty shop, hotel room, room with light smoking.
0.42 – 0.56	Cafeteria, place with small restaurant, general place of work, hospital room, restaurant, or room with medium smoking.
0.56 – 0.85	**Private place of work,** office, clinic, or room with heavy smoking.
0.85 – 1.7	Conference hall, nightclub, crowded room with heavy smoking.

Source: Law No. 4/1994
(*) Without using air-conditioners
Notes
- The space appropriated for each person shall not be less than 4.25 m^2.
- The floor area appropriated for each person shall not be less than 1.4 m^2.

Furthermore, the limits of exposure to temperature in the workplace according to Law No. 4/1994 are provided in the following Tables 4-4 and 4-5.

Table 4-4 Limit of Exposure to Temperature Permissible in Work Environment in accordance with Type of Work and Air Speed

Type Of Work	Low Air Speed		High Air Speed	
Light Work	30	Centigrade	32.2	Centigrade
Moderate Work	27.8	Centigrade	30.5	Centigrade
Heavy Work	26.1	Centigrade	28.9	Centigrade

Source: Law No. 4/1994

Table 4-5 Limits of Heat Exposure Permissible in Work Environment according to Work System

System of Work and Rest per hour	Light Work	Moderate Work	Heavy Work
Continuous Work :	30 ˚C	26.7 ˚C	25 ˚C
75% Work, 25% Rest	30.6 ˚C	28 ˚C	25.9 ˚C
50% Work, 50% Rest	31.4 ˚C	29.4 ˚C	27.9 ˚C
25% Work, 75% Rest	32.2 ˚C	31.1 ˚C	30 ˚C

Source: Law No. 4/1994

b) Water Quality

Article 60 of Law No. 48/1982 on Protection of the Nile and its Waterways stipulates the industrial fluid wastes that are permitted to be discharged in accordance with the standards shown in Table 4-6 below.

Table 4-6 Standards that Must be Met for Permitted Discharge into Fresh Waterways, as Provided in Law No. 48/1982

Description	Standard Measures in mg/L (otherwise, L) Mentioned
Colour	Not more than 100 degrees
Total Solid Materials	500
Temperature	5 degrees over the normal
Dissolved Oxygen	Not less than 5
Hydrogen Exponent	Not less than 7 and not more than 8.5
Absorbent Activated Oxygen	Not more than 6
Consumed Chemical Oxygen	Not more than 10
Organic Nitrogen	Not more than 1
Ammonia	Not more than 0.5
Greases and Oils	Not more than 0.1
Total Alkalinity	Not more than 150 and not less than 20
Sulphate	Not more than 200
Mercury Compounds	Not more than 0.001
Iron	Not more than 1
Manganese	Not more than 0.5
Copper	Not more than 1
Zinc	Not more than 1
Industrial Detergents	Not more than 0.5
Nitrate	Not more than 45
Fluorides	Not more than 0.5
Phenol	Not more than 0.02
Arsenic	Not more than 0.05
Cadmium	Not more than 0.01
Chromium	Not more than 0.05
Cyanide	Not more than 0.1
Lead	Not more than 0.05
Selenium	Not more than 0.01

Source: Law No. 48/1982

c) Noise

The maximum limits of noise intensity are set by Law No. 4/1994 as provided in Table 4-7.

Table 4-7 Maximum Limit of Noise Intensity in Different Areas

Kind of area	Maximum limit of equivalent noise intensity L Aeq in decibel		
	All day	Evening	All night
	(7 am – 6 pm)	(6 pm – 10 pm)	(10 pm – 7 am)
Rural residential areas, hospitals, and garden areas	45	40	35
Residential suburbs, with the existence of little movement	50	45	40
Town residential areas	55	50	45
Residential areas having some workshops or commercial activities, or on public roads	60	55	50
Trading and administrative areas, and downtown	65	60	55
Industrial zones (heavy industries)	70	65	60

Source: Law No. 4/1994

The permissible limits of indoor noise level inside places of productive activities are provided in Table 4-8 and Table 4-9.

Table 4-8 Intensity of Sound inside Places of Work and Indoor Places

	Place and Activity	Max. limit for equivalent noise intensity L Aeq in decibel (A)
1	Places of work with shifts up to 8 hours, with the aim of limiting noise hazards to the hearing sense.	90
2	Places of work which require hearing sound signals, and good hearing of speech.	80
3	Work rooms for computer or typewriters or the like.	70
4	Work rooms to follow up, measure and adjust operation.	65
5	Work rooms for activities which require routine mental concentration, and control rooms.	60

Source: Law No. 4/1994

Table 4-9 Maximum Period Permissible for Exposure to Noise in Places of Work (Factories and Workshops)

Equivalent noise intensity L Aeq in decibel (A)	95	100	105	110	115
Period of Exposure (1 hour)	4	2	1	0.5	0.25

Source: Law No. 4/1994

Table 4-10 below shows the limits applicable to emission of noise from heavy hammers, before hearing is affected.

Table 4-10 Maximum Limit Permissible for Exposure to Intermittent Noise Resulting from Heavy Hammers

Sound Intensity (decibel)	Number of knocks permissible during the period of daily work
135	300
130	1,000
125	3,000
120	10,000
115	30,000

Source: Law No.4/1994

d) Waste Disposal

Article 41 of Law No.4/1994 governs the handling, transportation, and dumping of wastes resulting from excavation work. The location for disposal must be at least 1.5 km from dwelling zones, and these wastes shall not be transported or disposed of except at the places appropriated for such purpose and licensed by the appropriate local government units. The Environmental Affairs Agency may amend the conditions or add new conditions thereto, whenever necessary.

(2) Current Environmental Condition

a) Air Quality, Noise and Vibration

The most recent and published data of ambient air pollution near the studied alignment is previously obtained through EEAA during the JICA Feasibility Study of High Priority Urban Toll Expressways. The results are provided in ANNEX 1.

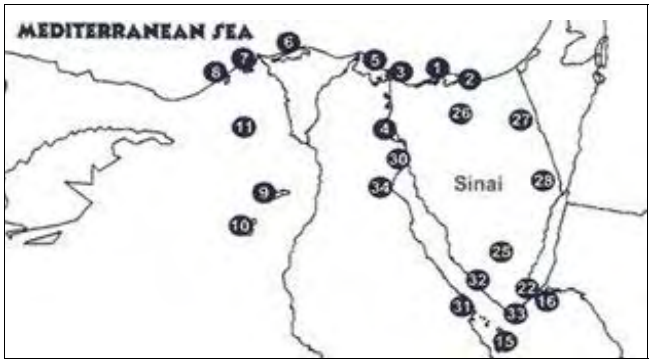
Most monitored air pollution levels were within the allowable limits of Egyptian standards but there were frequent high noise levels recorded above the higher limits. A major concern is the over ambient PM_{10} concentrations. The study found that the average vibration level at the foreground was greater than 70 dB (A), which is the maximum allowable level of L_{10} for traffic vibration according to Japanese Standards (there is no vibration standard in Egypt).

b) Flora and Fauna

Through preliminary site reconnaissance, the studied area appears to have little ecological significance and low biodiversity due to the immense alteration of the natural ecology. Almost all areas are considered built environments.

Only plants and animals that can tolerate urban pressures and live close to man are found in these areas. Even in the sparsely populated desert environment in the Phase 1 alignment, a previous study confirmed that the area has minimal significance for biodiversity. None of the few species of plants and animals are globally or locally threatened species.

With regards to Important Bird Areas (IBAs), their distribution in Egypt is presented in Figure 4-2. This figure shows that no area is within the study area.



(Available from EEAA website, http://www.eeaa.gov.eg/English/main/protect_bird.asp)

Figure 4-2 Distribution of Important Bird Areas (IBAs) in Egypt; All Outside Greater Cairo

c) Natural Protectorates

None of the studied alignment alternatives passes through or is nearby natural protectorate areas. The natural protectorates closest to the study area are Wadi Degla, the Petrified Forest, and the Hassana Dome, as declared in Law No. 102/1983 for Natural Protectorates. The closest protectorate is Hassana Dome which is a 1 km^2 geological protected area located more than 3 km away from the closest alignment alternative and at a higher ground level. No significant concern over the potential impact to the project implementation is therefore expected.

(3) Experience of EIA Study at Previous Metro Projects

The implementation of an EIA study for a Metro Line in Egypt is unprecedented since the previous Metro Line 1, 2, and 3 have not been requested by EEAA to conduct such study before the stricter regulations recently set by EEAA with reference to the Environmental Guidelines of 2009 and Law No. 9/2009 for the amendment of Law No. 4/1994. As explained during consultation meetings with the EEAA, the EEAA has requested the project executing agency to submit an EIA study for the phases of Metro Line 3 that have not started yet, and to also submit partial studies for the phase already under construction, such as planning mitigation measures and formulating an Environmental Management Plan.

Through an initial information survey by JICA Study Team, it is found that the most adequate reference EIA studies conducted in terms of similar nature, size, and geographic location, are the EIA studies for the Feasibility Study on High Priority Urban Toll Expressways (GARBLT/JICA) and the EIA study on the Natural Gas Pipeline (EGAS/World Bank), for which international standards of EIA procedures were practiced and alignments were spread throughout Greater Cairo.

(4) Next Research Objectives

- Research on previous cases of dealing with chance findings during

construction and their information for forecast in the study area
- Purchase of the archaeological maps of Giza and Cairo from SCA
- Purchase of the Local Administration Law No. 43/1979 from the Middle East Library for Economic Services
- To study precedent cases of core-boring researches in Giza area to forecast the average depth of the proposed buried cultural remains when the geological survey would be done in this project

4.2 Data Required for Resettlement Action Plan (RAP)

4.2.1 Relevant Legislations

The legislations relevant to land acquisition and resettlement in Egypt are shown in Table 4-11.

Table 4-11 List of Relevant Legislations

	Name	Description
1	Egyptian Constitution	
2	Law No. 10/1990	Regulation and procedure for expropriation of real estate in the public interest
3	Law No. 4/1994	Regulation for environmental management and mandate of EEAA
4	Law No. 12/2003	Labour Law
5	Law No. 94/2003	Establishing the National Council for Human Rights

Source: JICA Study Team

4.2.2 Procedure for Land Acquisition and Resettlement

The fundamental regulation related to land acquisition and resettlement is Law No. 10/1990, which specifies that land will be expropriated for the following public interest works:

- Construction and rehabilitation of roads, streets, squares
- Water and wastewater projects
- Irrigation and drainage projects
- Power and energy projects
- Construction of surface and underground passages
- Transportation and communication projects
- Public utility work regulated by other laws

The abovementioned projects will follow the procedure below in order to transfer the ownership of land. This procedure is also illustrated in Figure 4-3.

(1) Entitlement of Execution

By a presidential decree, the expropriating entity is entitled to execute acquisition of the properties concerned in the public interest.

(2) Establishment of Committee for Property Assessment

A presidential decree will be issued to establish a committee for the assessment of the physical properties that will be affected by a project. The committee consists of a delegate from the entity in charge of the expropriation, an officer and a cashier from the governorate.

Announcement of physical property assessment will be done at the central office of the governorate and in the premises of the mayor. The owners of concerned properties will be informed through an official letter about the result of the assessment. The owners of the affected properties are required to attend the assessment.

(3) Assessment of Compensation

After the committee examines the affected physical properties, assessment for compensation will be conducted at each governorate by a committee, based on a decree from the Minister of Public Works and Water Resources. A committee consists of a delegate from the survey department, a delegate from the department of housing and utilities in the governorate, and a delegate from the department of real estate taxes in the governorate. The committee prepares an assessment report, which includes the owner's name, address, and the size of the property. The result of the assessment will be announced to the property owner(s) through an official letter.

Within one month after the assessment, the entity in charge of expropriation will start to prepare the necessary budget for compensation. The entity in charge prepares the list of compensation containing the name of the property owner to be compensated, the address of the property to be expropriated, and the area to be expropriated. This list is announced at the central office of the entity, the survey authority, and the central office of the governorate. The amount of compensation will be communicated through official letter to the concerned owner(s). In addition, an announcement will also be made in the Egyptian Official Gazette, Official Journal, and two daily newspapers for a period of one week. Property owners are informed through official letters to deliver their properties within a period of five months.

(4) Transferring Ownership

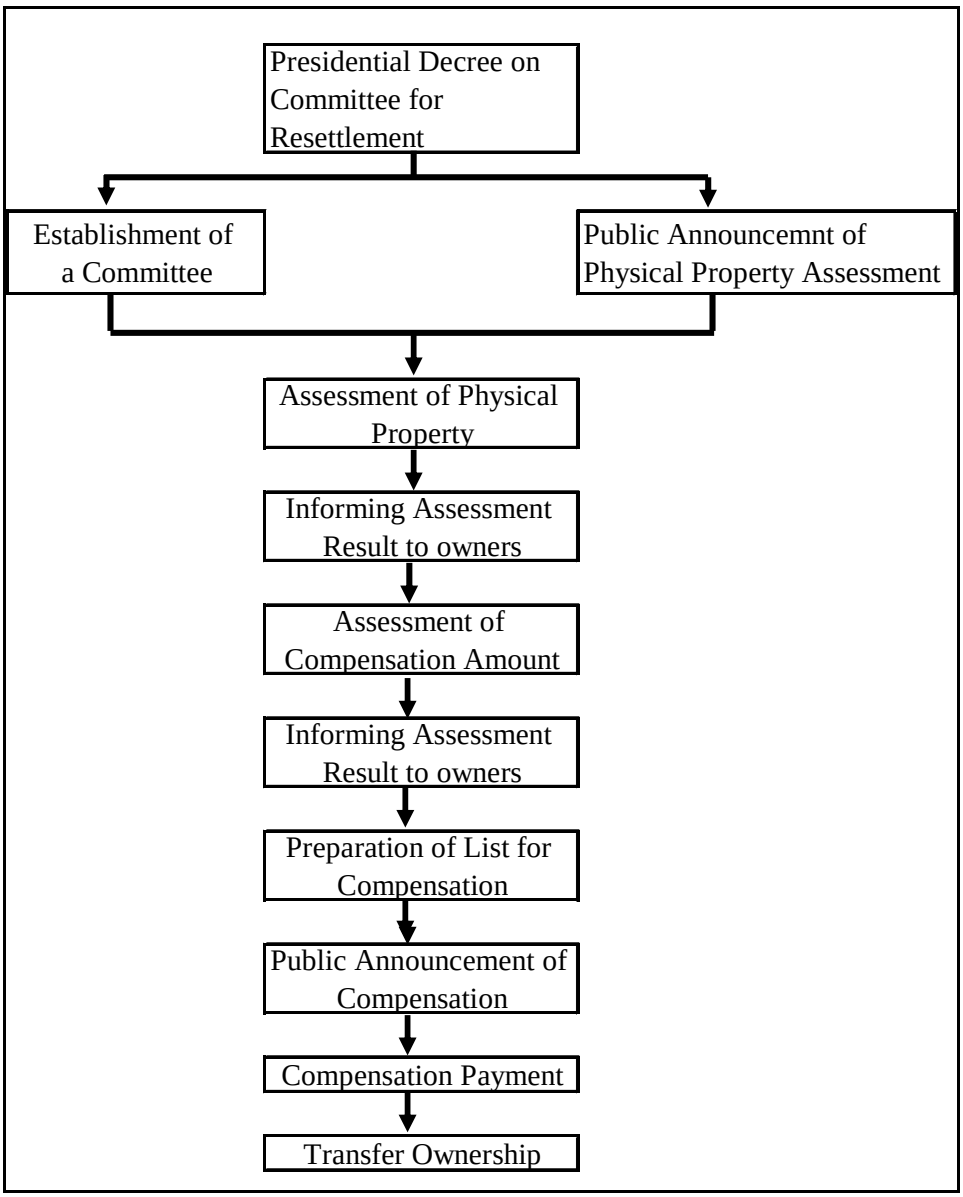
Owners must sign the form to transfer ownership of the properties to the public sector. In case the owners do not sign this form, a ministerial decree is issued to expropriate the said properties. The signed form and ministerial decree are kept at the Real Estate Notarization Office. Ownerships of properties are transferred when owners and tenants receive the compensation amount.

(5) Grievances

Owners are given 30 days after the expiry of the public announcement to notify grievances to the central office of the expropriating entity or governorate. In addition, the expropriating entity is allowed to contest the evaluation within 4 months after expiry of the public announcement.

(6) Void Assessment of Compensation

In case compensation is not paid within two years from the date of publication of the assessment of compensation, a resolution to declare the compensation invalid will be issued.



Source: Prepared by JICA Study Team based on Law No.10/1990

Figure 4-3 Flow of Land Acquisition and Resettlement

4.2.3 Method for Compensation

Egypt has two methods for compensation, namely: (i) compensation by cash payment and (ii) compensation by providing a replacement property. In the case of cash compensation, only the owners of properties which are to be expropriated are entitled to receive compensation. Tenants are not entitled to receive cash compensation. In the case of compensation through the provision of replacement properties, both owners and tenants have entitlements.

4.2.4 Previous Experience of Land Acquisition and Resettlement (for Similar Projects)

JICA Study Team collected and interviewed parties involved in the process of land acquisition and resettlement, and found that resettlement planning was not comprehensively applied in the case of similar projects in the past.

According to collected information, land acquisition and resettlement occurred at Abbasia Station on the Phase 2 section of Metro Line 3. JICA Study Team interviewed the parties concerned and concluded that:

- Land acquisition and resettlement tends to be implemented without enough public consultation or information disclosure;
- The compensation amount tends to be insufficient compared with market prices; and
- The affected households tend to return to their original place of abode.

4.2.5 Baseline Socio-economic Information

Collection of basic data was undertaken for the purpose of making an initial assessment of the socio-economic condition of communities in the study area. The data collected is summarized in the following sections. Unless otherwise specified, all information were collected from the “Egypt Human Development Report 2008” of the UNDP.

(1) Literacy and Participation in Education

The adult literacy rate in the study area is relatively high compared with the average rate in Egypt. In 2006, the adult literacy rates in Cairo, Qaliobeya, and Giza were 80.7%, 71.9%, and 72.7%, respectively, as compared with the national literacy rate of 69.5%.

The education system in Egypt is not compulsory but optional. The school system (not including universities) consists of three levels, namely: primary, preparatory, and secondary. In addition, there is the El Azhar system[6] from primary to secondary levels, and vocational schools at the secondary level. School enrolment rates[7] in the three governorates comprising the study area are given in Table 4-12. These are shown to be lower than the

[6] El Azhar provides religious classes in addition to normal educational classes.
[7] Enrolment rates are computed as the percentage of the number of students enrolled in education to the number in eligible age-groups within the population.

national average.

Table 4-12 School Enrolment Rates in the Study Area

	Cairo %	Qaliobeya %	Giza %	Egyptian Average %
Primary	83.5	85.4	94.2	96.7
Preparatory	75.9	74.7	80.6	92.5
Secondary	65.1	62.2	59.1	71.7

Source: Egypt Human Development Report 2008, UNDP 2008

(2) Access to Social Infrastructure

Access to electricity is high throughout Egypt. The proportion of households with television in the study area is evaluated as high, with 95.9% in Cairo, 95.3% in Qaliobeya, and 93.1% in Giza in 2004. The rate of access to electricity, piped water and sanitation is shown in Table 4-13.

Table 4-13 Rate of Access to Social Infrastructure in the Study Area

	Cairo %	Qaliobeya %	Giza %	Egyptian Average %
Electricity	99.5	99.6	98.9	99.3
Piped Water	99.2	97.6	98.4	95.5
Sanitation	98.2	52.6	69.3	50.5

Source: Egypt Human Development Report 2008, UNDP 2008

(3) Access to health services

According to available data, the number of health units (comprising hospitals and clinics) per 100,000 people in 2005 in the study area was 6.2 units in Cairo, 3.3 units in Qaliobeya, and 5.1 units in Giza, while the average rate in Egypt was 3.8 units per 100,000 people.

4.3 Data Required for Analysis of Archaeological Assets

4.3.1 Brief Description of Work Objective and Priority Tasks

The final objective for this section of the feasibility study is to propose a “Risk Assessment” for buried archaeological property within the vicinity of Metro Line 4 route alignment. The following tasks will be undertaken in order to satisfy this objective:

- Literature research on the known sites
- Interviews with local experts
- Site reconnaissance on the route alignment
- Review of the legal system for archaeological properties
- Soil study from borehole research

The results of these activities should evaluate the probability of locating unknown archaeological property, which will then require a ”Risk Assessment” to be made for small areas along the proposed route(s).

In addition, previous cases of the treatment of archaeological remains near construction projects will be reviewed and assessed.

4.3.2 Information and Data Collection to Support Priority Tasks

Collection of information and data to support the analysis of archaeological assets has been focused on three items, namely:

- Interviews with relevant organizations;
- Review of the legal system; and
- Archaeological research.

(1) Interviews with Relevant Organizations

a) Supreme Council of Antiquities (SCA)

On 22nd March 2009, members of JICA Study Team met with Mrs. Azza Shawarby, who is the general manager of the Department of Geographic Information System Center (GIS Center) in SCA. Established in 2000, this center is responsible for protecting Egyptian archaeological sites and for registering all known sites and their full data on the digital and satellite map using GIS application. The center plans to issue a detailed atlas for each governorate, and has published the first volume on the Ash-Sharqiyyah Governorate in the Nile Delta. Concerning this project, the study area for Metro Line 4 covers Giza, Cairo and Qaliobeya governorates. Preparation works on the atlases for these governorates are in progress, and data collection has already started. Mrs. Shawarby has undertaken agreed to provide JICA Study Team with all data and information relevant to Metro Line 4 project subject to the receipt of the necessary official request letter.

On 28th April 2009, members of JICA Study Team met with Dr. Mahmoud Afifi, General Director of Giza Antiquities who is responsible for the whole Memphite area, in order to collect updated information about the Giza area,

On 29th April 2009, members of JICA Study Team had an interview with Mr. Adel Al-Sadani, General Director of the Matariya Inspectorate, in order to determine the site distribution and recent situation of the excavations. Despite the historical importance, little is in the archaeological records of this area.

On 3rd May 2009, members of JICA Study Team met with Mr. Ibrahim Al-Nawawy at his office, in order to submit a request letter for a copy of the"Topographic Digital Map with Archaeological Site Distribution in the Greater Cairo Area". Mr Al-Nawawy is a supervisor at the GIS Center, which registers all known sites and their full data on digital and satellite maps using GIS application. Mr Al-Nawawy is also a consultant of Dr. Zahi Hawass, Secretary General of the SCA.

b) Grand Egyptian Museum (GEM)

On 23rd March 2009, members of JICA Study Team met with personnel of the GEM at its Giza office. Mr. Mikio Nakamura, Chief Adviser, explained the recent progress of the GEM project and told JICA Study Team that Dr. Yasel Mansour, Architect, who is the coordinator of technical committee of GEM, is in charge of the museum's master plan and that he could answer all the archaeological questions. Thus, an appointment was made to meet Dr. Mansour.

On 24th March 2009, members of JICA Study Team met with Dr. Mansour at his Giza office. He explained the planning of the museum and informed JICA Study Team that the underground boring conducted by GEM using core-drills had established that there were no archaeological remains in the planned area as well as the area for the Conservation Centre, which is already near completion. He also mentioned that SCA inspectors had been present all day during the construction of the Conservation Centre.

(2) Review of Laws and Regulations Relating to Archaeological and Cultural Properties

The legal system related to antiquities was reviewed. In Egypt, there is Law No. 117/1983 "Protection of Antiquities" which stipulates that SCA has sole responsibility for archaeological and historical property, and has authority for the excavation, restoration and protection of antiquities. This law consists of 51 articles. Some of these articles which are essential and relevant to the Metro Line 4 project are outlined below.

In *Article 5*, the Egyptian Antiquities Authority (now known as the Supreme Council of Antiquities) is designated as the quarter concerned with control and supervision of all matters related to antiquities, ancient and historical sites and areas, even if these have been discovered by accident.

In *Article 17*, the violating party shall restore the situation to its original condition, otherwise the Authority may proceed with restoring it to its original condition at the cost of the violator.

In *Article 20*, no construction licences shall be granted for archaeological sites or lands. No third party shall erect establishments or build roads in archaeological sites or on the lands lying within the approved lines of beautification of such antiquities.

In *Article 23*, any person who discovers and finds a real antiquity shall notify the Antiquities Authority. The Authority shall take steps as necessary to preserve and maintain such antiquity, and shall have the power, within three months, either to lift the antiquity existing in the realty of individuals, or take steps of land expropriation

where the antiquity is found, or leave the antiquity in its place. The value of antiquities existing in expropriated land shall not enter in the estimation of the land value.

In *Article 24*, any person who accidentally comes across an antiquity, shall notify such discovery to the nearest administrative department within 48 hours, and preserve and maintain it until it is received by the appropriate authority. Otherwise, he shall be considered as the holder of the antiquity without being licensed. The department shall also notify the Antiquities Authority thereof, on the spot.

(3) Examination of Baseline Information on Underground Cultural Assets/Confirmation of Handling of Similar Projects and Lessons Learned

a) Giza Plateau Area

On the Phase1 route, most attention should be paid to the Giza Plateau area. At this time, literature research and data collection on this area were conducted in order to assess the situation of the cultural properties.

Famous for the Great Pyramids, Giza Plateau is located only several metres from the last houses in the westernmost part of Giza City, where a limestone cliff (Middle Eocene Moqattam Formation) rises abruptly from the other side of a sandy desert plateau and stands 20-35 metres higher than the alluvial area. In order to keep away from the Nile inundation, almost all structures such as tombs and temples had been built on the higher plateau. This resulted to the huge complex of the Necropolis that can be seen nowadays (see Source: JICA Study Team

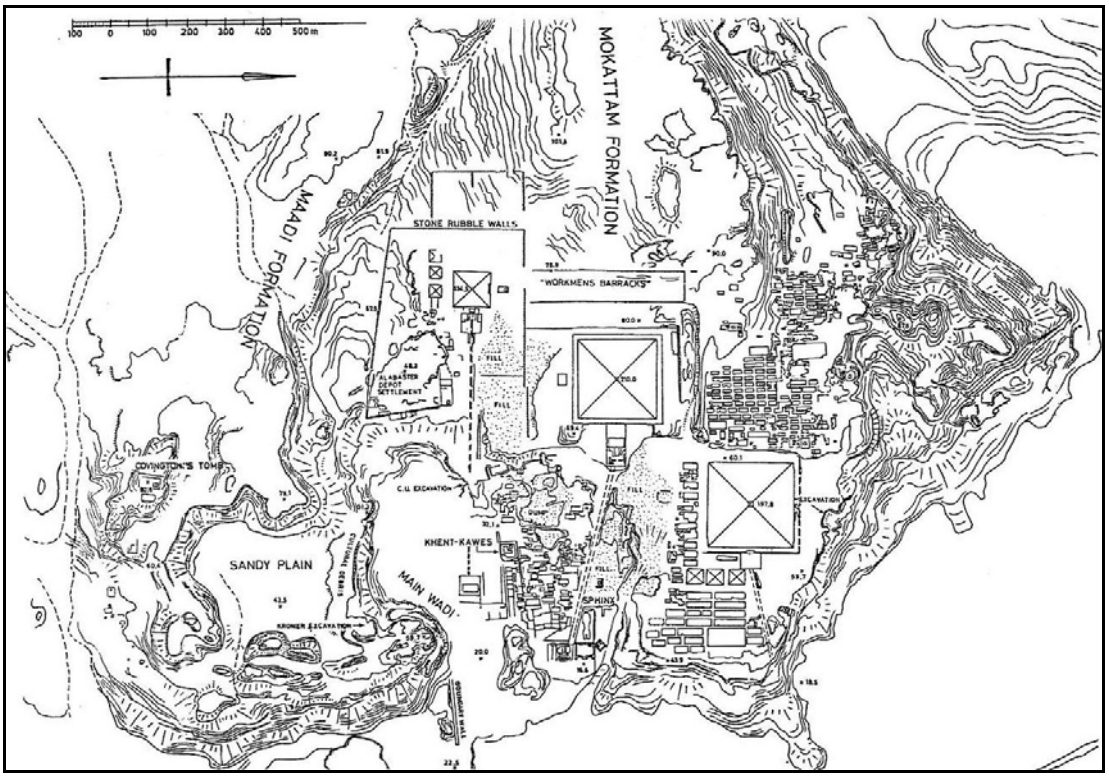
Figure 4-4).

However, some archaeological remains have been found in the alluvial area. Dr. Mark Lehner provides a reconstructed plan at the time of the construction of the Khufu Pyramid (see Figure 4-5) which shows that the valley temple, causeway, palace and settlement stand far beyond the limestone plateau.[8] This plan was based on evidence from borings and trenches made by the American British Consultants (AMBRIC) for the installation of a sewerage system as part of the Greater Cairo Wastewater Project, and the following salvage excavations by SCA in the late 1980s and early 1990s.[9] The project revealed that parts of the causeway and the valley temple of Khufu as well as the Old Kingdom settlement remained above the alluvial area, east of the Sphinx (see Figure 4-6). In addition, a large amount of pottery shards and some mud-brick structures were found scattered over a wide area stretching 3 km to the north, from the plateau to the nearby Pyramids Road and El Remayah Square, which are relevant to this feasibility study. These archaeological properties were reported to be buried at an average depth of 3.0 to 6.5 m below the modern ground level.

[8] M. Lehner, 1985, “The Development of the Giza Necropolis: The Khufu Project”, *MDAIK* 41: 109-143

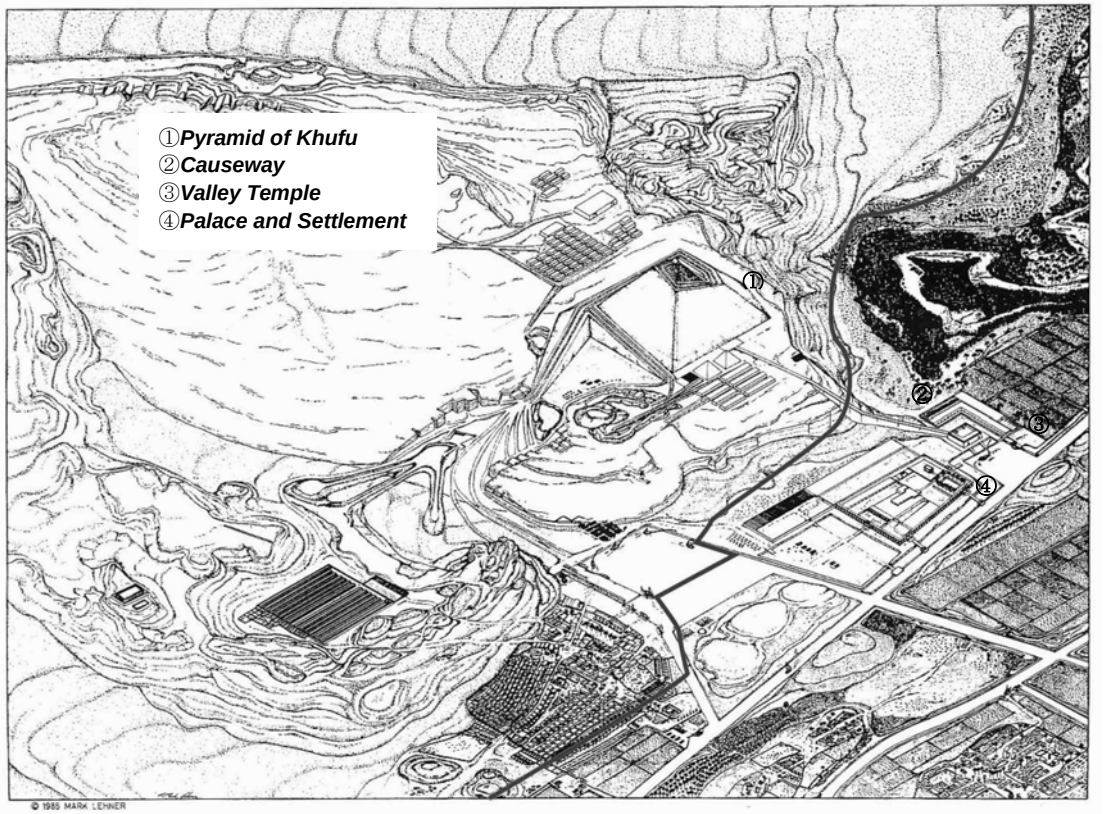
[9] Z. Hawass and A.Senussi, 2008, *Old Kingdom Pottery from Giza*, Cairo; Z. Hawass, 1997, “The Discovery of the Harbors of Khufu and Khafre at Giza”, *Études sur l’Ancien Empire et la nécropole de Saqqâra dédiées à Jean-Philippe Lauer*, Or.Monsp. IX: 245-256

Given this evidence, there might be a possibility of archaeological remains on the proposed route alignment of Metro Line 4.



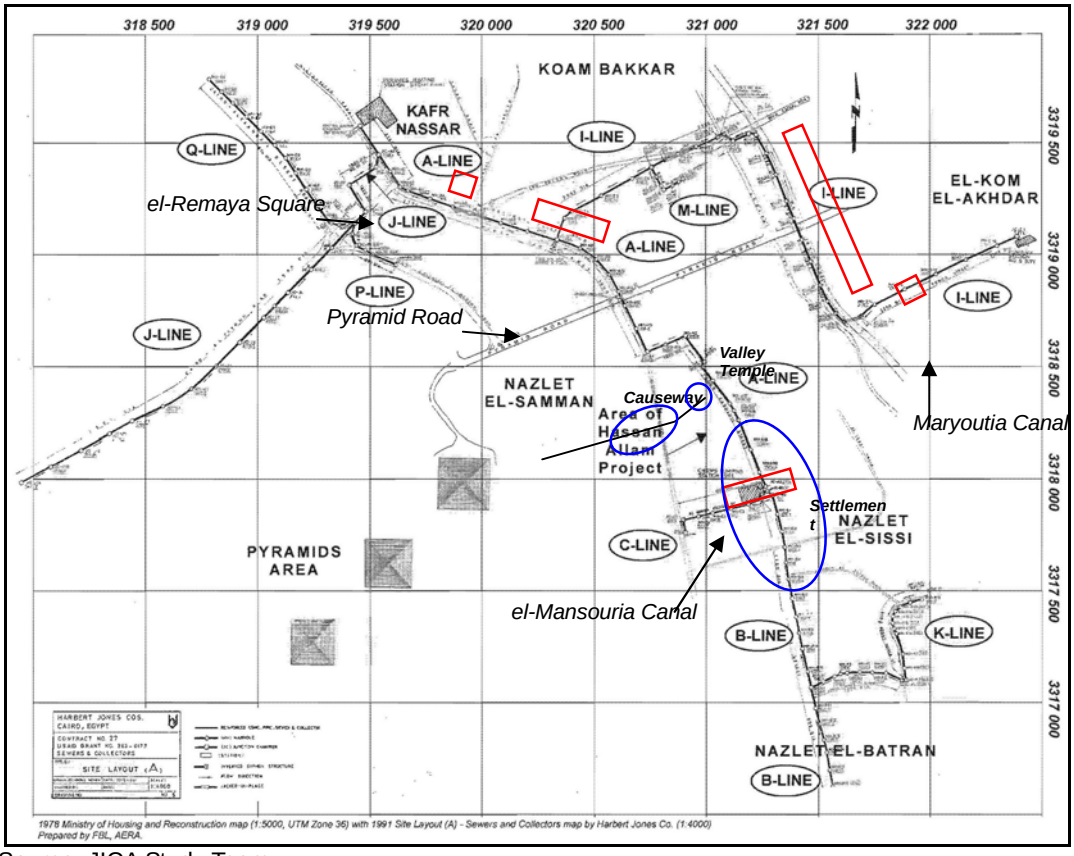
Source: JICA Study Team

Figure 4-4　Archaeological Map of Giza Plateau　（Lehner 1985: Fig.2）



Source: JICA Study Team
Note: Red line indicates modern border between desert and alluvial areas

Figure 4-5 Reconstruction Plan During the Construction of the Pyramid of Khufu (Lehner 1985: Fig. 3C)



Source: JICA Study Team
Note: Blue indicates architectural remains; Red indicates scattered objects)

Figure 4-6 Map of Sewers with Spots of Archaeological Finds (Hawass and Senussi 2008: Plan 6)

b) Matariya District

On the northern route of Phase 2 (east of the Nile River), the Matariya district is quite important for archaeological assets. As a result of the site visit with Mr. Adel Al-Sadani, General Director of the Matariya Inspectorate, the distribution of archaeological remains and the current excavations in this area are reported here.

Called Heliopolis in Greek, the area covering Matariya and Ain Shams was one of the three main cities and religious centre of the Sun cult in ancient Egypt. Despite the city's importance, no spectacular monuments can be seen in the area nowadays, except for an obelisk of Senwosert I standing in the small concession area of SCA. Because of proximity to Cairo, most of them were reused as architectural materials and buried in the underground of modern houses and cultivation. According to the records, however, there were at least 10 temples surrounded by massive mud-brick walls, estimated to be 1.2 by 1 km, at this place. Some parts of the walls have been uncovered and recent excavations revealed architectural remains at a depth of 2 m beyond the SCA's area (see Figure 4-7). This indicates that the archaeological remains are spread across a wider area.

Previous research confirms that tombs of the 6th Dynasty are located 550 m southeast of the obelisk, tombs of the Late Period are located some 950 m further in the same direction, and tombs of Mnevis Bulls are located about 1.3 km northeast of the obelisk (see Figure 4-8).[10]

In addition, recent excavations uncovered high-official tombs such as Panehsy and Waja-Hor from the 26th Dynasty some kilometres east of the obelisk and some parts of a sun temple precinct, mainly belonging to Ramesses II, about 60 m west of the obelisk.[11] Mr. Adel Al-Sadani said that around this area, the stratum with artifacts starts from 2-3 m below the ground surface to 8 m at most. Surprisingly, however, the tomb of Panehsy is reported to be situated at a depth of 60 m.[12]

The planned Metro Line 4 alignment runs towards El Sawaha Square along Port Said Street beside the Ismailiya Nile branch, which is the western end of Matariya district.

Figure 4-8 shows that the sites are found clustered on the eastern side. Mr. Adel Al-Sadani also indicated that no archaeological evidence so far has been uncovered in the west. However, the German mission working on the sun temple of Ramesses II assumes that the temple of Heliopolis was connected to the Nile branch by a canal, and had a large gate and sphinx avenue to the west. Thus, there is a possibility that archaeological properties are also buried within the western part of the Matariya district.

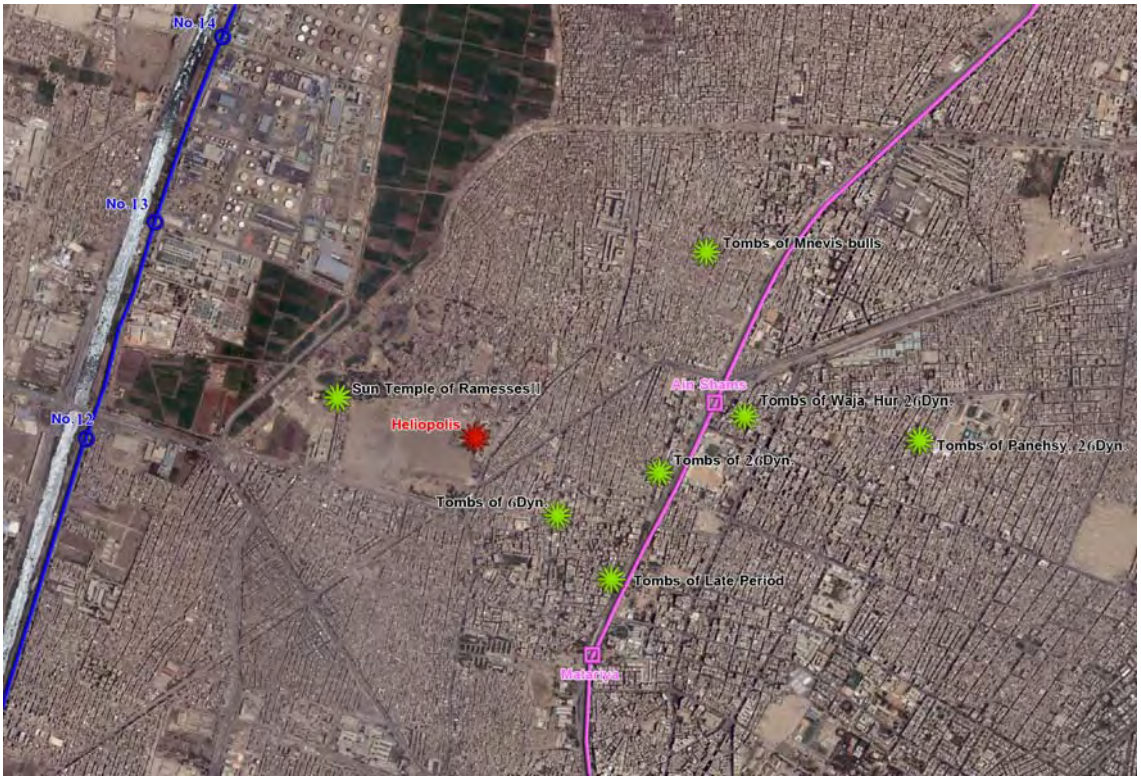
Source: JICA Study Team

[10] J. Baines and J. Malek, 1980, *Atlas of Ancient Egypt*, Oxford

[11] N. El-Aref, 2006, “Empire of the sun”, *Al-Ahram Weekly* Issue No.784, 2-8 March; SCA, 2006, *Antiquities of Egypt: SCA’s Monthly Letter* 1: 5; Deutsches Archäologisches Institut, 2006, *Rundbrief* 2006: 21-24

[12] N. El-Aref, 2005, “City of the sun”, *Al-Ahram Weekly* Issue No.744, 26 March

Figure 4-7 Pavements Uncovered Outside SCA's Concession



Source: JICA Study Team

Figure 4-8 Site Distribution Map in Matariya District

In addition, a general survey to assess underground cultural property was conducted at the Phase 1 route near its intersection with the 23rd March Corridor. This first survey has especially focused on the desert area, from the proposed depot site to behind GEM, which covers about 6 km extending west to east. Although it was a walking surface observation, there appeared to be no archaeological remains in the desert area. This result also agrees with the literature, data and historical perspective of the Giza Plateau, which show that the archaeological sites have been found closer to the Nile alluvial cultivation area, rather than in the desert area.

4.4 Data Required for Economic and Financial Analysis

4.4.1 Economic Analysis

(1) Broad Description of the Data Needed to Support the Economic Analysis

The methodology for the economic appraisal of Metro Line 4 provides some guidance on the type of data needed to support this task. This methodology will conform to the conventionally used methodology for transport investment projects worldwide.

Essentially, the appraisal will involve estimation of the net benefits of the project to society (in this case the local economy), through a comparison, over its life, of its economic benefits with its economic, or shadow-priced, capital and operating costs.

The economic benefits of the project will be measured by comparing the economic, or resource costs, of urban transport in the Greater Cairo Area (GCA), "*with"* and *"without"* the project, on the presumption that the project will bring about a reduction in these costs.

The starting point for this calculation is the definition of the "*With*" and "*Without"* project cases. In particular, the "*Without"* case has to be established by determining what alternative transport modes and routes will operate as part of the public transport network, *in the absence of Metro Line 4*. This case will therefore include all existing transport components of this network which are expected to continue operating, as well as all new components for which project funding has been, or is likely to be, committed.

The "*With"* case will then measure the traffic impact of the addition of the project to the network in the "*Without" case.* The traffic circulation volumes (vehicle-km, vehicle-hours, passenger-km and passenger-hours) associated with each case will be estimated *as a by-product of the transport demand forecast*. A comparison between the traffic circulation volumes of the "*With"* and "*Without"* cases will reflect a reduction in the volume of road traffic circulation after implementation of the project. The reduction in the road traffic volume will lead directly to a saving in vehicle operating costs (VOCs) and a reduction in air pollution costs, and indirectly through an increase in the average road traffic speed and accordingly, savings in the value of travel time (VOT). These comprise the economic benefits of the project and will be estimated by applying relevant unit values to the volume of the traffic reduction.

The *economic costs* of the project are estimated by re-valuing its capital and operating costs, expressed in financial terms, to represent economic or resource costs, through the application of relevant shadow pricing factors (SPFs). Application of these factors will remove transfer payments (taxes and charges) and the effect of market distortions from the factor prices used for the calculation of the project's capital and operating costs.

(2) Definition of the "With" and "Without" Project Cases

Details of the future urban transport network likely to affect demand for Metro Line 4 were assembled through review of the SDMP study report and discussion with the relevant authorities (in particular with the General Organization for Physical Planning (GOPP) of the Ministry of Housing, Public Utilities and Urban Development). These details were needed as the basis for defining the "Without" project case, which in addition to the existing urban transport network will include other new projects, either those which are currently under construction or others for which there is a commitment by the government for implementation within the forecast period of 2010-2050.

The SDMP study identified a total of 16 urban road projects which in 2007 were either under construction or under detailed planning. These projects are summarized in Table

4-14, but described in more detail in Chapter 3 of this report. All are expected to have an impact (to a greater or lesser extent) on the level of transport demand for Metro Line 4.

Table 4-14 Summary of Related[1] Road Projects in Greater Cairo, as of 2007

No.	Project Name	Status	In Charge
East of Greater Cairo			
1	Intersection of Cairo-Ismailia Desert Road with the Ring Road	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 the Ring Road from Cairo-Ismailia Desert Road up to Cornish Al Nile at Shubra Al Khyma	Under study	GOPP
4	Development of North Imbaba including Airport 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 Road New Corridor	Under study	GOPP
8	Improvement of El Ramayah Square	Approved	GOPP
9	Connection of Cairo-Alexandria Desert Road with Ring Road at km 21	Approved	GOPP
Inside Greater Cairo			
10	Connection of 15th May and 6th 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 May Bridge	Under study	GOPP
14	Construction of Intersection of Autostrade with Ramses Extension	On-going	Cairo Governorate
Ring Roads			
15	Upgrading of the Ring Road	Under study	GARBLT
16	Construction of the Regional Ring Road	Under study and On-going	MOT

Source: GOPP (as reported in SDMP study report)
Note: 1. Includes road projects which are related in terms of affecting the level of transport demand for Metro Line 4

In a meeting with the members of JICA Study Team, GOPP identified additional "in progress" or committed urban transport projects which are likely to have an impact on the demand for Metro Line 4. These are summarized in Table 4-15.

Table 4-15 Summary of Additional Related Transport Projects for Greater Cairo

No.	Project Name	Status	In Charge
East of Greater Cairo			
1	East Wing Railway	Under study	ENR
West of Greater Cairo			
2	Exclusive Busway system on 26th July Corridor (from Cairo University Metro Station to 6th October City, about 40 km)	Civil works to be completed within 2009; bus system selection under study	GOPP
Inside Greater Cairo			
3	Heliopolis Super Tram Project (upgrading of Heliopolis Tram and extension to New Cairo NUC)	Feasibility study in progress	GOPP
4	Urban Tollway (East Cairo)	Under study	GARBLT
5	6 road projects around GEM and El Remayah Square aimed at relieving local traffic congestion	Under construction	MOHUUD

Source: Meeting of JICA Study Team with GOPP, 25th March 2009

The projects identified in Table 4-14 and Table 4-15 when added to the existing public transport network for Greater Cairo comprising of the urban road network and Metro Lines 1-3, will constitute the "*Without"* project case, which would apply even if the construction of Metro Line 4 will not proceed. The "*With"* project case reflects the situation which would apply when Metro Line 4 is added to the urban transport network as defined by the "*Without"* project case. The urban transport traffic volumes associated with both cases will be determined by the transport demand forecasting process.

(3) Measurement of Economic Benefits

Although an urban public transport project such as Metro Line 4 can generate several types of economic benefit, it was considered that only three types of benefit can be practically measured within the timeframe allowed for this feasibility study, namely: savings in vehicle operating costs, savings in the value of travel time, and reduction in air pollution costs. All these benefits may be estimated on the basis of the reduction in road traffic made possible by the operation of Metro Line 4.

a) Savings in Vehicle Operating Costs (VOCs)

Unit VOC data, which consists of the economic costs per vehicle-km and per vehicle-hour of fuel, lubricants, tyres, maintenance labour, spare parts, crew (in the case of buses and trucks), vehicle depreciation and insurance, is usually obtained through a highway costing model, such as the World Bank's HDM-4 Highway Costing Model. Unfortunately, such model is not applied for the purposes of transport project evaluation in Egypt. Thus, it was necessary to make estimates on the basis of information supplied by auto retailers, bus operating companies, truck operators, and insurance companies, as well as to review the VOC data generated in the SDMP study.

Fuel costs will be estimated separately from other (non-fuel) VOCs, mainly because of the differences between the economic structure of fuel prices and the prices of other VOC components. Similar procedure will also apply to the methods to be used for the translation of VOCs in financial values to VOCs in economic values. In addition, since the emissions of Greenhouse Gases (GHGs) and other pollutants are related to the volume of fuel consumed, it was considered necessary to make a separate calculation of fuel consumed in both the "With" and "Without" cases. This is done by applying the typical fuel consumption rates of representative vehicles in each type category to vehicle-km in both cases. For the purposes of the economic appraisal, fuel will be valued at the retail price less taxes (basically sales tax of 15%) plus an allowance for the fuel price subsidies applied by the Egyptian Government. Although Compressed Natural Gas (CNG) is now widely used as an automotive fuel in Cairo, its overall volume as a share of the total volume of fuel consumed in the city is still quite small. It was assumed

therefore, for practical purposes, that diesel and gasoline would account for nearly all of the fuel consumed in the Greater Cairo Area.

The physical vehicle characteristics used as parameters for establishing the unit VOCs are given in Table 4-16.

Table 4-16 Physical Characteristics of Vehicle Population

Item		Vehicle type:						
	Private cars	Taxis	Shared taxis (mini-buses)	Medium buses	Large buses	Light trucks	Medium trucks	Heavy trucks
Representative vehicle type	1600 CC sedan					Four wheel rigid	Six wheel rigid	Ten wheel rigid
Annual Km	20,000	80,000	100,000	75,000	75,000	50,000	75,000	75,000
Annual operating hours	400	3,433	4,286	4,737	4,737	1,300	1,950	1,950
Fuel consumption (litres/'000 km	96	100	138	160	300	160	250	357
Assumed life (yrs)	13	10	10	10	13	10	12	13
Deprec % dist.rel.	79%	81%	81%	89%	90%	88%	89%	89%
Deprec % time rel.	21%	19%	19%	11%	10%	12%	11%	11%
Tyre number	4	4	4	6	6	4	6	10
Average crew size	Not relevant	1	1	2	2	1	2	2
Average vehicle occupancy	1.9	2.0	11.0	15.0	47.0	Not relevant	Not relevant	Not relevant

Sources: SDMP study report; consultant's estimates, based on enquiries to transport operators

For the purposes of revaluing the unit VOCs from financial to economic values, it was necessary to establish appropriate conversion factors. Different factors were derived for different types of inputs.

Traded inputs, such as imported vehicles and tyres, are valued at border prices by excluding import duties and other taxes. For this purpose, the standard conversion factor of 0.84 developed for the SDMP study was used. This factor was derived as the ratio of the value of imports and exports to the value of imports and exports plus import duties and less export duties.[13]

The economic values for non-traded inputs, such as services and locally manufactured goods, were established by eliminating the sales tax component from domestic prices and subsidies in certain special cases (such as petroleum fuels). Since sales tax rates of 10% and 15% apply respectively to services and to most locally manufactured goods, economic values for these inputs were established by applying adjustment factors of 0.91 and 0.87 to domestic prices, respectively.

The subsidy rate on petroleum fuels was estimated by dividing the total amount of the subsidy in 2006 and 2007 for gasoline and diesel fuel, respectively by the total

[13] *The Strategic Urban Development Master Plan Study for a Sustainable Development of the Greater Cairo Region in the Arab Republic of Egypt,* Final Report (Volume 4), page 8-3

volume of these fuels consumed domestically in that year. The resulting estimate is given in Table 4-17.

Table 4-17 Estimation of Petroleum Fuel Subsidies

Fuel type	Amount of subsidy in 2006/2007	Volume consumed domestically in 2006/2007	Estimated subsidy per litre	Estimated subsidy after reduction in 2008/2009
	(L.E. Million)	(Million Litres)	(L.E.)	(L.E.)
Diesel	10,360	11,670	0.89	0.74
Gasoline (all grades)	3,130	4,990	0.63	0.53
Average	13,490	16,660	0.81	0.71

Sources: (1) Ministry of Finance website (petroleum subsidies)
(2) American Chamber of Commerce: *Oil and Energy Profiles in Egypt,* 2008 (petroleum consumption)

Notes: Fuel prices in Egypt increased in May 2008 by an average of about 46% per litre. This was expected to lead to a reduction in the subsidy of about LE 15 billion over 3 years.

The subsidies identified in the above table were added to the retail prices of diesel and gasoline to arrive at the economic prices of these fuels.

Unit economic values for each VOC component are given in Table 4-18 below. They were derived by applying relevant conversion factors to the financial estimates obtained through enquiry from motor vehicle sales companies, transport operators, insurers and motor vehicle repair shops.

In the case of vehicle maintenance costs, it was assumed that: (a) the cost of lubricants is included in the annual maintenance cost, and (b) the costs of materials (including spare parts and lubricants) and maintenance labour would respectively comprise 45% and 55% of the annual maintenance cost. Maintenance materials were assumed to be imported and their costs were converted to economic values using a conversion factor of 0.84. Maintenance labour, as a service item, was assumed to carry a sales tax of 10% and its cost was therefore converted to an economic value using a conversion factor of 0.91.

Based on information obtained from insurance companies, a standard insurance rate of 4.25% was assumed to apply to the new vehicle purchase prices for all categories of vehicles. The economic value of insurance was estimated by applying a conversion factor of 0.91 to the financial value of insurance premiums (in order to exclude the 10% sales tax).

Table 4-18 Unit Prices for VOC Components

Item	Vehicle type:							
	Private cars	Taxis	Shared taxis (mini-buses)	Medium buses	Large buses	Light trucks	Medium trucks	Heavy trucks
New vehicle price								
Financial (L.E.)	92,000	92,000	116,600	200,000	357,500	154,490	250,000	850,000
Economic (L.E.)	77,300	77,300	97,900	168,000	300,300	129,800	210,000	714,000
Tyre price								
Financial (L,E.)	500	500	400	575	1,250	600	900	3,000
Economic (L.E.)	420	420	336	483	1,050	504	756	2,520
Fuel price – Diesel								
Financial (L,E.)			1.10	1.10	1.10	1.10	1.10	1.10
Economic (L.E.)			1.84	1.84	1.84	1.84	1.84	1.84
Fuel price – Gasoline 92 octane								
Financial (L,E.)	1.85	1.85						
Economic (L.E.)	2.38	2.38						
Maintenance (annual cost per vehicle in L.E.)								
Financial	1,000	4,000	5,000	5,250	7,500	2,000	2,000	5,000
Economic	878	3,514	4,392	4,612	6,589	1,757	1,757	4,392
Crew cost – (annual wages in L.E.)								
Financial		18,000	18,000	24,000	30,000	18,000	24,000	30,000
Economic		14,400	14,400	19,200	24,000	14,400	19,200	24,000
Insurance cost (annual per vehicle in L.E.)								
Financial (4.25%)	3,910	3,910	4,956	8,500	15,194	6,566	10,625	36,125
Economic	3,558	3,558	4,510	7,735	13,826	5,975	9,669	32,874

Sources: SDMP report; consultant's estimates, based on enquiries to motor vehicle sales companies, insurers and vehicle repair shops

Estimates of the unit VOCs per thousand vehicle-km and per vehicle operating hour are given in Table 4-19. They are the result of applying the unit input prices of Table 4-18 to the physical operating parameters of Table 4-17.

Fuel, tyre replacement and vehicle maintenance costs were assumed to be entirely dependent on distance. Insurance and crew costs (for all commercial vehicles) were assumed to be wholly related to time. Vehicle depreciation was assumed to be 80-90% distance-dependent and 10-20% time-dependent.

Tyres were assumed to be replaced every two years in the case of private cars and every year in the case of all other vehicles.

Table 4-19 Estimated Unit Vehicle Operating Costs (VOCs)

Item	Vehicle type:							
	Private cars	Taxis	Shared taxis (mini-buses)	Medium buses	Large buses	Light trucks	Medium trucks	Heavy trucks
Distance related VOC (L.E. per thousand Km)								
Fuel cost	228.48	238.00	253.92	294.40	552.00	294.40	460.00	656.88
Tyre cost	42.00	42.00	26.88	38.64	84.00	40.32	60.48	336.00
Maintenance cost	43.90	43.93	43.92	61.49	87.85	35.14	23.43	58.56
Depreciation cost	236.07	78.43	79.46	199.07	276.99	227.76	206.65	650.25
Sub-total	550.45	402.35	404.18	593.60	1,000.84	597.62	750.56	1,701.69
Overhead rate		15%	15%	20%	20%	25%	35%	35%
Overhead cost	0	60.35	60.63	118.72	200.17	149.40	262.70	595.59
Total	550.45	462.71	464.81	712.32	1,201.01	747.02	1,013.25	2,297.28
Time related VOC (L.E. per hour)								
Crew cost		4.19	3.36	4.05	5.07	11.08	9.85	12.31
Insurance cost	8.90	1.04	1.05	1.63	2.92	4.60	4.96	16.86
Depreciation Cost	39.81	4.24	4.30	3.95	6.38	12.25	12.32	41.03
Sub-total	48.70	9.47	8.71	9.63	14.37	27.92	27.12	70.19
Overhead rate		15%	15%	20%	20%	25%	35%	35%
Overhead cost	-	1.42	1.31	1.93	2.87	6.98	9.49	24.57
Total	48.70	10.89	10.02	11.56	17.24	34.90	36.61	94.76
Annual Km	20,000	80,000	100,000	75,000	75,000	50,000	75,000	75,000
Annual Hours	400	3,433	4,286	4,737	4,737	1,300	1,950	1,950

Sources: SDMP report; consultant's estimates

b) Travel Time Savings

Travel time savings typically represent a major economic benefit of mass transit projects. Travel time savings will be estimated for both mass transit and remaining road users, the former receiving a direct benefit as a result of much faster mass transit trip times and the latter receiving an indirect benefit resulting from the faster average road speeds made possible by the transfer of traffic from the roads to the mass transit system.

The valuation of travel time savings is conventionally based on household income data, with different rates applied to different categories of commuters. This reflects the likelihood that bus passengers will value time differently from private car occupants, while mass transit passengers will value their time differently from the other two groups of commuters.

The stream of benefits resulting from the reduction of travel time will be estimated by applying travel time values to the difference between the person-hours estimated for the urban transport network in the "*With*" and "*Without*" project cases.

In this feasibility study, estimates of urban travel time values will be based on household income estimates derived from a household opinion survey conducted by the SDMP team between June and July 2007. The SDMP extended base

estimates of the value of time until 2027 at the rates of increased forecast for Gross Regional Domestic Product (GRDP) per capita. For the purposes of the feasibility study, it was necessary to re-cast the SDMP estimates on the basis of revised per capita GRDP growth projections (see Section 2.1.4 above) and to extend the forecast to 2050.

The socio-economic framework used to forecast household income and the average income per worker in the study area is given in Table 4-20.

Table 4-20 Socio-economic Framework in the Study Area

Indicator		Unit	2006	2007	2008	2009	2010	2011	2012	2020	2030	2040	2050
Population		1000	16,101	16,464	16,836	17,217	17,606	18,004	18,411	21,639	25,387	29,783	34,941
No.of Households		1000	4,007	4,097	4,190	4,284	4,381	4,480	4,582	5,385	6,318	7,412	8,696
Household Size		Persons/household	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02
Average age of HH members		Years	28.70	29.00	29.18	29.36	29.54	29.72	29.90	31.68	32.80	33.97	35.17
Labour force		1000	4,613	4,777	4,915	5,056	5,202	5,352	5,506	6,858	8,427	10,005	11,475
Unemployment		%	7	6	6	6	6	6	6	5	5	4	4
No.of Workers	Primary	1000	260	266	275	283	288	296	306	380	463	551	654
	Secondary	1000	1,667	1,741	1,797	1,849	1,895	1,950	2,014	2,517	3,064	3,642	4,312
	Tertiary	1000	2,384	2,467	2,547	2,620	2,707	2,785	2,876	3,619	4,477	5,412	6,513
	Total	1000	4,310	4,475	4,620	4,753	4,890	5,031	5,196	6,515	8,006	9,605	11,479
GRDP		Million L.E.	148,648	159,202	170,665	176,808	182,113	188,942	197,444	352,138	692,708	1,240,534	2,020,700
GRDP per Capita		L.E. per capita	9,232	9,670	10,137	10,270	10,344	10,495	10,724	16,273	27,286	41,652	57,832
Household Income		L.E. per household	1,072	1,134	1,189	1,204	1,213	1,231	1,258	1,908	3,200	4,885	6,782
No.workers in household		worker/household	1.08	1.09	1.10	1.11	1.12	1.12	1.13	1.21	1.27	1.30	1.32
Worker's income		L.E. per worker	997	1,038	1,078	1,086	1,087	1,096	1,109	1,577	2,525	3,770	5,138

Sources: SDMP; Consultant's estimates

The survey-derived household income data, on which average values of time were based, are given in Table 4-21. The average number of working hours per month used to calculate the average monthly income for workers in the study area was assumed to be 176 (22 working days per month x 8 hours per day) hours.

Table 4-21 Average Monthly and Hourly Income of Workers in the Study Area

Item		Unit	2007	2008	2009	2010	2011	2012	2020	2030	2040	2050
Household Income	Low and Middle Income Households	L.E./month	748	784	794	800	812	830	986	1225	1520	1888
	High Income Household	L.E./month	2,985	3129	3170	3193	3240	3311	3936	4887	6068	7534
	High and Middle Income Households	L.E./month	1,322	1386	1404	1414	1435	1466	1743	2164	2687	3336
Workers in household		Workers/HH	1.09	1.10	1.11	1.12	1.12	1.13	1.21	1.27	1.30	1.32
Worker's Income	Low and Middle Income Workers	L.E./month	686	711	716	717	723	732	815	966	1,173	1,430
	High Income Workers	L.E./month	2,739	2,838	2,858	2,861	2,885	2,919	3,254	3,857	4,683	5,707
	High and Middle Income Workers	L.E./month	1,213	1,257	1,266	1,267	1,278	1,293	1,441	1,708	2,074	2,528
Working Hours per Month		Hours/month	176	176	176	176	176	176	176	176	176	176
Worker's Hourly Income	Low and Middle Income Workers	L.E./hour	3.90	4.04	4.07	4.07	4.11	4.16	4.63	5.49	6.67	8.13
	High Income Workers	L.E./hour	15.56	16.12	16.24	16.26	16.39	16.59	18.49	21.91	26.61	32.43
	High and Middle Income Workers	L.E./hour	6.89	7.14	7.19	7.20	7.26	7.35	8.19	9.71	11.78	14.36

Sources: SDMP study; consultant's estimates

Since it is likely that different categories of commuters will value their time differently, it is necessary to calculate a factor reflecting the weighted average distribution of commuter trips by trip purpose, for the conversion of hourly income

into time values. This factor, which was derived from the demand survey conducted for the SDMP study, was found to be 75.5% (see Table 4-22). The factor was used in combination with the hourly income data in the above table to calculate the average values of time for the three main commuter categories, namely: public transport users, car users and taxi and shared taxi users.

Table 4-22 Weighted Distribution of Commuter Trips by Trip Purpose

Trip Purpose	Share (%)	Weight	Weighted Distribution (%)
Work	44.0	1.0	44.0
Business	7.0	1.0	7.0
Study	28.9	0.5	14.5
Private	20.1	0.5	10.1
Total	100.0	3.0	75.5

Source: SDMP study report

The resulting time value estimates are given in Table 4-23. These estimates assume that the following:

- Public transport users are mostly from the middle and low income groups;
- Car users are predominantly from the high income group; and
- Taxi and shared taxi users (including air-conditioned bus users) are mostly from the high and middle income groups.

Table 4-23 Estimated Value of Travel Time, by Commuter Category, in the Study Area

Commuter category	Assumed income category	Unit	2007	2008	2009	2010	2011	2012	2020	2030	2040	2050
Public Transport Users	Middle and low	L.E./hour/person	2.94	3.05	3.07	3.08	3.10	3.14	3.50	4.15	5.03	6.14
Car Users	High	L.E./hour/person	11.75	12.17	12.26	12.27	12.38	12.52	13.96	16.54	20.09	24.48
Taxi and shared taxi users	High and middle	L.E./hour/person	5.20	5.39	5.43	5.44	5.48	5.55	6.18	7.33	8.90	10.84

Sources: SDMP study report; Consultant's Estimates.

c) Reduced Air Pollution

The economic savings from reduced atmospheric emissions from road vehicles similarly represent a significant potential economic benefit of mass transit system development, especially in a city with the size and traffic density of Cairo.

This benefit is of two types:

- Savings from reduced vehicle emissions of greenhouse gases that add to global warming, such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O); and
- Savings from reduced vehicle emissions of noxious gases and particulate matter that are harmful to health, such as sulfur dioxide (SO_2), PM_{10}, nitrogen oxides (NOx), carbon monoxide (CO) and Volatile Organic Hydrocarbons (VOH).

Both types of emissions are fuel combustion products and their tonnage can therefore be calculated in terms of per litre of fuel consumed (as is usual for greenhouse gas emissions), or in terms of per vehicle-km (as is usual for emissions of noxious gases and particulate matter).

Recent studies suggest that a typical CO_2 emission rate is about 2.3 kg per litre of fuel consumed for gasoline-fuelled mid-sized cars and about 2.7 kg per litre of fuel consumed for diesel-fuelled trucks and buses.

In the case of emissions of noxious gases and particulate matter, estimates of emission rates are available from a JICA-sponsored project on the improvement of regional air pollution control and management in Egypt. A selection of emission rates for different vehicle types, as shown in Table 4-24, was excerpted from a related study report. [14]

Table 4-24 Estimated Emission Factors in grams per kilometre

Type of vehicle	Type of pollutant		
	NO_x	***SO_x***[1]	***PM_{10}***
Car	1.600[4]	0.010	0.110[2]
Taxi	1.680[4]	0.012	0.116[2]
Shared Taxi	4.330[3]	0.027	1.408[2]
Minibus	4.330[3]	0.027	1.408[4]
Public Bus (large)	4.763[3]	0.030	2.872[3]
2-Axle Truck	19.327[3]	0.031	4.329[4]
3-Axle Truck	20.206[3]	0.032	4.525[4]
> 3-Axle Truck	21.084[3]	0.034	4.722[4]

Notes:
1. Sulfur content of gasoline is considered to be 50 wt.ppm and of diesel, 150 wt.ppm.
2. Expert estimation based on emission factors for Iran, Malaysia, USEPA and spot data from South Africa.
3. Based on Chassis Dynamometer test, conducted in Malaysia.
4. Expert estimation based on emission factors of Malaysia.

While fairly robust indicators are available for the measurement of the physical volume of emissions, both of greenhouse and noxious gases by motor vehicles, the valuation of emissions presents a particular problem. This is especially so where a carbon trading market does not operate, or where there are no monetary measurements of the local damage caused by vehicular emissions of noxious gases in the country under study. Egypt does not have a carbon trading scheme nor is there any similar scheme operating in the Middle East. So far, there have been no studies of the monetary consequences of atmospheric pollution caused by road transport in Cairo.

For these reasons, the valuation of road vehicle emissions in Cairo will be based on the European Union Emissions Trading Scheme in the case of greenhouse gas

[14] JICA and EEAA: *Mobile Emission Sources Inventory Survey and Emission Loads, Vehicles in Delta Region,* September 2008 (Component 1), for Regional Air Pollution Control Management System Improvement Project.

emissions and on data from a World Bank study on energy and environment in Egypt in the case of emissions of noxious gases and particulate matter.[15]

The valuation of greenhouse gas emissions in terms of the price of European carbon emission permits (or EUAs) is considered valid for two reasons. First, they represent the *willingness to pay* for the right to emit greenhouse gases and thus represent an appropriate measure of market value. Secondly, since the effects of the greenhouse gas emissions are widespread, there will be a tendency for global carbon prices to converge towards the prices established in the European Carbon Trading Scheme, which is the world's largest and longest established carbon market.

The spot market price of EUA's is currently € 13.80 per tonne, equivalent to LE 103.50 (Point Carbon, 6th May 2009).

The valuation of noxious gas and particulate emissions is more problematic since the effects of noxious gas emissions are specifically related to the number of receptors (exposed persons), the extent to which their health conditions are impaired, and the extent to which their health impairments will be reflected in increased medical costs. Clearly, the measurement of these effects requires substantial amounts of time and resources, which may explain why no such study has been conducted in Cairo to date.

This feasibility study will make use of the unit values of noxious gas and particulate emissions as estimated in the World Bank study of 2002. Estimates of the "damage costs" from emission of certain pollutants in Egypt were given in this study as shown in Table 4-25. These estimates were inflated to 2009 values based on the trend of per capita health expenditures in Egypt[16], as also shown in the table.

Table 4-25 Estimates of Air Pollution "Damage Costs", Egypt

Pollutant	Value (LE per ton) As at July 2002	Value (LE per ton) As at July 2008
PM_{10}	16,000	**33,046**
NO_x	2,200	**4,544**
SO_2	6,800	**14,045**
CO	700	**1,446**
NMVOC's	1.80	**3.72**

Sources: World Bank and EEAA: The Energy-Environment Review 2002; Consultant's estimates

The benefits of reduced air pollution generated by the project will be established by comparing and valuing the volumes of pollutants emitted by road traffic in the "*with"* and "*without"* project cases.

[15] World Bank and EEAA: *The Energy-Environment Review,* 2002.
[16] Between 2002/03 and 2007/08, per capita Health Expenditures were estimated to have increased from LE 72.61 to LE 149.97, equivalent to a growth factor of 2.065.

4.4.2 Financial Analysis

A full financial appraisal of the Metro Line 4 project will be carried out. This appraisal will consist of a detailed Discounted Cash Flow (DCF) analysis, which will determine the project's financial viability under alternative assumptions with respect to: (a) revenue generation; (b) project capital and operation and maintenance (O&M) costs; and (c) project financing arrangements.

The positive cash flows of the project will be limited to fare revenue. The basis of the revenue forecasts will be the passenger and passenger-km (or "ridership") estimates of the transport forecasts.

The negative cash flows of the project will comprise of its capital, financing and O&M costs. The project's capital costs will be estimated by JICA Study Team's engineering specialists following the finalization of the route alignment, project specifications and construction schedule. The project's O&M costs will be estimated from the output of the Train Operating Plan, to be prepared by JICA Study Team's operations specialist on the basis of the transport demand forecast which has yet to be prepared.

Initial collection of data for the financial appraisal has focused on establishing the current structure and level of fares for the existing metro lines (i.e. Lines 1 and 2), as well as the terms and conditions for the financing of Metro Line 3 and the financing terms available from other loan sources (such as Japanese Yen Loans).

(1) Structure and Level of Existing Metro Fares

The financial appraisal will involve the testing of several options for the structure and level of fares to be adopted for Metro Line 4. The Government of Egypt sets the absolute level of metro fares and also determines when and at what rates fare levels will be varied based on the advice of the Egyptian Company for Maintenance and Operation of the Underground (ECMOU), which is the metro operating company.

Therefore, the current level of average fare revenue and the current structure and level of fares constitute the starting point for the analysis of fare alternatives.

Table 4-26 shows the revenue data for the 2007/08 financial year provided by the ECMOU to the JICA Study Team.

Table 4-26 Cairo Metro - Number of Passengers and Revenue for 2007/08

Item	Amount
Total revenue from daily ticket sales (million L.E.)	323.64
Revenue from quarterly ticket sales (million L.E.)	47.58
Revenue from yearly ticket sales (million L.E.)	10.32
Penalty revenue (million L.E.)	4.91
Total revenue (million L.E.)	*386.45*
Number of daily tickets sold (Millions)	325.67 (45%)
Number of concessional passengers (Millions)	391.16 (55%)
Total number of passengers (Millions)	716.83
Average ticket value (normal), L.E.	0.994
Average ticket value (concessional), L.E.	0.148

Source: Egyptian Company for Maintaining and Operating the Underground (ECMOU)

The key point to note about the distribution of total ticket sales by type of customer is that purchasers of normal (i.e. non-concessional) daily tickets represent only 45% of the total number of passengers. The balance of 55% travels at concessional fare levels. Thus, while the average fare revenue from normal ticket holders is just below LE 1, the average revenue from concessional ticket holders is less than 15 piaster. Therefore, the operating company generally collects an average revenue of only 54 piaster per ticket.

Metro fares are varied infrequently. The last major variation was implemented on 14th July 2006, when *normal daily ticket prices* were increased by 33% from 75 to 100 piaster (LE 1). At the time of writing, therefore, current fares have been in force for nearly 3 years.

Concessional fares are available to three separate commuter categories: public sector employees; Metro employees; and students, police, the blind and other physically handicapped persons. These fares apply to the purchase of quarterly (i.e. 3 monthly) tickets at the current rates indicated in Table 4-27.

Table 4-27 Cairo Metro - Quarterly Ticket Fare Concessions

No. of stations	Normal price	Concessional ticket holder categories		
		Public sector employees	Metro employees	Students, police, blind/handicapped
	LE	LE	LE	LE
25	107	64	30	22
34	140	84	36	27

Source: ECMOU
Note: Fares implemented by Decree No 4480-315-2006 on 14th July 2006.

Weekly and annual fares are also offered. In the case of annual tickets, these are sold at concessional fare rates to four commuter categories: private sector employees; public sector employees; press workers/military personnel/police personnel; and persons over 60 years of age. Fares range from LE 160 (equivalent to 44 piaster per day) for press workers/military personnel/police personnel to LE 386 (equivalent to LE 1.06 per day) for private sector employees.

(2) Project Financing Terms and Conditions

The financial appraisal of the Metro Line 4 project will consider several alternatives for the financing of the project. The terms and conditions for the construction of Metro Line 3 will be the benchmark for establishing the financing alternatives for this project.

Details of the project financing terms and conditions for the Metro Line 3 were obtained from the Finance and Administration Department of the National Authority for Tunnels (NAT). These terms and conditions were compared with those of the Yen loan financing provided by the Government of Japan.

Finance for the construction of Metro Line 3 is being provided by France through a low interest government-to-government loan and through commercial bank loans. The government-to-government loan will be executed through protocols signed between the Government of Egypt and France for the allocation of loans in the amount of 200 million Euros to each of Phases 1 and 2 of the Metro Line 3 project. The loans will be applied to the funding of all project components, except rolling stock, which will be financed through an agreement with the Government of Japan (currently under negotiation). Finance from France will cover about 54% of the total project cost of Phase 1[17], with the balance to be covered through a Japanese Yen Loan (for rolling stock procurement) and equity funding by the Egyptian Government. Financing arrangements for Phase 2 of Metro Line 3 project are currently being finalized.

Details of the terms and conditions of potential Japanese Yen loans are available from the JICA website.[18] Different terms and conditions are applied to different countries depending on the level of their gross national income (GNI) per capita. Egypt falls within the “Lower - Middle Income Countries” category with a GNI per capita ranging from USD906 to USD1,735.

Table 4-28 lists the terms and conditions of loans for the Cairo Metro development.

[17] Estimated at about LE 4,000 million
[18] Terms and conditions pertaining to ODA loans can be found at:
http://www.jica.go.jp/english/operations/schemes/oda_loans/standard/

Table 4-28 Terms and Conditions of Loans for Cairo Metro Development

Type/category of loan	Allowable coverage of total project cost	Interest rate	Grace period (years)	Repayment period (years)	Conditions for procurement
Loans from France for Phase 1 of Metro Line 3 project					
Low interest government-to-government	Up to 200 million Euros (approx. 37% of project cost)	0.2%	6	18	Tied
Commercial Bank		5.1%	4	10	
Loans from France for Phase 2 of Metro Line 3 project					
Low interest government-to-government	Up to 200 million Euros	0.15%	5	20	Tied
Commercial Bank		Not yet finalized	4	10	
ODA loans from the Government of Japan					
General terms:					
Standard	Up to 85%	1.40%	10	30	Untied
Option 1	Up to 85%	0.80%	6	20	Untied
Option 2	Up to 85%	0.70%	5	15	Untied
Preferential terms:					
Standard	Up to 85%	0.65%	10	40	Untied
Option 1	Up to 85%	0.55%	10	30	Untied
Option 2	Up to 85%	0.50%	6	20	Untied
Option 3	Up to 85%	0.40%	5	15	Untied
STEP					
Standard	Up to 100%	0.20%	10	40	Tied
Option	Up to 100%	0.10%	10	30	Tied

Sources: Finance and Administration Department of NAT; JICA website

Among the ODA Loans, the Preferential Terms and Special Terms for Economic Partnership (STEP) loans are the categories relevant to Metro Line 4 project.

Projects which will prevent air pollution and those that will save energy and conserve resources, among others, are eligible for the Preferential Terms Loans. Urban mass transit projects would clearly fall under these categories.

Projects within specified sectors and fields and for which Japanese technologies and equipment are substantially utilized are eligible for STEP loans. The specified sectors and fields include, among others, bridges and tunnels and urban mass transit systems.

Details of the loan terms and conditions of other potential financing sources will be evaluated for inclusion in the financial appraisal.

CHAPTER 5
COLLECTION OF OTHER RELEVANT DATA AND OTHER WORKS DONE

CHAPTER 5 COLLECTION OF OTHER RELEVANT DATA AND OTHER WORKS DONE

5.1 Design Specifications and Criteria

Design specifications for rolling stock, stations, and the depot, which reflect results such as “demand growth points”, “demand volume”, and “information about available space for stations and depot”, will be obtained from the preliminary demand forecast and site condition survey.

Existing design specifications and criteria applied to Metro Line 1, 2 and 3 are being collected by JICA Study Team. The collected related data are mentioned in the following sections.

JICA Study Team will continue its efforts to collect information and data related to the existing metro system and civil design for further study.

5.2 Selection of the Route of Phase 2

Information and data were collected to support the selection of the route and station locations for Phase 2. Specifically, an “As Built” drawing of the El Azhar Road tunnel was obtained from the General Authority for Roads, Bridges and Land Transport (GARBLT). In addition, a site survey was undertaken along the Phase 2 northern route as evaluated in the CREATS and SDMP studies.

5.2.1 Alternatives to be Assessed for the Phase 2 Section

Two basic alternatives should be assessed for the Phase 2 section:

- Alternative 1, with a length of about 18 km, would run in a northerly direction up to an intersection with the Ring Road (this route would start from El Malek El Saleh and run, via Port Said Street, to El Sawaha Square); and
- Alternative 2, with a length of about 23 km, would run towards the east as far as the east end of Nasr City.

5.2.2 Criteria for Route Alignment and Station Location

The following conditions were adopted for the selection of route and station locations:

(1) Route Selection

- The route will be under the road for most of its entire length.
- An interchange between Metro Lines 3 and 4 must be provided to allow the transfer of passengers between the two lines.
- The possibility of a connection between Metro Lines 3 and 4 which will permit their inter-operability will also be studied.

(2) Station Location

- The distance between the stations is assumed to be 1.0 -1.5 km.
- Priority will be given to the location of stations near intersections with other forms of transport (e.g., major road intersections).
- Priority will be given to the provision of stations near major tourist attractions and commercial centres.

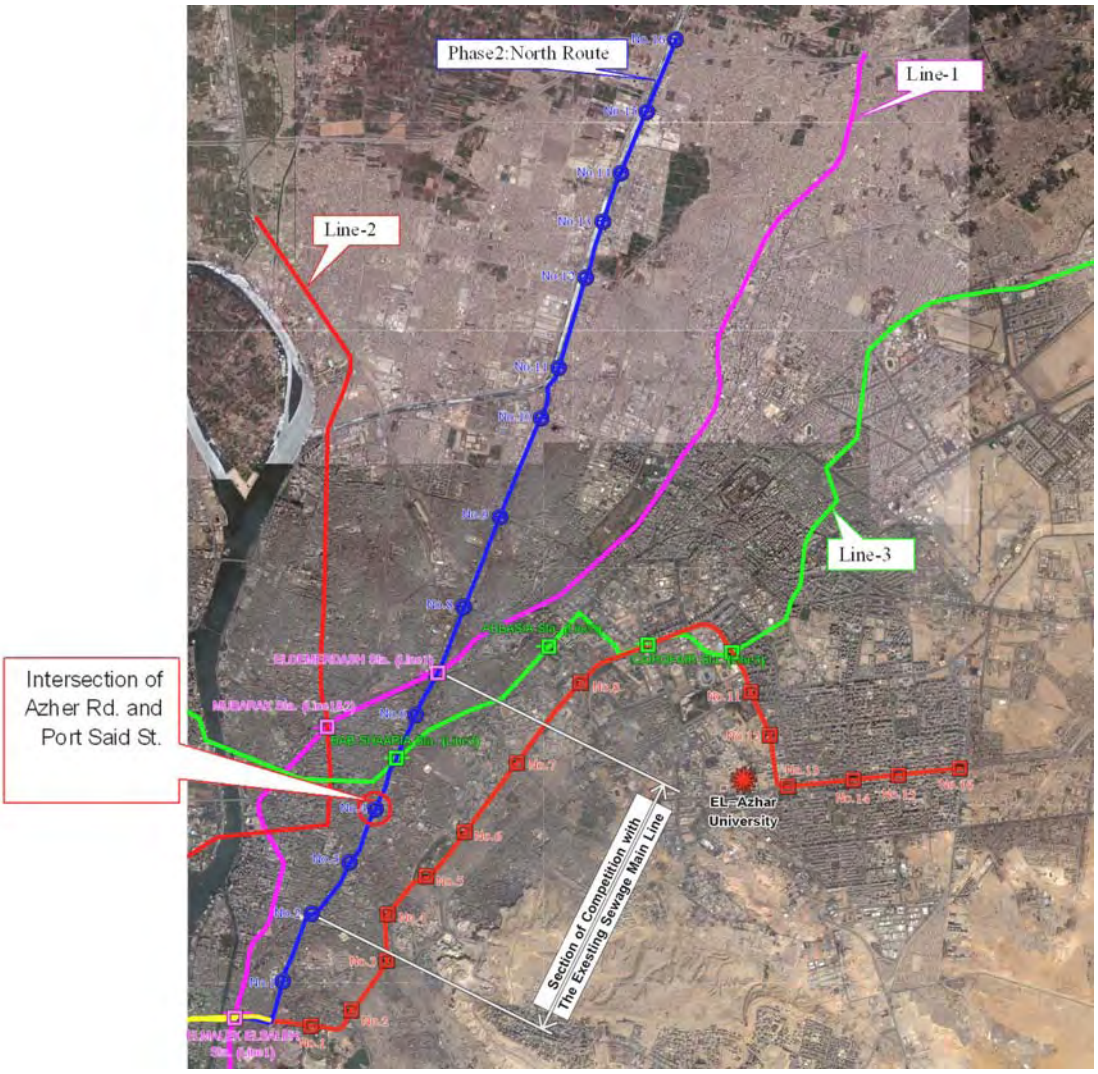


Figure 5-1 Phase 2 Section Route Plan

5.2.3 Other Considerations

The structures for the two route alternatives (e.g. tunnels, elevated or at-grade structures) will be compared with the construction methodology, the outline construction schedule, the outline construction cost, and problems at individual locations, etc.

Further, the presence of competing infrastructure and some difficult intersections with other infrastructure on some sections of the Alternative 1 route will require special attention when

planning and designing the route alignment. Examples are:

- the competition between the Alternative 1 route and the existing sewage main line along a section of Port Said Street (see Figure 5-1); and
- the intersection of the Alternative 1 route with the existing road tunnel at El Azhar Road (see Figure 5-2 and Figure 5-3), where a very deep Metro tunnel and station will be necessary to provide clearance between the Metro Line 4 and the existing utility and road tunnels. Another possible alternative may be to consider an optional route deviation of the Metro Line 4 in order to avoid this intersection, in which case the merits and costs of both route options for Alternative 1 would require detailed assessment.

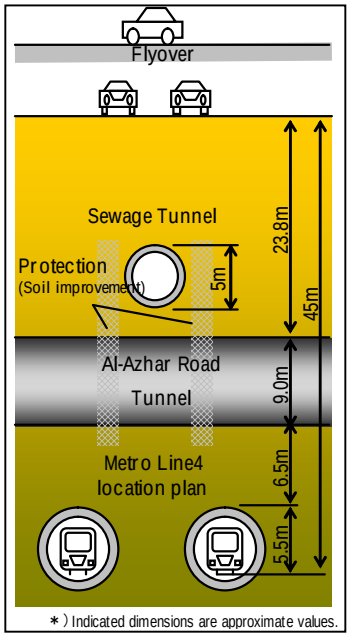


Figure 5-2 Cross Section

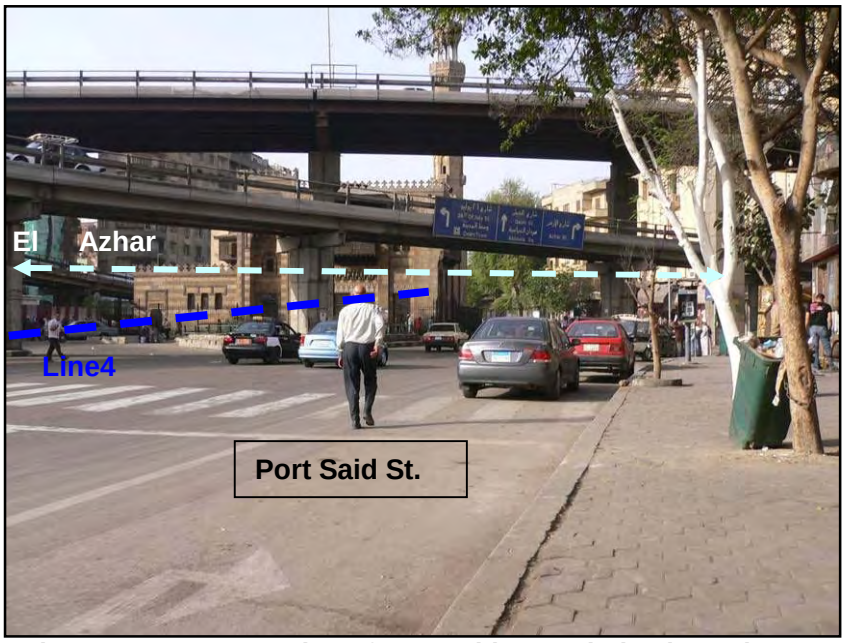


Figure 5-3 Intersection of Port Said St. and El Azhar Rd.

5.3 Alignment for Phase 1, including Selection of Depot Location

5.3.1 Information and Data Collection

Information and data were collected from the relevant government agencies in order to support the planning of the alignment for Phase 1 route section. Documents obtained included the following:

- Drawing of Land Use Plan showing potential site for new depot (from NAT);
- *Metro Line 3 Technical Specification for Track Laying on Mainline and at Workshop* (from NAT);
- Documents from the Land Development Plan for the area near Giza Plateau (from GOPP); and
- Documents from the Road Improvement Plan for El Remayah Square (from

GOPP).

5.3.2 Preparation of a Draft Alignment and Station Arrangement Plan

JICA Study Team has prepared a draft alignment and station arrangement plan for the Phase 1 section, including extension of the earlier proposed route (cf. CREATS and SDMP) and some alternative routes.

The drawn alignment between El Malek El Saleh Station and the Grand Egyptian Museum (GEM) Station (as shown in Figure 5-4) is based predominantly on the route proposed in the CREATS and SDMP studies.

After the GEM Station, the section is extended to the new depot site, which was agreed with NAT in April 2009. Figure 5-5 shows this extension, as well as some alternative route plans which are currently under consideration by JICA Study Team and NAT. The advantages and disadvantages of these alternative route plans are indicated in Table 5-1.

JICA Study Team has already discussed extensively with NAT engineers regarding the route selection, alignment details and station arrangement. Details of recent meetings are as follows:

Date	Participants
14th April 2009	NAT Engineers, JICA Study Team
21th April 2009	NAT Engineers, JICA Study Team
23th April 2009	NAT Managers & Engineers, JICA Egypt, JICA Study Team

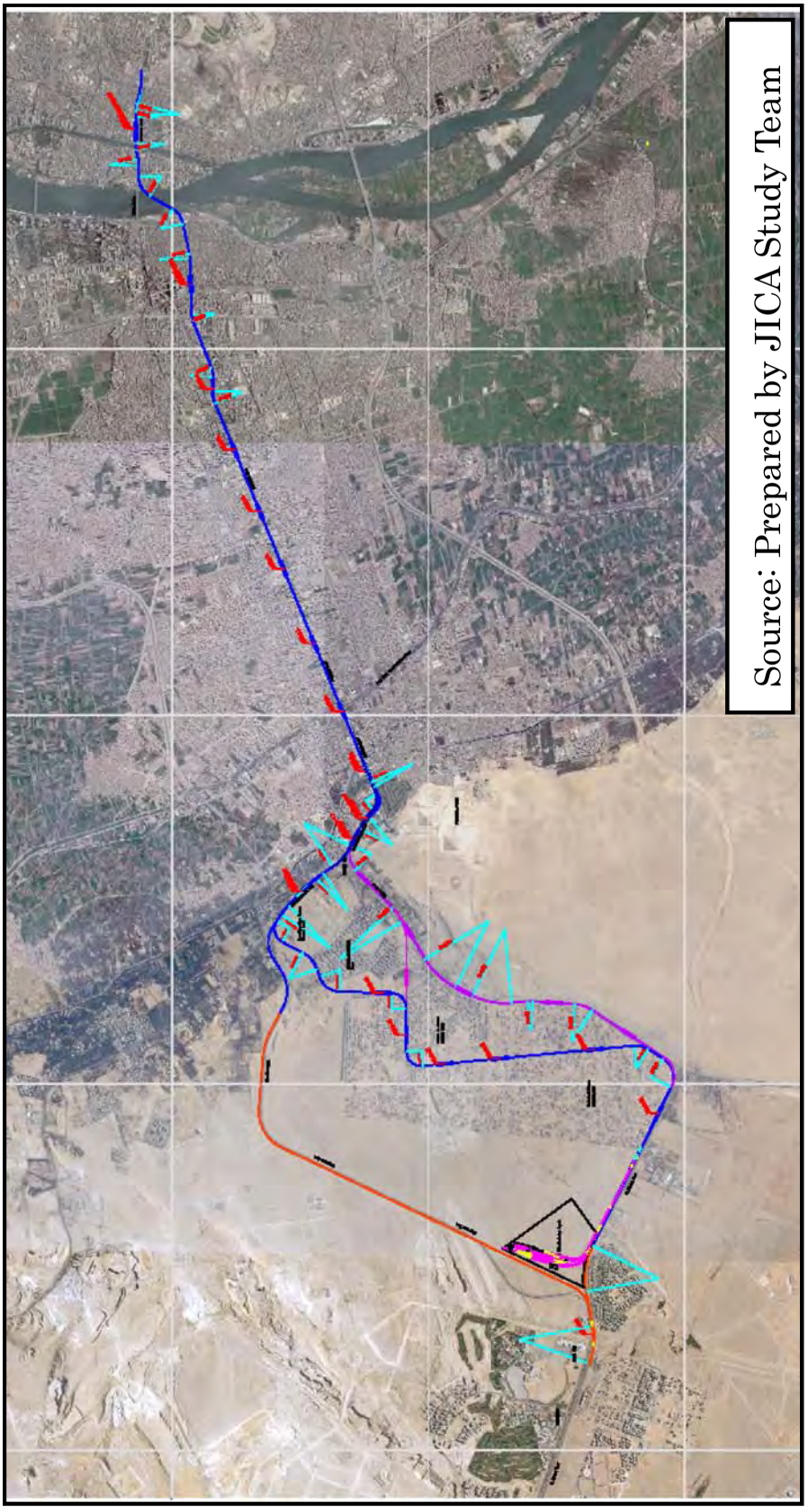


Figure 5-4 Drawing of Alignment between El Malek El Saleh Station and GEM Station

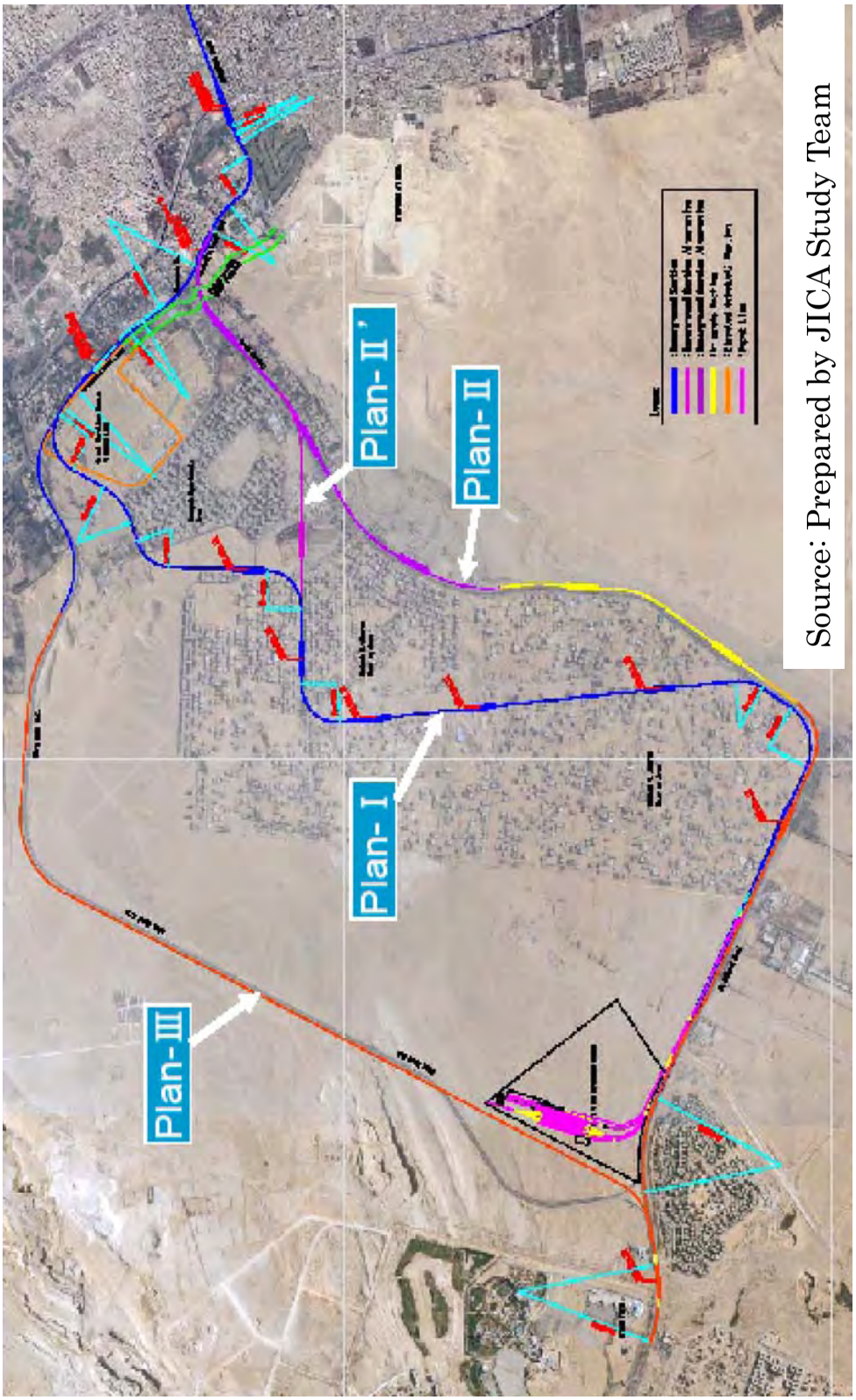


Figure 5-5 Drawing of Alternative Alignments between GEM Station and Proposed New Depot Site

Table 5-1 Advantages and Disadvantages of Alternative Route Plans for Extended Section

Factor	**Plan-I (Hedaeck Al-Aharam)**	**Plan- II (Fayoum Rd.)**	**Plan-II' (Hedaeck Al-Aharam + Fayoum Rd.)**	**Plan- III (Ring Road Extension)**
Advantage	New station is located in front of GEM entrance	New station is located between PYRAMIDS and GEM near the pedestrian path	New station is located between PYRAMIDS and GEM near the pedestrian path	New station is located in front of GEM entrance
	Much more ridership expected	At-grade and viaduct is possible and construction cost is cheaper than tunnelling	Much more ridership expected than for Plan-III	At-grade and viaduct is possible and construction. cost is cheaper than tunnelling
		No conflict with El Remayah Square Road Tunnel which is currently planned by GOPP	No need to cross the Remayah Square Tunnel which is currently planned	
Disadvantage	Speed restriction is necessary because of small curve radius.	Military facilities located at East side of Fayoum Road will need to be removed	Military facilities located at East side of Fayoum Road will need to be removed	Lower ridership can be expected
				Nearly the entire section will be inside of Military land in the future
				It is difficult to pass through under the junction of Ring Road and Alexandria Road
Social & Environmental Issues	Should be considered to reduce social & environmental impact on residential area	Should be considered to incorporate future development plans of the Giza Plateau west-side	Should be considered to reduce social & environmental impact on residential area	Not likely to cause significant negative impact

Source: Prepared by JICA Study Team

5.4 Train Operation Plan

Collection and study of the necessary data and information for the train operation plan will be carried out and incorporated in the next report.

5.5 Civil Structure Plan

5.5.1 Information and Data Collection

JICA Study Team obtained a copy of the Metro Line 3 Design Manual from NAT.

5.5.2 Site Survey

JICA Study Team inspected the construction site at Bab El Shaaria Station of Metro Line 3. At this site, JICA Study Team obtained information about methods and conditions of construction, including measures taken to protect neighbouring buildings and to avoid interference with road traffic (see Figure 5-6 and Figure 5-7 below). .

Figure 5-6 Cast in-situ Roof Slab of Underground Station

Figure 5-7 Situation of Grouting for Ground Water Protection

JICA Study Team will continue its efforts to collect information related to the construction methods in Cairo in order to finalize a structure plan for Metro Line 4 project.

5.6 Station Plan

5.6.1 Major Information Collection Activities and Study of Station Plans during March 2009

(1) Site Investigation

The whole Phase 1 route was visited several times in order to obtain relevant information on the environmental and geographical condition of potential station locations. The site investigation particularly focused on proposed major station locations, such as the Grand Egyptian Museum (GEM), Pyramids, El Giza and El Malek El Saleh. It involved careful analysis of the scope for provision of easy-access to the surrounding important facilities, efficient intersection with other transport modes, and the possibility of integrated redevelopment with other facilities.

(2) Interview with, and Collection of Information from, Relevant Authorities and Organizations

On 19th March 2009, members of JICA Study Team met with Mr. Ayman A. Hassanein, a Consultant Engineer of Arab Constructing Engineers (ACE), in order to obtain the following information needed to support the preparation of the station plan:

- Latest information on public or private redevelopment plans along the proposed route of Metro Line 4
- Information related to the standard stations of Metro Line 3
- List of laws, codes, regulations and standards related to station building design; and
- Preparation of the schematic drawings and 3D perspectives for the proposed stations

In addition, the following information was provided by Mr Hassanein:

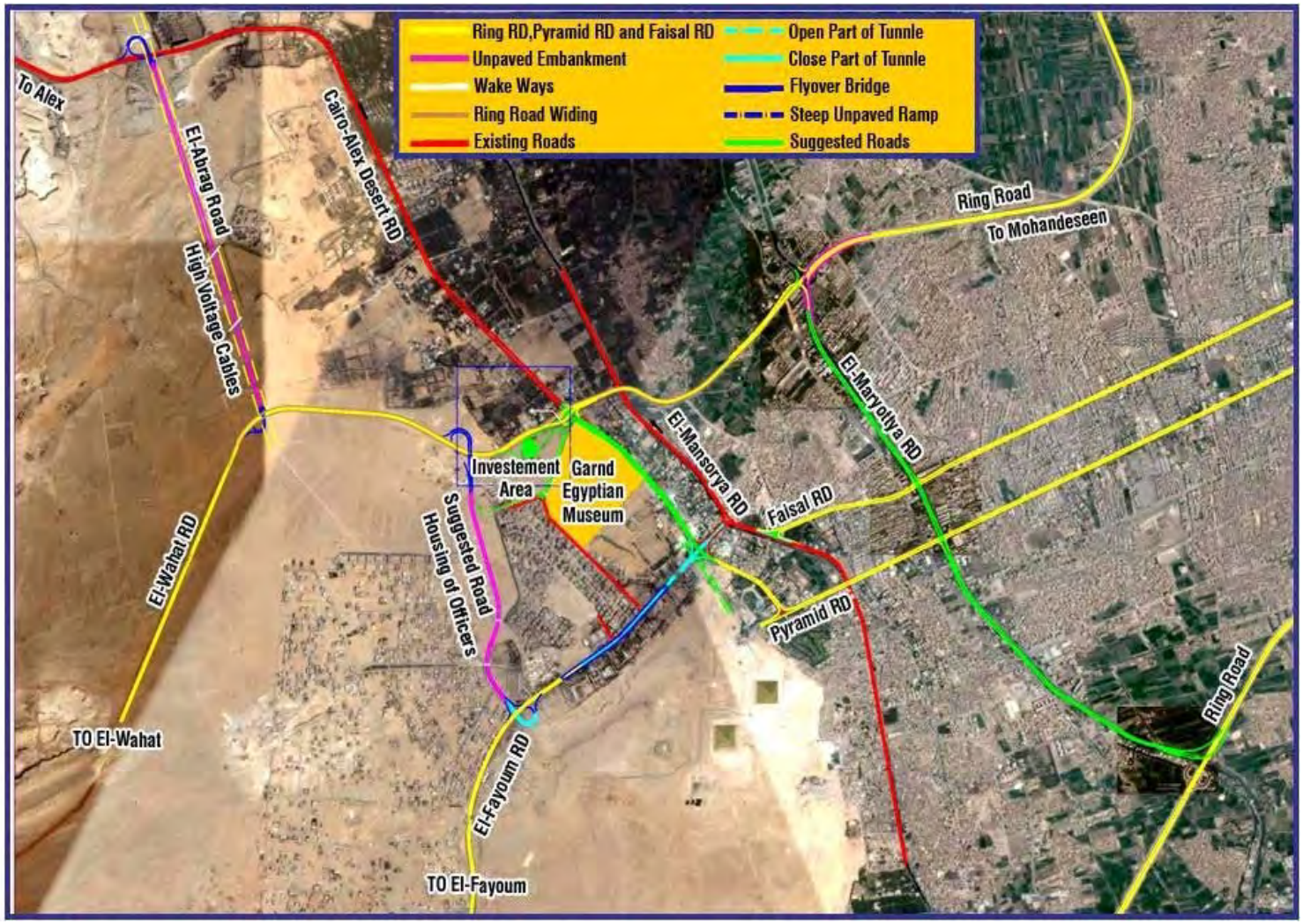
- A set of general drawings of Metro Line 3 standard underground stations (hard copy)
- Part of the general drawings of Dubai standard underground stations; and
- A booklet on the Standard Law for Disabled Persons in the public facilities of Egypt

On 23rd March 2009, the following information and data were collected through an interview with Dr. Yasel Mansour (Architect), Coordinator of Technical Committee of the Grand Egyptian Museum (GEM) Project:

- A hard copy of the master plan of GEM
- A soft copy of the site boundary plan of GEM; and
- A general information booklet of GEM

Dr. Yasel provided his views on the location of station entrances and on the aesthetical requirements for any structures to be built above-ground around GEM. He also informed JICA Study Team members that Alexandria Desert Road, which runs in front of GEM site will be widened, and as part of the widening project, a spacious pedestrian promenade will be constructed to link GEM area with the Pyramid gate area.

Other information, particularly the plan for the improvement of El Remayah Square (see Figure 5-8), were collected through meetings with GOPP of the Ministry of Housing, Urban Development and Utilities.



Source: Original data from GOPP/ Arranged by JICA Study Team

Figure 5-8 El Remayah Square Improvement Plan

5.6.2 Proposal of Preliminary Design Concept for the Whole Metro Line 4 and Major Stations

A preliminary floor plan, conceptual section and design concept for the Pyramid and GEM stations are proposed to NAT. These two stations are so important that they will be designated as the signature stations on Metro Line 4. Figure 5-9 presents the design concept proposed for these stations.

5.6.3 Future Work Plan

The following tasks will be undertaken during the next work assignment:

- Prepare aspects of environmental and geographical characteristics of the locations around stations from an architectural perspective
- Finalize the design concept for Phase 1 stations and classify station types
- Prepare concepts for the design of important station facilities, such as ticket gates, platform space volume, Platform Screen Doors (PSD), signage, facilities for the disabled and integrated commercial development;
- Prepare schematic general drawings and 3D perspectives for Phase 1 stations, considering the need for smooth passenger flows within stations and efficient access to stations from pedestrian sidewalks, as well as for safe evacuation in case of disaster.

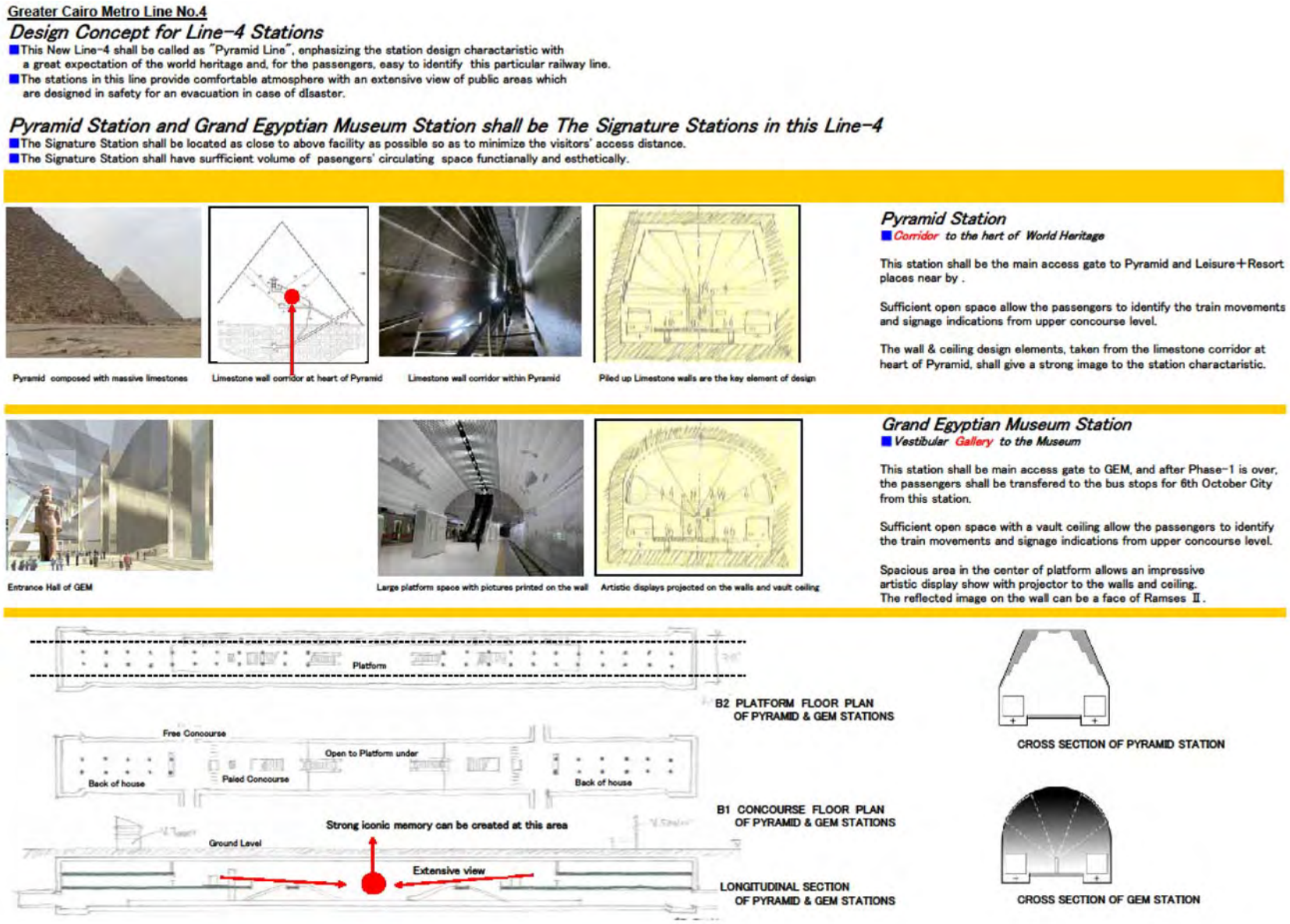


Figure 5-9 Design Concept of Signature Stations

5.7 Depot/Workshop Plan

5.7.1 Depot Location

The location of the future Metro Line 4 depot is constrained by the fact that the initial section of Metro Line 4 to be completed will be in the western section. Clearly, it is impossible to locate such facility near the city centre. Therefore, a site will be selected at the western end of the Metro Line 4 in May 2009, the depot location is not yet finalized but NAT will inform JICA Study Team of the final depot location once approved by all relevant parties, including NAT, GOPP, and the Egyptian Military authorities.

5.7.2 Track Layout in the Depot

From an operational viewpoint, the basic design of stabling yards should conform to the following two conditions:

- One train-set on a single stabling track if train-set can go into/come from the stabling tracks only from one end; and
- Incoming/outgoing traffic from/to the depot should not compete with shunting works inside the depot.

Figure 5-10 shows some designs of stabling tracks.

Recently, new stabling yards tend to be designed with six or three train-sets per stabling track, on the precondition that train-sets are designed uniformly and train-set operational management is simple. This design may be intended to reduce construction cost. In reality, however, train-set operations with this design will be cumbersome for the following reasons:

- Stabling a train-set behind another will increase the number of shunting works in the depot;
- Each train-set has to be assigned to a unique train operation schedule even though the specifications of rolling stock will be uniform.

When a disruption happens, the dispatcher in Central Control Point (CCP) may want to reduce the number of trains on the main line for quick recovery. During this time, the whole train operation plan will not be fixed. Under such circumstance, the minimum shunting plan cannot be established even with a state-of-the-art stabling system. There may be several stabling tracks at stations and the depot which may further complicate the train-set operations for the operators.

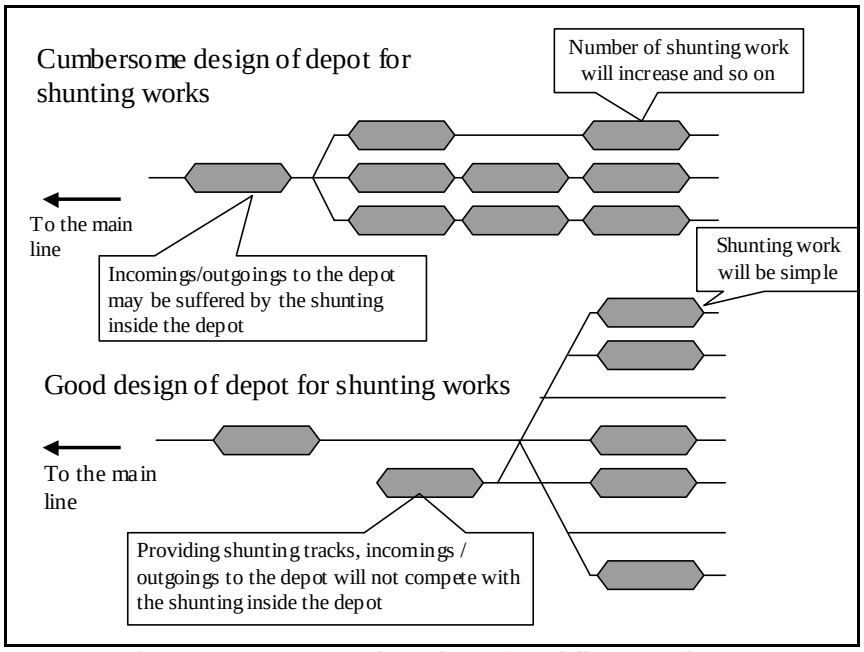


Figure 5-10 Good Design of Stabling Tracks

5.7.3 Outsourcing of Component Repair to Existing Depots

JICA Study Team will investigate to what extent it will be feasible, effective and convenient to outsource some of the repair of the major components from the new Metro Line 4 rolling stock to the existing Metro Line 1 and 2 depots. Candidate components and assemblies for the potential outsourcing of repair work may include such items as bogies, traction motors, air conditioning units, etc.

The feasibility of such an arrangement will depend substantially on the technical similarity of the rolling stock selected for Metro Line 4, to those of the existing Metro Line 1 and 2 vehicles. Equally important in the evaluation of this possibility will be the capacity of the maintenance equipment installed at Metro Line 1 and 2 facilities, the extent to which these are currently occupied and the cost of the logistics involved in process management, transportation and the additional spare parts holding of any units selected for such an arrangement.

JICA Study Team carried out a summary inspection of the existing maintenance facilities at the existing Metro Lines 1 and 2 depots. Metro Line 1 depot facilities are quite old and both these and the staff capabilities are suitable only for the maintenance of the older series, classic DC traction-equipped vehicles. Notwithstanding this fact, the depot does not appear to have any substantial spare capacity that would be needed to accommodate outsourced work. It is therefore not practical to have any outsourcing arrangement with the existing Metro Line 1 depot for the maintenance of new Metro Line 4 rolling stock.

On the other hand, Metro Line 2 depot is relatively recent, extensively equipped and capable in the maintenance and repair of modern technology vehicles. Furthermore, it appears that it has reasonable spare capacity in order to support an outsourcing

arrangement for vehicles coming from another line.

JICA Study Team understands that the following philosophy has been adopted for the maintenance, overhaul and repair of the new rolling stock for Metro Line 3:

- Metro Line 3 maintenance facilities to be constructed in Phase 1 will be for light maintenance and repairs only;
- Additional Metro Line 3 maintenance facilities will be constructed as part of Phase 3, in order to handle heavy maintenance, repairs and overhaul of Metro Line 3 rolling stock;
- Any heavy maintenance, repairs and overhaul of Metro Line 3 rolling stock, in the initial phases, will be outsourced to the existing Metro Line 2 workshops.

It is essential that the above situation be formally clarified by NAT and that any existing studies and reports relative to the maintenance of Metro Line 3 rolling stock be made available to JICA Study Team. Without comprehensive data on the effect of Metro Line 3 maintenance policy and strategy and its impact on the existing Metro Line 2 workshops, it will be impossible for JICA Study Team to make an effective analysis of any outsourcing potential relative to the Metro Line 4 rolling stock.

Despite the fact that the information necessary for an effective analysis, to be conducted by JICA Study Team, has not yet been made available, there are logical assumptions that can be made in the interim:

- Currently, there is indeed sufficient spare capacity available within the existing Metro Line 2 workshops to support the outsourcing of heavy maintenance and repair for vehicles of another line.
- By the time Metro Line 3, Phase 3 is implemented, such spare capacity will no longer exist. Otherwise, there would be no need to construct heavy maintenance/repair workshops for Metro Line 3 itself.
- It is unsafe to assume that the future Metro Line 3 heavy maintenance/repair workshops will be capable of undertaking outsourcing for Metro Line 4 rolling stock since nothing is known by JICA Study Team regarding these facilities.

Therefore, JICA Study Team must work on the assumption that Metro Line 4 maintenance depot and workshops will have to be self-sufficient in terms of space, equipment and manpower.

5.8 Signalling & Telecommunications Plan

Meetings were held with the operators of Metro Line 1 and 2 for the purpose of collecting information and data on the signalling and telecommunications systems installed on these lines. Test rides on both lines and visits to the following facilities have also been undertaken:

- Signal and Telecommunication Equipment Room of Metro Line 2

- CCP of Metro Line 1 and Line 2; and
- Metro Line 1 and 2 Depots

The following observations were made during the above-mentioned site visits:

- The signalling system on Metro Line 1 may be described as a Wayside-Signalling system backed up by Automatic Train Protection (ATP). This system is similar to the Japanese Automatic Train Stop (ATS) system.
- The signalling system on Metro Line 2 comprises an ATP system with continuous speed control (which resembles a Japanese Wayside Automatic Train Control system or WS-ATC), mixed with a Cab-signal Automatic Train Control (CS-ATC) system and an Automatic Train Operation (ATO) system.
- The telecommunications systems of Metro Line 1 and 2 are of a standard level urban railway system type (resembling the systems used on Japanese urban railways). However, optical fibre transmission is not used in these systems.
- A single CCP controls both lines and is equipped with an ATS (Automatic Train Supervision) system. The telecommunication and sub-station control systems for CCP resemble those used on Japanese urban railways. This CCP has insufficient space to accommodate CCP function for Metro Line 4.

Requests have been made to NAT and the local consultant for Metro Line 1, 2 and 3 for information on the signal and telecommunications system architecture.

5.9 Power Supply

For the power supply system, a study will be carried out with regard to the necessity of having common specifications with other lines for through service or for compatible use of rolling stock.

In order to study interoperability between Metro Line 4 and the existing Metro lines, it is necessary to collect information regarding the electrical specifications of the existing lines. The documents regarding these issues were collected, and the basic electrical conditions of Metro Lines 1 and 2 were understood.

On the other hand, the available information regarding Metro Line 4 is not sufficient as basis for determining the power system specifications. Accordingly, JICA Study Team will continue its efforts to collect further relevant information.

5.10 Rolling Stock Plan

For the purpose of designing the specifications of the rolling stock for Metro Line 4, it is necessary to know the specifications of rolling stock for the existing Metro Line 1 and 2. As a first step, site visits were made to Tura Workshop, Shubra Workshop, and the SEMAF Factory. Following these visits, information is being collected by the local consultant engaged for the study. The following is a list of the required data and information:

- Egyptian regulations and standards for rolling stock used in metro lines
- Specifications of rolling stock for Metro Line 1, 2 and 3
- Information about the difference between the rolling stock for Metro Line 2 and that for Metro Line 3
- Information about the system relevant to the maintenance of rolling stock on the existing lines, as well as that proposed for Metro Line 3
- Information about the causes of rolling stock failures

The first two items above have already been collected and the remaining items will be collected.

Although the data collection task has not yet been completed, the main rolling stock specifications are given in Table 5-2 below.

Table 5-2 Main Specification of Rolling Stock (RS) for Cairo Metro

Description		RS for Metro Line 1	RS for Metro Line 2	RS for Metro Line 3
Train formation		M-T-M-M-T-M-M-T-M	M-N1-T-N2-N2-T-N1-M	M-N1-T-N2-N2-T-N1-M
Gauge		1.435 m	1.435 m	1.435 m
Power supply		OHC (1,500 VDC)	3rd rail (750 VDC)	3rd rail (750 VDC)
Train full length		190.2 m	140 m	140 m
Car body	Length	21.65 m/20.1 m	17.96 m/17.31 m	17.96 m/17.31 m
	Width	2.88 m	2.69 m	2.69 m
	Height	4.3 m	3.35 m	3.35 m
Passenger Capacity AW3 (at 9 person/m2)		3,195 passengers	1,796 passengers	1,796 passengers
Bogie	wheel base	2.5 m	2.1 m	2.1 m
	wheel diameter	1020 mm/920 mm	860 mm	860 mm
Propulsion system		Rheostatic control + DC motor	VVVF Inverter with GTO + Induction Motor	VVVF Inverter with IGBT + Induction Motor
Train speed (max. operating)		100 km/hr	80 km/hr	80 km/hr
Air conditioning		Not installed	In cab only	In cab and passenger car
OBIS		Not installed	9,600 bps	Over 1 Mbps

Source: JICA Study Team

The rolling stock for Metro Line 1 is a typical design for a suburban commuter train, which prioritizes passenger capacity and maximum operation speed. Those for Metro Line 2 and 3 are typical metro system designs, which can be operated on lines with small curve radii. It is likely that the rolling stock specification for Metro Line 4 will be an extension of those for Metro Lines 2 and 3, but it is important that this should be determined independently on the basis of the demand forecast and operation plan.

During a visit to the SEMAF Factory, it was learned that this factory has the basic technology for welding thick steel materials and construction of rolling stock in skeleton structure, but the welding technology for stainless steel and aluminium is relatively delicate and sensitive. It is therefore likely that SEMAF will need to develop the skills and experience needed to work with these materials.

Site visits to the workshops provided further useful information related to local conditions,

as listed below:

- The climate in Cairo is so dry that the maintenance work for corrosion of car bodies is much less for the Cairo Metro than for metro systems in Japan. It was noted that car body painting equipment has not been used since the Shubra Workshop started operation;
- The VVVF system and induction motor have contributed greatly to the reduction of system breakdown and maintenance work.
- The utilization of OBIS is useful to reduce inspection time.

Such information must be noted for the application of up-to-date technology.

5.11 Operation and Maintenance (O&M) Management System

The operation and maintenance issues and financial situations of the existing Metro lines will be analyzed based on the available documents and consultations with NAT and other relevant agencies. JICA Study Team will collect necessary data and information for the operation and maintenance plan.

5.12 Project Implementation Plan including Cost Estimation and Implementation Schedule

In order to reduce the project cost and make a suitable implementation plan, some types of structures and construction methods (e.g. viaduct, cut and cover, shield TBM, etc.) will be compared in terms of their construction and operation and maintenance costs. The size and scale of tunnels and underground stations are different according to the applied standard/regulation relating to emergency incidents and emergency management/prevention. This will affect the cost of the project. The practices and standards/regulation of emergency incidents and emergency management/prevention in Japan will be studied as a means of reducing costs. On the other hand, cost estimation will reflect the prevailing local inflation rates, as well as local tax and duty regimes.

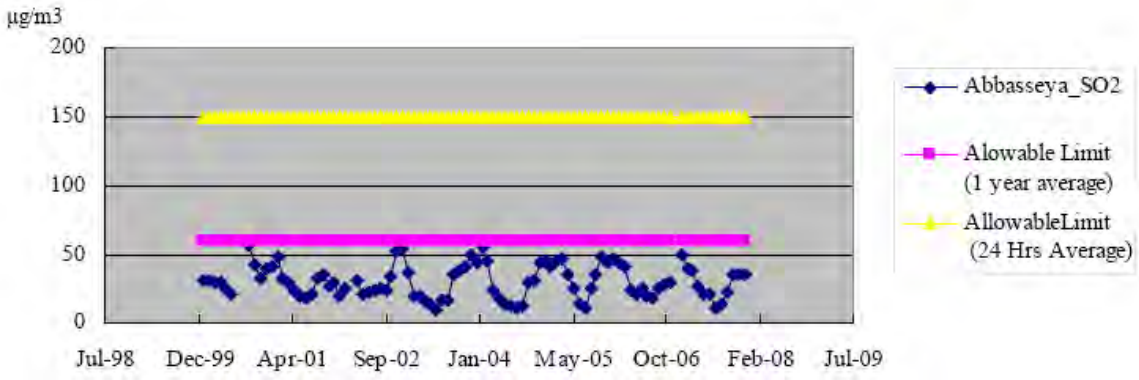
The procurement conditions including waiting time for imported materials, equipment and machinery will be investigated and reflected in the implementation plan and cost estimates.

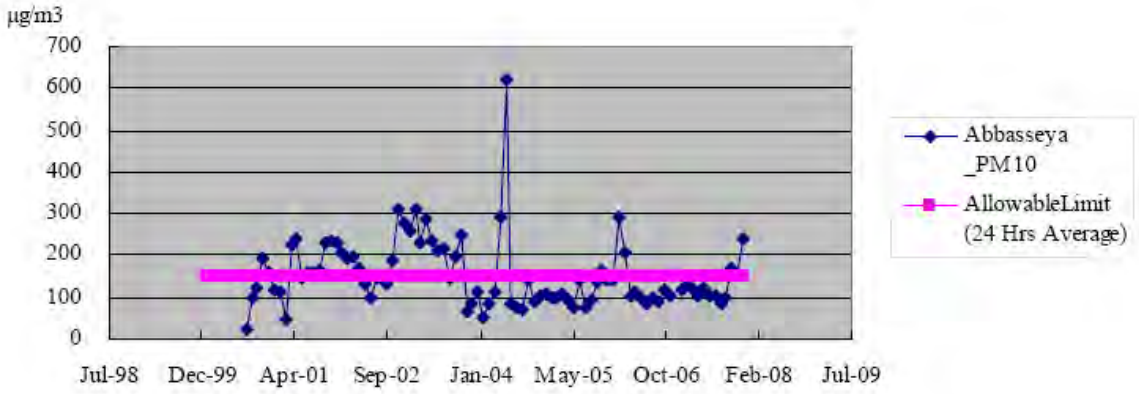
The collection of the necessary data and information for project implementation and cost estimation will be carried out in July 2009.

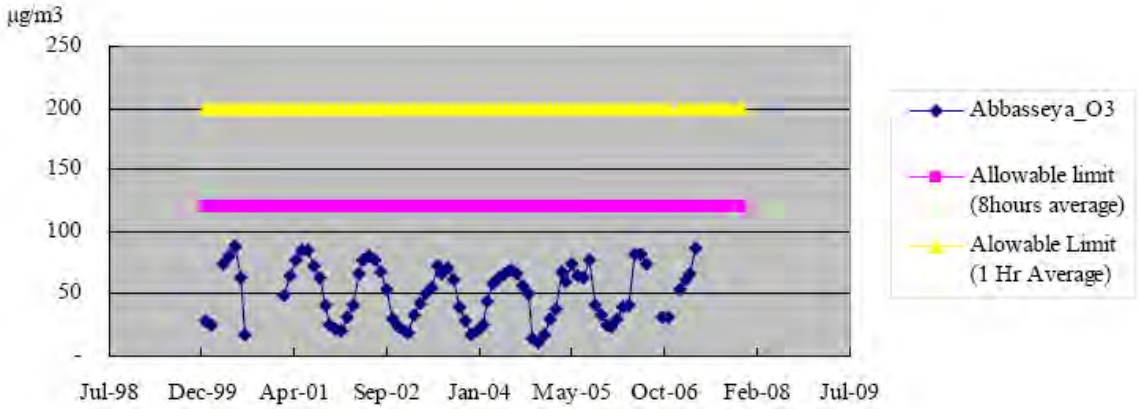
ANNEX 1
EXISTING DATA OF AIR QUALITY MONITORING OF EEAA IN MONTHLY AVERAGES

ANNEX 1 Existing Data of Air Quality Monitoring of EEAA in Monthly Averages

Existing Data of Air Quality Monitoring of EEAA in Monthly Averages (1)







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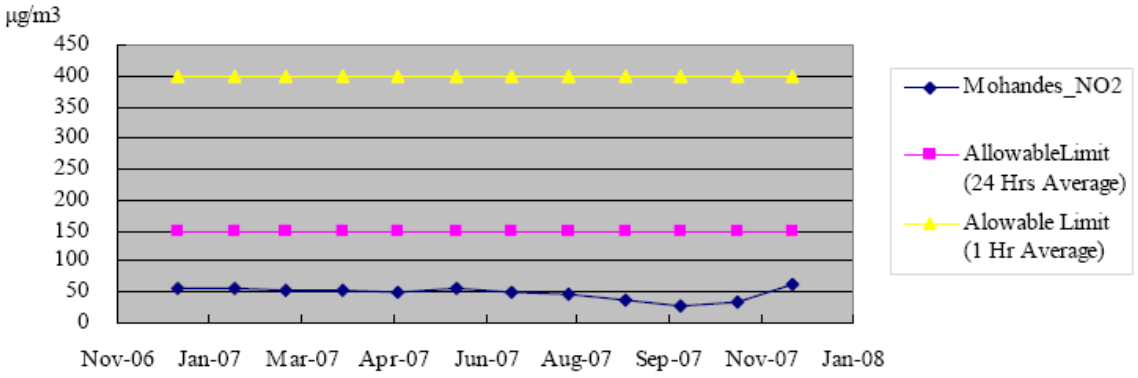

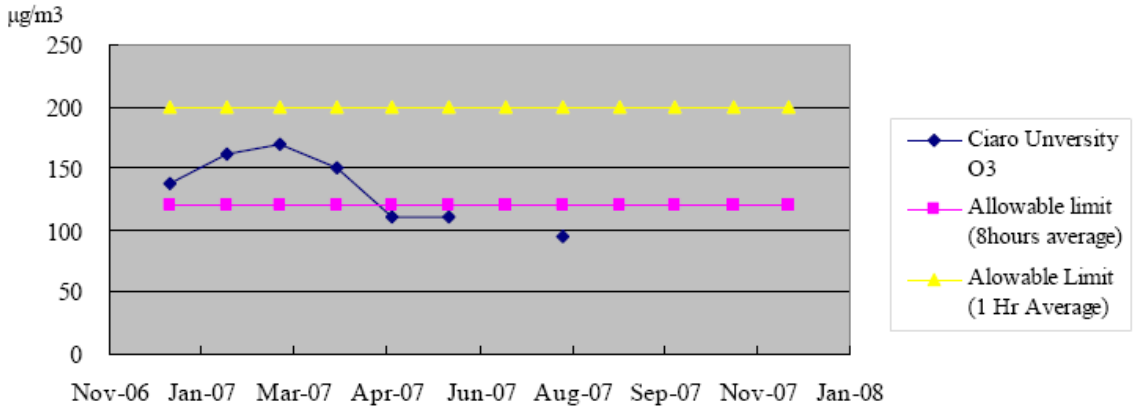

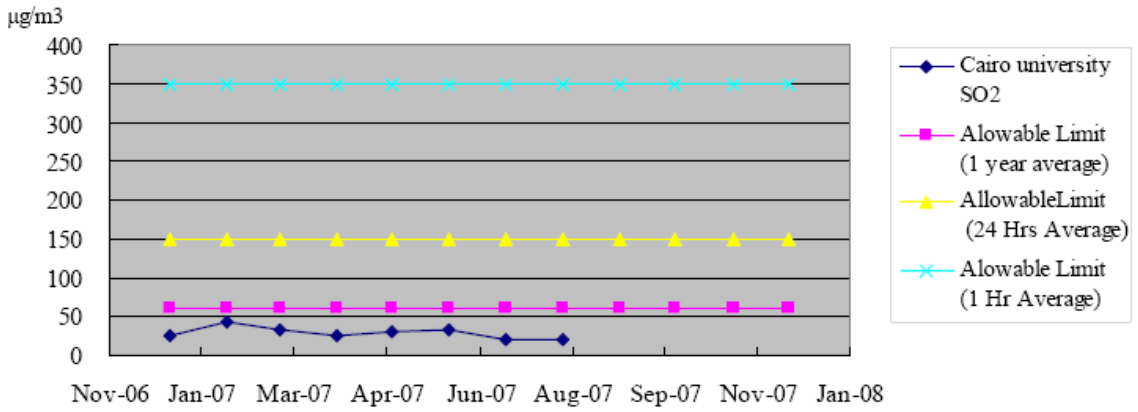

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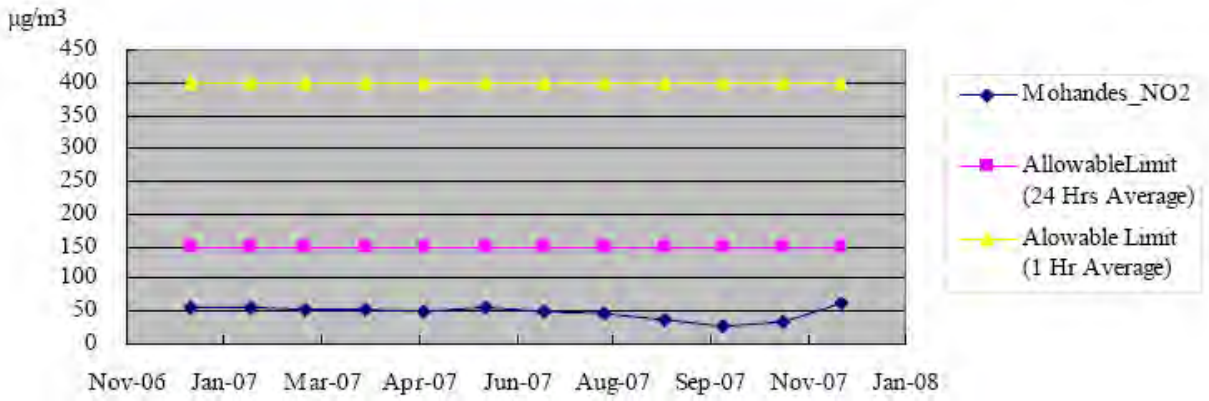

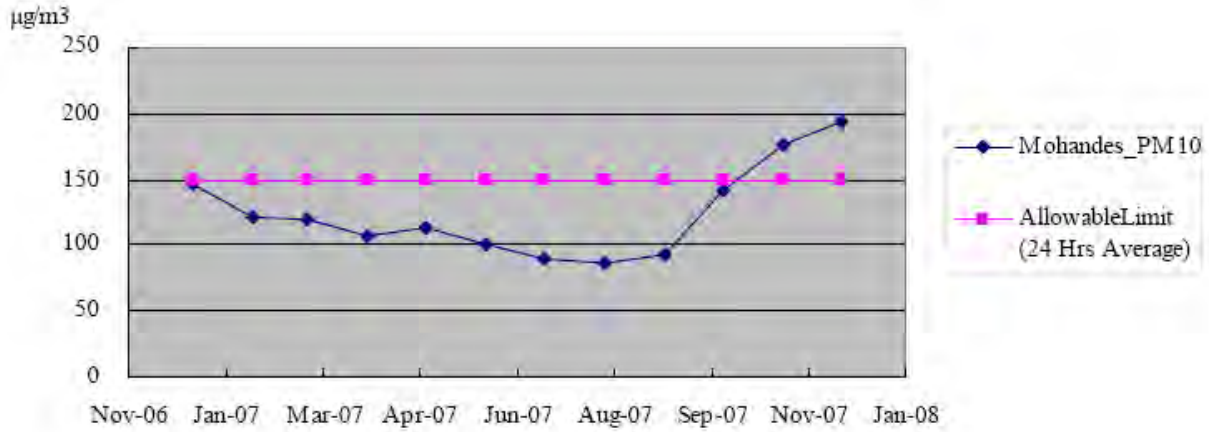

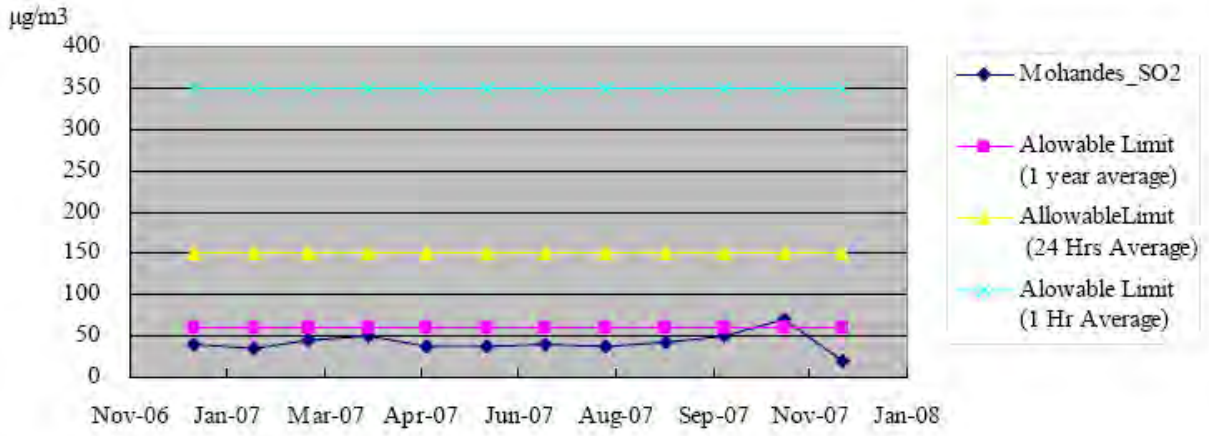

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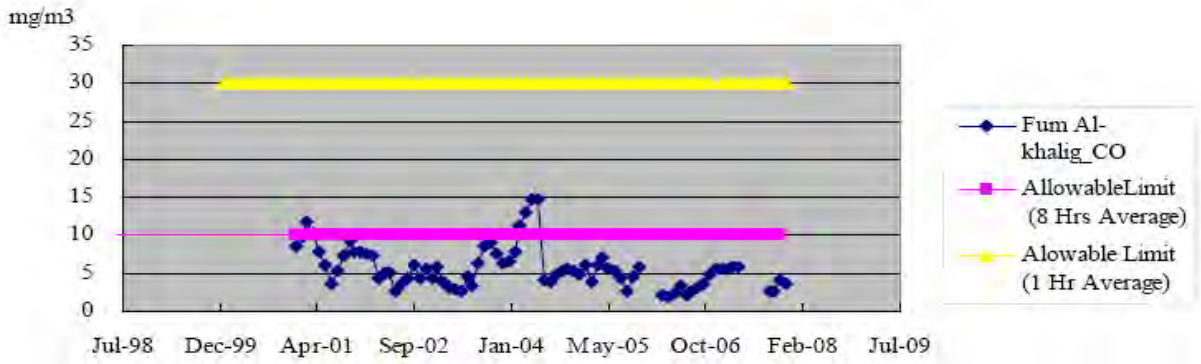

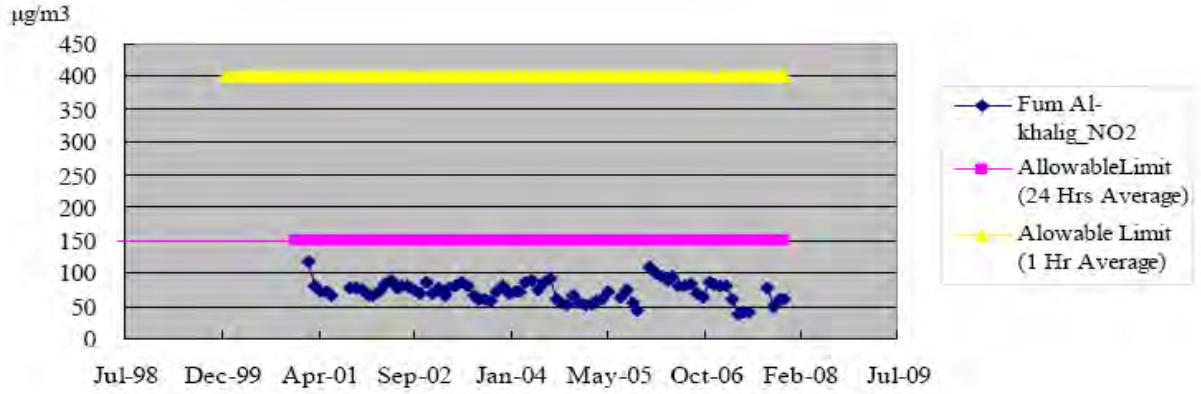

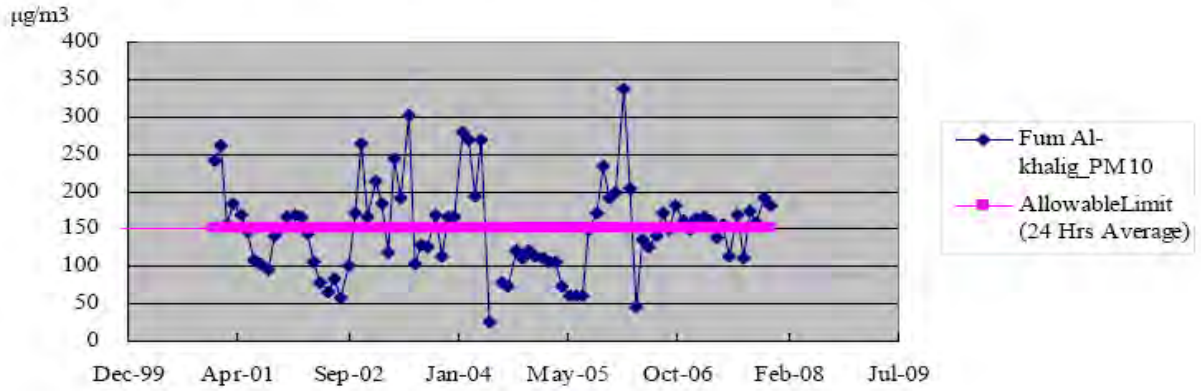

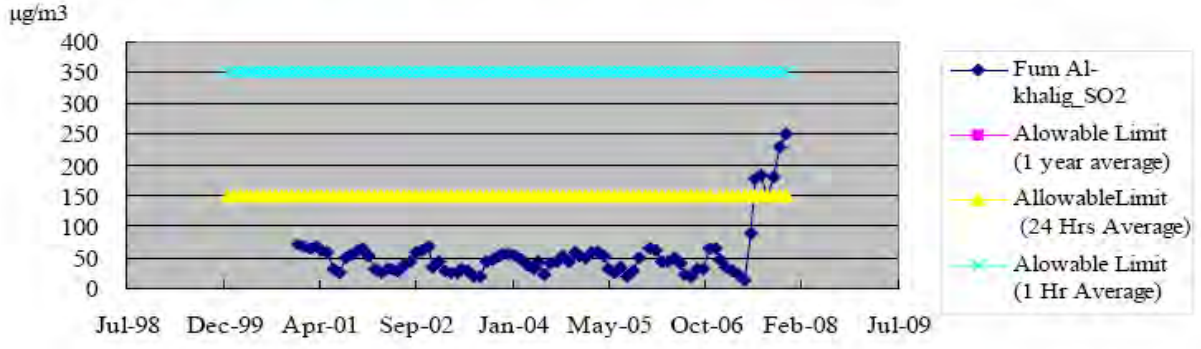

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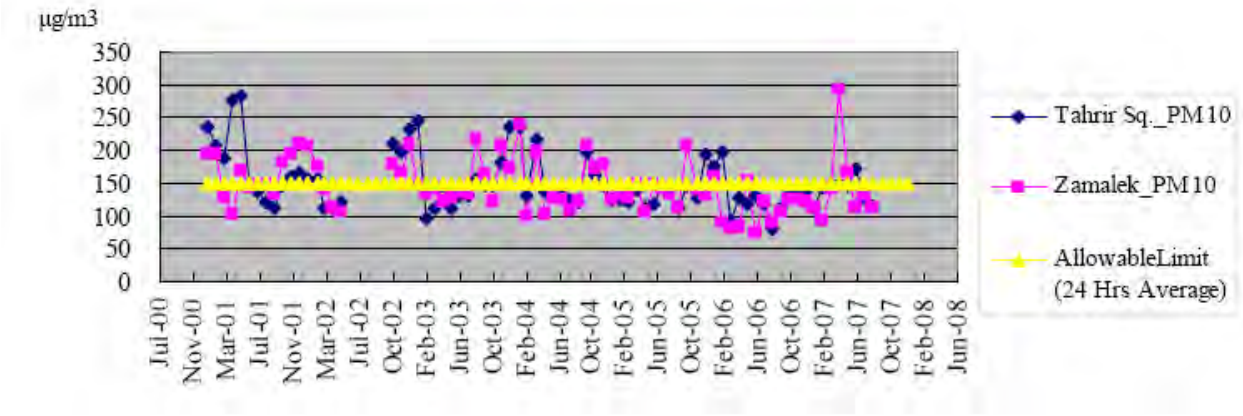

Note

All data in Annex 1 were taken from the “Feasibility Study on High Priority Urban Toll Expressway in Cairo in Arab Republic of Egypt, issued in January 2009”, conducted by JICA.

ANNEX 2
INFORMATION SUPPORTING ANALYSIS OF ARCHAEOLOGICAL ASSETS

ANNEX 2 Information Supporting Analysis of Archaeological Assets

1 Law No.117/1983 “Protection of Antiquities”

Following is an abstract of articles considered relevant and essential for the Feasibility Study of Metro Line 4.

*Article 5 (partial)
The Egyptian ANTIQUITIES AUTHORITY shall be the QUARTER concerned with the control and supervision of all that is related to antiquities affairs, in its museums and stores, and in the antique, ancient and historical sites and areas, even if these have been come across by accident.
The AUTHORITY shall assume the discovery of antiquities lying on the ground surface, and carry out excavation missions and works for those buried underground, in inland waters and in Egyptian territorial waters.

*Article 16
The MINISTER concerned with CULTURAL Affairs, upon the proposal of the AUTHORITY’s BOARD and in exchange for a just compensation, may arrange easement rights on neighbouring realties close to the archaeological sites and historical edifices, in order to guarantee the maintenance of their technical characteristics or general appearance. The Decree to be issued in this respect shall determine the realties on which one or more easement rights are arranged, and the scope of such right as well as the restrictions to be set to the right of the landlord or holder of such, accordingly.

*Article 17
Subject to the penalties prescribed in this or other laws, the BOARD CHAIRMAN of the AUTHORITY, upon the decision of the PERMANENT COMMITTEE ON ANTIQUITIES and without need of resorting to the Court, may decide removing all encroachment on the archaeological site or realty through administrative channels. The ANTIQUITIES POLICE authorities shall be in charge of implementing the removal decision. The violating party shall restore the situation to its original condition otherwise the AUTHORITY may proceed with restoring it to its original condition at the cost of the violator.

*Article 20 (partial)
No construction licenses shall be granted for archaeological sites or lands. No third party shall erect establishments or cemeteries, dig canals, build roads, or cultivate in archaeological sites, public utilities of antiquities and ancient remains, or lands lying within the approved lines of beautification of such antiquities.
The provision of the previous clause shall apply to lands bordering the site and lying outside the scope of such sites, as referred to in the previous paragraph, to a distance of three kilometres in the inhabited areas, or to a distance to be determined by the AUTHORITY in a way that ensures the protection of the environment of the antiquity in other areas.

*Article 22
The Department concerned, after getting the approval of the AUTHORITY, shall have the power to license buildings and constructions in areas and lands bordering the archaeological sites within the inhabited areas.
The Department concerned shall include in the license such conditions considered by the AUTHORITY to guarantee the erection of the building in a suitable way that does not trespass the antiquity or defile its appearance and guarantees for it a suitable shrine, taking into consideration the archaeological and historical surroundings and the

specifications guaranteeing its protection and preservation. The AUTHORITY shall give its view with respect to the license application, within SIXTY days from the date of receipt of the application. Otherwise, the lapse of this period shall be considered as a decision to refuse the application.

*Article 23 (partial)
Any person who discovers and finds a real unregistered antiquity shall notify it to the ANTIQUITIES AUTHORITY. The ANTIQUITY shall be considered a property of the STATE. And the AUTHORITY shall take necessary steps to preserve and maintain such antiquity, and it shall have the power within three months either to lift the antiquity existing in the realty of individuals, or take steps of land expropriation where the antiquity is found, or leave the antiquity in its place and registering it according to the provisions of this law. The value of antiquities existing in expropriated land shall not enter in the estimation of its value.

*Article 24
Any person who accidentally comes across a movable antiquity or a part or parts of a fixed antiquity shall notify such discovery to the nearest administrative DEPARTMENT within forty eight hours from finding such movable antiquity, and preserve and maintain it until the appropriate authority have received it. Otherwise, he shall be considered as unlicensed holder of the antiquity. The said administrative department shall also notify the ANTIQUITIES AUTHORITY thereof, on the spot.
The antiquity shall become a property of the STATE, and the STATE, if the antiquity's importance is estimated, may grant the individual finding it and notifying about its discovery a compensation to be determined by the concerned Permanent Committee.

*Article 30 (partial)
The AUTHORITY shall also bear the restoration costs of registered historical buildings in its' and other authorities' possession, unless the cause for such restoration has resulted from the holder's abuse of the antiquity, as shall be decided by the concerned Permanent Committee, in which case the holder of the antiquity shall bear the restoration cost.

About the Supreme Council of Antiquities (SCA)

The Supreme Council of Antiquities (SCA) is the government body in Egypt concerned with and responsible for all aspects of running the cultural heritage of the country; being in charge of its welfare, management, protection, conservation, preservation, exhibition, documentation, research and media presentation. The support services for these tasks are undertaken by six sectors that cover all administrative, financial, legal, technical, engineering and scientific needs. The six SCA sectors are: General Secretariat Sector, Egyptian (Pharaonic) and Graeco-Roman Antiquities Sector, Coptic and Islamic Antiquities Sector, Antiquities and Museum Financial Support Fund Sector, General Projects Sector and Museums Sector.

The highest SCA authority is the Administrative Council (Board), which acts as a governing body. The President of the Council is the Minister for Culture, who is the sole legal representative of SCA. The heads of the six sectors form the executive core of the Administrative Council as Permanent Members (ex officio, i.e., by virtue of their office). The Head of the General Secretariat Sector, i.e., the General Secretary, acts as the Executive Head of SCA in running its everyday functions and directing all sector operations and activities. The other sector heads are working under his direct supervision.

The establishment of a government body in charge of Egypt's cultural heritage goes back to the year 1859. Such body has initially assumed the name (title) of The Department of Antiquities (under the Ministries of Public Works, Education, National Guidance and Culture) and retained it until 1971, when it acquired the new name of "The Egyptian Antiquities Organization" or EAO. The latter was transformed into the present Supreme

Council of Antiquities by virtue of Presidential Decree Number 82 of 1994.

Further detailed information on the nature of the work of the various sectors, their operations and achievements; may be obtained directly by writing to the Public Relations Department, the Press Office, the Information Center or the sector heads concerned in the address given below. The SCA website is also available (given below) as an alternative.

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2 Articles about archaeological finds

Empire of the sun

Nevine El-Aref reports that an ancient Egyptian sun temple has been found in Matariya.
 2 - 8 March 2006
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During a routine excavation to inspect the site of Souk El-Khamis in Matariya, an Egyptian-German team uncovered the remains of a sun temple dating back to the reign of King Ramses II. This site is believed to be an important part of the ancient city of Iunu (ancient Heliopolis), which was one of ancient Egypt's three main cities. In addition to being the city of sun worship, Iunu was an astronomical centre and a literary hub where intellectuals including Greek philosophers studied.

Among the unearthed artifacts were a pink granite colossus, weighing five tons, whose features resemble those of Ramses II, and a 1.5 meter sandstone headless statue of a Pharaonic figure, whose back is engraved in hieroglyphic text. While brushing the sand off, three cartouches of Ramses II were also uncovered, scattered on the temple ground, along with an unidentified pink granite royal head wearing a *nemes* (head dress).

Zahi Hawass, secretary-general of the Supreme Council of Antiquities, told *Al-Ahram Weekly* that further excavations revealed a number of *talatat* (small painted stones) bearing the name of Queen Nefertiti. "This suggests that the monotheistic King Akhenaten once built a temple or a shrine in this area," he said, adding that archaeological evidence of massive constructions of sun temples had been carried out much earlier than the 19th Dynasty.

Archeologist Mohamed Megahed said that several fragments decorated with the sun god Aten have been found scattered in the sand along with a clay oven from the reign of Ramses II.

Matariya also contains the remains of the 20.4 meter-high granite obelisk erected by Middle Kingdom Pharaoh Senusert I, along with a modest collection of tables and statues, as well as the ruins of an obelisk belonging to Thutmose II, superimposed with inscriptions of Ramses II, and objects bearing the names of Amenhotep II, Thutmose IV and Amenhotep III.

Older monuments include the ruins of a Third Dynasty shrine built under King Djoser, part of a Sixth Dynasty obelisk of King Teti, several Old Kingdom tombs of high priests and a stela of Tuthmosis III. Excavations have also revealed several Ramesside constructions including temples, a cemetery for Mnevis bulls, which were sacred to Re, and a 12th Dynasty donation list from the time of Ramses III, indicating that the temples at Heliopolis were second only to those of Amun at Thebes.

In 1993, while foundations and drainage were being installed near the granite obelisk, a cache of limestone statues, granite sarcophagi and stelae were found. They originate in the 26th Dynasty Saite period and their decoration styles and breathtaking sizes suggest that they once belonged to royals or high-ranking officials at least. Once cleaned and restored, the monuments were placed on temporary exhibition next to the obelisk. Two years later, another tomb from the 26th Dynasty, i.e., the resting place of man called Panehsy which means the Nubian, was accidentally discovered two kilometers east of the obelisk during the demolition of a villa owned by the Egyptian Lawyers' Syndicate, which had filed a request for archaeological inspection prior to the start of construction of a new member’s residence. While the mud brick chapel disappeared, the burial

chamber remains intact. It is composed of a vaulted limestone room, whose frescos feature the sky goddess Nut, while beautiful vignettes and spells from the Book of the Dead decorate its walls. And in 2001, the tomb of Waja-Hur, a well-known architect, was found. An impressive structure, it consists of two long corridors leading to three burial chambers with the first belonging to the deceased, and the other two, which have yet to be excavated, in all likelihood to members of his family. Although devoid of funerary equipment, the tomb contains 19 *ushabti* figures bearing his name.

All tombs have now been dismantled and relocated to a dry area well above the ground water level. It was now developed into an open-air museum at the heart of the concrete jungle, where royal granite sarcophagi found near Panehsy's tomb are already shown and a concrete base installed. While the site has yet to be displayed, highlights will include a four meter-high quartzite colossus of Ramses II that was found broken in the backyard of the Arab Contractors Hospital in Nasr City. This masterpiece, thus far neglected, had been subject to mistreatment by construction workers in the area so much so that it was obscured by rubbish and remained unnoticed for 14 years.

The museum is being paved with blocks of stone. A route will be laid out for tourists. Starting at the colossus, it leads to Panehsy's tomb and the granite sarcophagi, onto the tomb of Waja-Hur, and then finally out of the museum to the Tree of the Virgin. The journey ends at the famous obelisk, where offering tables, statues and parts of the Thutmose II obelisk are currently being prepared for display.

City of the sun
Astrology centre or suburbia? Nevine El-Aref visits another Heliopolis

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The word Heliopolis brings to mind a chic suburb built in 1905 by Baron Empain. What the name originally refers to is in fact an area 10 km away. Today, it covers the lower middle-class quarters of Ain Shams, Matariya and Tel Al-Hisn. A city of antiquity, it was more or less completely obliterated in modern times. Connected to the Nile by a canal, Heliopolis (the Ancient Egyptian Iunu and Biblical On) was always a place of eminence. As early as pre-dynastic times, it was considered a holy site -- a fact which the discovery, in the 1950s, of a large cemetery containing 145 human and 14 goat and dog mummies has testified. These simple graves set into round or oval pits of various sizes and depths, with a few lined with reed or wood, contained only the most basic items. Subsequent studies by the archaeologist credited with the discovery, Fernand Debono, and the Desert Institute point to the performance of ritual activities in these burial chambers, with hearths suggesting funerary meals.

Through ancient times, together with Memphis and Thebes, Iunu was one of three vital cities. It had the status of the city of sun worship, an astronomical center and a literary hub where intellectuals as well as Greek philosophers studied. "Here," Zahi Hawass, secretary-general of the SCA, told *Al-Ahram Weekly*, "Egyptian priest-philosophers wrestled with the questions of creation, forging an elaborate myth whose prime players were the nine gods of the Ennead." Iunu-based scholars became the "greatest seer" (or "chief astronomer") and their fame spread throughout the Mediterranean world. According to ancient religious texts, Iunu was also associated with the mythology of kingship.

"As the prototypical solar symbol," Hawass pointed out, "the pyramid-shaped *benben*, was housed in one of Iunu's temples." Myths about King Khufu seeking esoteric

information hidden in Heliopolis to help him build the Great Pyramid developed during the Middle Kingdom (2055-1650 BC). The wife of an Iunu priest was said to have given birth to the first three kings of the Fifth Dynasty, all of whom were the sons of the Heliopolitan sun god, Re. It was after the Ramesside that Heliopolis became neglected though the Saities of the 26th Dynasty built tombs there. The city was largely destroyed during the Persian invasion of 343 BC (and that of 525 BC), but its abiding reputation was to attract Graeco-Roman visitors like the historians Herodotus and Strabo, who in the first century BC found it in ruins, with most of its statuaries and obelisks relocated in Alexandria and Rome. In Coptic times, On re-emerged as the Biblical home of Joseph's wife, who was a priest’s daughter there. In the Middle Ages, however, it was little more than a quarry with its once glorious edifices providing much of the stone.

Despite its intellectual prominence, little is known about ancient Heliopolis. According to SCA inspector Tareq El-Awadi, its principal feature was a temple devoted to the sun gods Atum and Re-Horakhty, whose exact location is not known for certain. Today, all that remains are the 20.4 meter-high granite obelisk erected by the Middle Kingdom Pharaoh Senusert I, along with a modest collection of miscellaneous offering tables and statues, as well as the ruins of an obelisk belonging to Thutmosis II and superimposed with inscriptions of Ramses II, and objects bearing such glorious names as Amenhotep II, Thutmosis IV and Amenhotep III. Older monuments include the ruins of a Third Dynasty shrine of king Djoser, part of a Sixth Dynasty obelisk of king Teti, several Old Kingdom tombs of high priests and a stelae of Thutmosis III. Excavations have also revealed Ramesside constructions including temples, a cemetery for the Mnevis bulls, which were sacred to Re, and a 12th Dynasty donation list from the time of Ramses III indicating that the temples at Heliopolis were second only to those of Amun at Thebes.

The situation was partially remedied in 1950, when the Antiquities Department commissioned a German firm to raise the obelisk on a base. Efforts were undertaken to clear and develop the site, and lawns were planted all around. Later in the mid-1970s, the areas around the obelisk and the nearby Tree of the Virgin (in the shade of which the Holy Family are said to have rested on their way to Egypt and hence a place of pilgrimage credited by many Christians with miraculous powers) were further improved. However, both would remain largely inaccessible to tourists until the completion of a new bridge crossing the railway station separating Cairo from Matariya. Subsequent excavation in Arab Al-Hisn, part of ancient Heliopolis, has since uncovered a glimpse of a large temple complex with monuments dating back to the New Kingdom. Among the most fascinating architectural elements still visible, in Hawass's view, are the temples of Ramses II and Ramses IV. He further says that a chapel built by the latter's son Nebmaatre, who held the title of Greatest Seer, is particularly interesting. rectangular mud-brick foundations and circular granaries, not to mention a granite column of King Meneptah depicting the king making offerings to various gods as well as figures of bound and humiliated enemies commemorating a victory over Libyans, are equally visible near the temple remains. "This column is a very significant historical document," Hawass explains. "It points to the vast extent of temple buildings that must lie beneath this quiet village of Arab Al-Hisn."

In 1983, a new law placed Heliopolis under SCA supervision, which now oversees (and has the right to reject) any construction proposals. Hawass explained that archaeological objects, in areas where monuments are found and can be harmlessly removed, can be cleared and handed over to their owners. But where irremovable monuments are found, the land is declared an archaeological protectorate and the SCA compensates the owner with either a fair price or another piece of land. "This law facilitated some wonderful discoveries in the last few decades," Hawass recounts, beaming. "In 1993, while foundations and drainage were being installed near the granite obelisk, a cache of limestone statues, granite sarcophagi and stelae were found. These come from the 26th Dynasty Saite Period and their decoration styles and breathtaking sizes suggest that

they beloged to royals or high-ranking officials..." Once cleaned and restored, the monuments were placed on temporary exhibition next to the obelisk.

Two years later, another tomb of the 26th Dynasty, i.e., the resting place of a man called Panehsy which means the Nubian, was accidentally discovered 2 km east of the obelisk during the demolition of a villa owned by the Egyptian Lawyers Syndicate, which had filed a request for archaeological inspection to replace it with residence for its members. The mud brick chapel had disappeared and only the burial chamber, a vaulted limestone room with ceiling paintings that feature the sky goddess Nut and walls decorated with beautiful vignettes and spells from the *Book of the Dead*, remained intact. Hawass recounts that the SCA paid the Lawyers Syndicate LE8 million.and because it was located 60 m below ground level, Panehsy's tomb was partly inundated, limestone blocks had titled and cracked, and the resulting saline water damaged the reliefs. Still, the digging has unearthed Late Period limestone sarcophagi as well as gold and faience amulets. Likewise, the tomb of Waja-Hur, a well-known architect, was found in 2001. It is an impressive structure consisting of two long corridors leading to three burial chambers with the first belonging to the deceased and the other two, which have yet to be excavated, in all likelihood to members of his family. Although devoid of funerary equipment, the tomb contained 19 *ushabti* figures bearing his name. The discovery seemed to seal the fate of the area.

Now that the ancient Heliopolis is easily accessible via the Matariya Bridge, the idea of developing it into a tourist site quickly resurfaced. It was regarded as an urgent matter since its speedy implementation will help curb further damage to the monuments due to, drainage leakage and subterranean water, among other aspects of urban expansion. Accordingly, the project was promptly commenced to follow in the footsteps of the Panehsy tomb rescue operation. "To protect Panehsy's tomb from further damage," Abdel-Hamid Qutb, the Giza Governorate's Engineering Department Director explains, "an insulating substance was inserted in the space separating the ground from the lower strata of the blocks, and the reliefs were cleansed of encrusted salt and restored." The tomb has already been dismantled and relocated to a dry area well above the ground water level. It was now developed into an open-air museum at the heart of the concrete jungle, where royal granite sarcophagi found near Panehsy's tomb are already shown, and a concrete base installed. Highlights will include a four meter-high quartzite colossus of Ramses II, found broken in the backyard of the Arab Contractors Hospital in Nasr City. This masterpiece, thus far neglected, had been subject to mistreatment by construction workers in the area so much so that it was obscured by rubbish and remained unnoticed for more than 14 years.

The museum is being paved with blocks of stone. A route will be laid out for tourists that will start at the colossus, lead to Panehsy's tomb and the granite sarcophagi, onto the tomb of Waja-Hur, and then finally out of the museum to the Tree of the Virgin. The journey ends at the famous obelisk, where miscellaneous offering tables, statues and parts of the Thutmosis II obelisk are currently being prepared for display. The only negative consequence is the removal of the greenery, which requires irrigation that could damage the monuments. "Each statue will be set up on a base with placards giving the full details," Hawass announced. "Excavations will continue in this area, and we are confident that more monuments will be unearthed. When they are, they will be properly treated and restored before being placed in the new museum area." Workers and restorers were milling around, even as of this time, brushing, cleaning and positioning objects for display as if in answer to Minister of Culture Farouk Hosni's promise: "Every effort is being made to develop this open-air museum; it's going to be a pleasure to see."