Environmental and Social Impact Assessment - Vol. 2 Main Document

Additional Services for Cairo Metro Line 3 - Phase 3, Environmental and Social Impact Assessment Study (SGN/ACH/2012-014)

Grontmij A/S in association with EcoConServ

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TABLE OF CONTENTS

LIST OF TABLES

-

1 INTRODUCTION

1.1 Background

The European Investment Bank (EIB) and the French Development Agency (AFD) are contemplating co-financing the construction of Greater Cairo Metro Line 3 – Phase 3. The Executive Agency and owner of the construction project is the National Authority for Tunnels (NAT). After final handover of the works, the new assets are transferred for operation and maintenance to the Egyptian Company for Metro Management and Operation (ECM).

The current Cairo metro network consists of two lines with a total length of about 65 km which carry approximately 2 million passengers on a daily basis. The Cairo Metro Project is part of the Ministry of Transport's (MoT) national plans for urban transportation in the Greater Cairo Region (GCR), which started with the realization of the first two lines. It will link various districts of the wider GCR, including New Urban Communities (NUCs), with the city centre. Line 3 was identified as a priority investment to serve the main transportation corridors of Greater Cairo in the 1999 Transportation Study of the Greater Cairo Region. The 2002 Transport Master Plan confirmed the necessity to implement Metro Line 3 on the route identified in the previous study, serving the Cairo Business District and being an east-west connector through the Greater Cairo region. The construction of a fourth metro line began in 2011 and completion is planned by 2020.

The total Metro Line 3 includes four phases, of which phase 1 was inaugurated in February 2012, and phase 2 is under construction with operations scheduled by the end of 2013. A subsequent Phase 4 will link downtown with Cairo's international airport to the east. The proposed project will finance the design, construction and commissioning of Greater Cairo metro Line 3 Phase 3, which is in turn divided in three sub-phases: sub-phase 3A from Attaba to KitKat Square, sub-phase 3B, from Kit-Kat Square to Rod El Farrag, and sub-phase 3C, from Kit-Kat Square to Cairo University. Sub-phase 3A will be full underground. Sub-phases 3B and 3C are a combination of underground alignments, and at-grade and elevated designs.

The aims of the Metro project are to: (i) mitigate climate change and pollution (air and noise) by providing more environmentally sustainable transport means; (ii) contribute to the economic growth by reducing urban congestion and thus increasing labour productivity; and (iii) improve the livelihoods of Cairo's socially disadvantaged population by enhancing their mobility and thus their access to education, jobs and other services.

In accordance with EIB's Statement of Environmental and Social Principles and Standards (2009)[1] as well as its Environmental and Social Practices Handbook (2010)[2] and the AFD's guidelines, the Banks require an Environmental and Social Impact Assessment ("ESIA") to be undertaken for this type of project. The ESIA should be prepared in compliance with the Bank's environmental standards and specifically the requirement for ESIAs to meet the EU EIA Directive and related guidance[3] and AFD's guidelines. An Environmental and Social Impact Assessment (ESIA) for the Project, funded through AFD was prepared by EQI. A comprehensive review determined that there were gaps in the substance and that the assessment

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[1] http://www.eib.org/about/publications/environmental-and-social-principles-and-standards.htm
[2] http://www.eib.org/about/publications/environmental-and-social-practices-handbook.htm
[3] http://ec.europa.eu/environment/eia/eia-support.htm

was not in compliance with the EIB Environmental and Social Standards and Requirements.

In April 2012 AFD contracted Grontmij and its partner EcoConServ to verify the gaps; compare the scope and content with the environmental and social requirements of the EIB in the existing ESIA, and ensure a Final ESIA be prepared in line with EIB and AFD standards, and in compliance with the relevant national legislation.

1.2 Environmental and Social Impact Assessment

The ESIA process is a systematic technique used to identify and assess the environmental and social issues related to the project study area. These include potential risks and benefits to the community well-being and the physical, biological, and socio-economic environments of the study area. The assessment ensures that any adverse environmental and social impacts/key areas of concern are appropriately addressed through mitigation measures as outlined in the management plan.

This ESIA report has been prepared in accordance with international best practices. It assesses the relevant legislative framework; the social and environmental baseline; the alternatives considered during the project's design phase; the social and environmental impacts; and puts forward appropriate mitigation measures and a management plan for their implementation.

In addition, the objectives of the ESIA are to:

- meet and/or surpass the Egyptian and international and social requirements;
- record pre-project environmental, social, economic and health baseline conditions to provide stakeholders with an understanding of the valued resources, their constraints and other resource users in the areas;
- provide a forum for communities to become knowledgeable about the project;
- ensure that the impacts of the project on different environmental receptors, project affected people and social groups are understood, recorded and considered;
- identify environmental and social risks to the people affected by the project and suggest risk mitigation options;
- promote positive and counteract negative impacts throughout the construction and operational phases though implementation of the ESMP; and
- provide a baseline management information essential to the long-term viability of the project including monitoring and review requirements.

1.3 Partners Involved

The following organisations are identified as being the core stakeholders of the ESIA report development process:

- The National Authority for Tunnels (NAT): executive agency responsible for the construction phase of Metro Line 3, Phase 3.
- The Egyptian Company for Metro Management and Operation (ECM): implementing agency responsible for the operation phase of Metro Line 3, Phase 3.
- The Egyptian Environmental Affairs Agency (EEAA): approving agency responsible for ensuring an EIA process in compliance with national legislation.
- Systra: responsible for overseeing the construction of Metro Line 3, phase 3, including preparing feasibility studies and tender documents.

- The European Investment Bank (EIB) and The French Development Agency (AFD): financing the construction of Metro Line 3, Phase 3. The ESIA is part of this finance package and will need to be approved by the financing agencies.
- Grontmij and EcoConServ: responsible for delivering an ESIA in compliance with the EIB and AFD standards.
- EQI: delivered a draft ESIA, which was considered not to be in compliance with EIB standards.

1.4 Structure of the ESIA

The ESIA is structured into the following chapters:

Chapter 2 Policy, Legal and Administrative Framework
Discusses the policy, legal and administrative framework within which the Assessment is carried out including national regulations, and obligations implementing relevant international social and environmental treaties, agreements, and conventions.

Chapter 3 Project Description
Concisely describes the proposed project and its geographic, ecological, social, and temporal context, including any related facilities that may be required, including maps showing the project site and the project's area of influence. Description of the physical characteristics of the whole project and the land-use requirements during construction and operational phases, as well as quantity of the materials used.

Chapter 4 Alternative Considerations
Provides an outline of the main alternatives studied by the promoter and an indication of the main reasons for this choice, taking into account the associated environmental and social effects.

Chapter 5 Approach and Methodology
Presents the approach and methodology used for the ESIA.

Chapter 6 Spatial and Temporal Boundaries of the Study
Describes the spatial and temporal boundaries of the ESIA.

Chapter 7 Baseline Information
Assesses the dimensions of the study area and describes relevant physical, biological, socioeconomic, and labour conditions, including any changes anticipated before the project commences.

Chapter 8 Environmental and Social Impact Assessment and Proposed Mitigation Measures
Describes the likely significant effects of the proposed project on the environment and socio-economy resulting from the existence of the project. Assesses the identified potential impacts from the construction and operation phase, and proposes mitigation measures.

Chapter 9 Environmental and Social Management Plan

Presents a set of mitigation and management measures to be taken during implementation of the project to avoid, reduce, mitigate, or compensate for adverse social and environmental impacts, and their timelines. Describes the desired outcomes as measurable as performance indicators that can be tracked over defined time periods, and indicates the resources, including budget, and responsibilities required for implementation.

Chapter 10 Summary of Public Consultation
Summarises the public consultation carried out including a description of the process and the stakeholders that participated and the concerns raised.

2 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 National Legal Framework and Guidelines

This section aims at summarizing the Egyptian social and environmental legislations, regulations, guidelines that govern the implementation of the project. Not only that but also to set focus on the social and environmental consideration required for conducting the EIA studies as part of the documents needed for EEAA.

The main legislations and guidelines that will be discussed under this section are as follows:

Egyptian legislation related to environmental aspects:
- EEAA guidelines and requirement for Environmental Impact Assessment;
- National environmental legislation;
- Health and Safety Laws and Decrees;
- Traffic Laws; and
- Urban planning Laws.

Egyptian legislation related to social aspects
- EEAA guidelines related to the Public Consultation;
- Land acquisition and involuntary resettlement;
- Protection of human rights;
- Protection of antiquities; and
- Procurement laws.

Egyptian legislation related to Socio-economic environment
- EEAA guidelines related to the Public Consultation
- Paragraph 6.4.3 Requirements for Public Consultation
- Paragraph 6.4.3.1 Scope of Public Consultation
- Paragraph 6.4.3.2 Methodology of Public Consultation
- Paragraph 6.4.3.3 Documentation of the Consultation Results
- Paragraph 7 Requirement and Scope of the Public Disclosure

Land acquisition and involuntary resettlement
- Law 94/2003 on the National Council for Human Rights (NCHR)
- The Constitution (1971, amended in year 1980)
- Constitutional Declaration 30th of March 2011
- Law 10/1990 on property expropriation for public benefit
- Other laws governing expropriation

Protection of human rights

- Law no. 94/2003 on establishing the National Council for Human Rights

Protection of Antiquities

Law 117 / 1983 concerning the protection of monuments is applicable.

Procurement laws

- The Procurement Law No.89/1998

Laws and regulations related to archaeology

- Law 119/2008
- Law 117/1983

The following table illustrates different laws related to the Cairo Metro Project:

Table 2-1: National regulations related to socio-economic environment

Title of legislation	**Summary and how this legislation applies to this project**	**Year**
EEAA guidelines related to the Public Consultation		
Law 4/1994 on Environmental Protection	Consultation of the community people and concerned parties with the needed information about the project. All stakeholders should be invited. Paragraph 6.4.3 from Law 4/1994 on Environmental Protection provides detailed information on the scope of public consultation, methodology and documentation **Paragraph 6.4.3 Requirements for Public Consultation** • Paragraph 6.4.3.1 Scope of Public Consultation • Paragraph 6.4.3.2 Methodology of Public Consultation • Paragraph 6.4.3.3 Documentation of the Consultation Results • Paragraph 7 Requirement and Scope of the Public Disclosure	1994
Land acquisition and involuntary resettlement		
Law 10/1990	On Property Expropriation for Public Benefit identifies transportation projects as public benefit activities. It describes acquisition procedures as follows: 1. The procedures start with the declaration of public interest pursuant to the presidential decree accompanied with memorandum on the required project and the complete plan for the project and its structures (Law 59/1979 & Law 3/1982 provided that the Prime Minister issues the decree); 2. The decree and the accompanying memorandum must be published in the official newspapers; • A copy for the public is placed in the main offices of the concerned local Government unit. This law has specified, through Article 6, the members of the Compensation Assessment Commission. The commission is made at the Governorate level, and consisting of a delegate from the concerned Ministry's Surveying Body (as President), a delegate from the Agricultural Directorate, a delegate from the Housing and Utilities Directorate, and a delegate from the Real Estate Taxes Directorate in the Governorate. The compensation shall be estimated according to the prevailing market prices at the time of the issuance of the Decree for Expropriation.	1990
Law 577/1954	**Law 577/54**, which was later amended by Law 252/60 and Law 13/162, and establishes the provisions pertaining to the expropriation of real estate property for public benefit and	1954

Title of legislation	Summary and how this legislation applies to this project	Year
	improvement.	
Law 27/ 1956	**Law No. 27 of 1956**, which stipulates the provisions for expropriation of districts for re-planning, upgrading, and improvement, and the amended and comprehensive Law No.10 of 1990 on the expropriation of real estate for public interest. The **first article of Law No. 27 of 1956** allows for the expropriation of districts for their improvement, upgrading, re-planning, and reconstruction. Article 24 of Law 577/54 also stipulates that in case only partial expropriation of real estate property is required, and the remaining un-expropriated part will not be of benefit to the owner; the owner shall be given the right to submit a request within 30 days (beginning from the date of final disclosure of the list of the expropriated property) for the purchase of the entire area. It should be noted, that the new law has not restricted the right to request the purchase of the remaining un-expropriated portion of real estate whether it is a building or land.	1956
Egyptian Constitution that was cancelled after the 25th of January Revolution but main issues related to private ownership was included in the new constitution declaration 2011	**The Constitution Chapter Two Part One: Social and Moral components** The State shall guarantee equality of opportunity to all Egyptians and coordination between woman's duties towards her family and her work in the society, considering her equal to man in the political, social, cultural and economic spheres without detriment to the rules of Islamic jurisprudence	
	The Constitution Chapter Two: Economical components Article 29 States that ownership subject to the control of people is protected by the State, and is divided into three types: public, co-operative and private property.	1971
	The Constitution Chapter Two: Economical components Article 34 Declared that "Private ownership shall be safeguarded and may not be placed under sequestration except in the cases defined by law and in accordance with a judicial decision." Acquisition can only be exercised with respect to real property belonging to persons (individuals or corporation) or to State private property. State public property may not be expropriated; rather concerned administrative parties would agree with respect to such property either by divesting the property in question of its public characterization or by re-appropriating the said property to another public use or entity.	1971
	The Constitution Chapter Three: Public Freedoms, Rights and Duties Article 40 All citizens are equal before the law. They have equal public rights and duties without discrimination due to sex, ethnic origin, language, religion or creed.	1971
	The Constitution Chapter Three, Public Freedoms, Rights and Duties, Article 50 Specifies that no citizen shall be prohibited from residing in any place or be forced to reside in a particular place except in cases defined by law.	1971
	The Constitution Chapter Three, Public Freedoms, Rights and Duties, Article 63, Specifies that every individual shall have the right to address public authorities.	1971
Constitutional Declaration	**Constitutional Declaration Article 6**	2011

Title of legislation	**Summary and how this legislation applies to this project**	**Year**
30th of March 2011	Public ownership is inviolable, It is the duty of every citizen to protect and support it in accordance with the law, private property is inviolable and may not be placed under sequestration except in circumstances prescribed by law and by virtue of a judicial, not be expropriated except for the public benefit and against compensation in accordance with law and the right of inheritance shall be guaranteed.	
Civil code 131/1948	**Articles 802-805 recognize private ownership right**. • Article 802 states that the owner, pursuant to the Law, has the sole right of using and/or disposing his property. • Article 803 defines what is meant by land property • Article 805 states that no one may be deprived of his property except in cases prescribed by Law and would take place with an equitable compensation.	1948
Protection of communities Human Rights Laws		
Law no. 94/2003	On establishing the National Council for Human Rights (NCHR) aims to promote, ensure respect, set values, raise awareness and ensure observance of human rights At the forefront of these rights and freedoms are the right to life and security of individuals, freedom of belief and expression, the right to private property, the right to resort to courts of law, and the right to fair investigation and trial when charged with an offence. This Constitution came into force after a public referendum on 11 September 1971 and was amended on 22 May 1980 to introduce the Shoura Council and the press.	2003
Protection of Antiquities		
law 117 / 1983	Law no. 117 of the year 1983 concerning the protection of monuments is applicable. The law defines antiquities as each structure or movable object produced by different civilizations. The definition includes productions of arts, science, literature and religions from ancient age's unit 100 years ago. The definition also includes human corpses, and species from the same age, remained from ancient ages. All discovered antiquities are registered by Decrees of the Minister of Culture; this registration implies certain standards and precautions. Standards that are applicable to the project are: • It is not allowed to demolish all or parts of structures, renovate or change the structure features (Article 13) • The Minister of Culture identifies beatification zones surrounding the site. These beatification zones are considered part of the site, and it is not allowed to construct or excavate or plant trees inside these zones. (Articles 19 and 20) • Each person finds a movable antiquity, or parts of antiquity structure, should notify the nearest administrative authority within 24 hours and should keep the antiquity in its discovered status. The antiquity becomes State's property. (Article 24)	1983
Procurement law 89/1998	The Tender Law, Law 89 of 1998 (Law 89/1998), and its executive regulations, issued by the Ministry of Finance in 1998 (MoF 1367/1998), govern all procurement of goods and services. Upon its enactment, it replaced the former tender law (Law 9 of 1983) as well as the law on implementation of works (Law 147 of 1962). The law governs procurement by all administrative units, including governorates and local authorities. It is the applicable law for procurement of solid waste	1998

Title of legislation	**Summary and how this legislation applies to this project**	**Year**
	management services by governorates.	
Laws and regulations related to archaeology		
Law 117/1983	**Definition of monuments** Article 1 defines a monument as a building or movable property produced by different civilizations or by art, sciences and literature and religions from prehistoric era and during successive historical eras until a hundred years ago or historical building. Article 2 states that any building or movable property that has an historical, scientific, religious, artistic or literary value could be considered as a monument whenever the national interest of the country impose its conservation and maintenance without adherence to the time limit contained in the preceding Article no.1 Article 5 of the law states that the supreme council of antiquities is the competent authority responsible for antiquities in Egypt	1983
	Construction license Article 20 states that licenses of construction in archaeological sites or land are not permitted, and it is prohibited to make any installations or landfills or digging channels or constructing roads or agriculture land or for public benefits in the archaeological sites or land within its approved border lines Also, Article 20 states that a buffer zone around the monument or the site is defined as three kilometres in the uninhabited areas or any distance determined by the SCA to achieve environmental protection of the monument in other areas (article 20-Ch.1).The provisions of this article (20) apply on land which appears to the SCA - based on conducted studies – that there is a probable existence of monuments in the subsoil. The provisions of this article are also applied on desert and areas where quarrying work is licensed. Article 22 states that: licenses of construction in the immediate vicinity of archaeological sites within the populated areas could be delivered by the competent authority, after the approval of SCA. The competent authority must state in the license; the conditions which the SCA emphasizes to guarantee that the building does not have a negative visual impact on the monument and its direct buffer zone that protect the archaeological and historical surroundings. The SCA has to pronounce its verdict in the license demand within 60 days of the date of submission. Otherwise, the elapsing of this period is regarded as a decision of refusal. **During Construction** Article 23 states that the SCA should take the necessary steps to expropriate land that is found in or kept in place and registered according to the roles of this Law. (Article 23- Ch.1). [These roles are defined in the second chapter of the Law 117 – articles 26-30]. Article 24 states that everyone who finds by chance the part or parts of a fixed monument in its place must promptly inform the nearest administrative authority within forty-eight hours **Urban planning**	

Title of legislation	Summary and how this legislation applies to this project	Year
	Article 51 : The SCA coordinates work with the competent authorities in the planning, housing , tourism, utilities, security and governorates' councils to ensure the protection of monuments, museums and historical buildings from vibrations, traffic bottlenecks, causes of seepage and contamination, industrial risks and changing the historical and archaeological environment in order to achieve balance between the demands of urbanism and the necessities of conservation and preservation of monuments and heritage	
Law 119/2008	The unified building Law no. 119 of the year 2008 defines in its second section - which includes 12, articles in 3 chapters- the framework of urban harmony. The law created an organization called the National Organization for Urban Harmony (NOUH) which works under the authority of the Ministry of Culture. NOUH has listed many buildings (which are not protected by the Law 117 of 1983 for antiquities) to be protected by the Law no. 119 as they have special architectural, urban or historical value.	2008

2.2 National Institutional Framework

The following is a brief description of the different national authorities and institutions of relevance to this project (NAT, Ministry of Transport, EEAA, etc.).

2.2.1 Egyptian Environmental Affairs Agency and its Regional Branch Offices

The Egyptian Environmental Affairs Agency (EEAA) is the National Authority in charge of coordinating environmental management in Egypt. The law identified three main roles of EEAA;

- it has a regulatory and coordinating role in most activities, as well as an executive role restricted to the management of natural protectorates and pilot projects
- The agency is responsible for formulating the environmental management (EM) policy framework, setting the required action plans to protect the environment
- Following-up their execution in coordination with Competent Administrative Authorities (CAAs). In specific to this project, EEAA is responsible for:
- Review and approve of the environmental impact assessment studies as for new projects/expansions undertaken in the transport sector
- Follow-up on the implementation of the environmental management plan during both construction and operation phases through inspection, monitoring as well as investigation of complaints, if any.

These two roles are distributed internally in EEAA, where a dedicated department for EIA (Central Department for EIA) mandated to review the EIA and issue its opinion regarding the study. The department's role ends when it issues its decision concerning the EIA. As for the second role, EEAA has a General Department for Inspection which mandate is to undertake inspection and investigate complaints. EEAA has eight regional branch officers (RBOs) including Greater Cairo RBO. The RBOs implement in their specific regions the responsibilities of EEAA in terms of inspection, ambient monitoring and investigating complaints.

After submission of an ESIA for review, the EEAA may request revisions in the ESIA report within 30 days, including additional mitigation measures, before issuing the approval of the report. NAT will have the right to issue an appeal within 30 days from its receipt of the EEAA's decision. It should be noted that once the ESIA has been approved, the ESMP as presented in the report will be considered an integral part of the project; and NAT and ECM will be legally responsible for the implementation of that plan, depending on their involvement in construction or operation. It is therefore worth mentioning that NAT must ensure that all mitigation measures and environmental requirements described in the ESMP have been clearly referred to in the tender documents for the construction works, the construction contracts, and have been respected. NAT will follow-up on the construction contractor to ensure that the ESMP is adequately implemented in the construction phase.

2.2.2 Governorates (Environmental Management Unit at Governorate and District level)

The government is responsible for the environmental performance of all projects/facilities within the governorates premises. The governorate has established environmental management units at both the governorate and city/district level. The EMU is responsible for the protection of the environment within the governorate boundaries and thus are mandated to undertake both environmental planning and operation-oriented activities. The environmental management unit is mandated to:

- Follow-up on the environmental performance of the projects within the governorate during both construction and operations to ensure the project abides by laws and regulations as well as mitigation measures included in its EIA approval Investigate any environmental complaint filed against projects within the governorate
- The EMU are affiliated administratively to the governorate yet technically to EEAA. The EMUs submit monthly reports to EEAA with their achievements and inspection results.
- The governorate has solid waste management unit at the governorate and district level. The units are responsible for the supervision of solid waste management contracts.

2.2.3 Ministry of Transport

The Ministry of Transport's (MoT) strategic objectives are to:

- Sustain economic growth and improved productivity through reliable and efficient transport networks.
- Improve environmental performance in the transport sector.
- Strengthen transport safety and security.
- Enhance access to jobs, services and social networks.
- Encourage investment in the transportation sector.

To achieve these objectives, MoT seeks to:

- Improve the current operation and capacity of transport networks and services.
- Shape the future pattern of demand for transport, and land use planning.
- Track the environmental impacts of transport.
- Plan and manage long term investment programmes
- Regulate and license public transport services and operators.

The Ministry of Transport is the entity responsible for planning all transport projects in Egypt. In that respect, the Ministry is the Competent Administrative Authority (CAA) for all transport projects and provide the construction permits for these projects. Being the CAA, the Ministry:

- Receives EIAs from project proponents and forward them to EEAA for review
- Follow-up on the implementation of the EMP in both construction and operations phase

2.2.4 National Authority of Tunnels

The National Authority for Tunnels (NAT) is the entity responsible for planning and Construction of metro lines in Egypt. Accordingly:

- NAT is responsible for the preparation of the EIA for new transport projects and for submitting it to EEAA via the Ministry of Transport, the CAA, for review.
- NAT is responsible for ensuring that all mitigation measures and environmental requirements in the construction phase have been complied with and have been clearly referred to in the contractors contracts, and have been complied with.
- NAT follows-up on the construction contractor to ensure that the EMP is been properly implemented in the construction phase.
- The construction Contractors, appointed by NAT, should abide by the requirements and mitigation measures included in the ESMP of the EIA.

2.2.5 Egyptian Company for Metro

The Egyptian Company for Metro (ECM), which is part of the Egyptian National Railway (ENR), ECM will be also responsible for the project’s environmental performance, once the Line becomes operational. It will ensure that the mitigation measures are enforced during operation, as indicated in the EEAA approval, and action is taken in case of non-compliance. An environmental office has been set-up specifically to manage the environmental performance of the project.

The nature and path of the project will call for the coordination and cooperation of several entities, in order to acquire permits (research, construction), discuss conditions/requirements for traffic diversions and construction activities, as well as to ensure the Line does not cross other Entities of Relevance The nature and path of the project necessitates the coordination with other entities for the implementation of the project. This coordination will include permit acquisition, discussion of conditions/requirements, cooperation for detouring and construction activities as well as ensuring that the path is well away of protected areas whether military, archaeological or sensitive.

These entities include:

- Supreme Council of Antiquities (SCA) that facilitates the ESIA study and the implementation of the project itself
- Traffic Department- Ministry of Interior
- Nile Research Institute- Ministry of Irrigation and Water Resources
- General Organization for Physical Planning (GOPP)
- National Organization for Urban Harmony (NOUH)

In addition to the above mentioned list, some other entities might have influence on the project i.e. Authorities responsible for utilities (Holding Company for Potable Water and Wastewater, Electricity Holding Company, etc.)

Figure 2-1 illustrates the responsibilities of the Executive Agency and owner of the construction Cairo Metro Line 3 Phase 3 project.

2.3 International Standards and Guidelines

According to the Terms of Reference, this ESIA is based on the following international standards:

- EIB[4]
- World Bank Operational Policy 4.12 – Involuntary Resettlement

2.3.1 EIB

The EIB finances projects to achieve a number of priority EU policy objectives. In this work it is guided by a series of standards as outlined in the Statement of Environmental and Social Principles and Standards (2009). The manner in which these are applied by EIB in its daily project work is described in the Environmental and Social Practices Handbook (2010).

<u>Environmental and Social Principles and Standards</u>
As a priority, EIB funds projects that support sustainable development through the protection and improvement of the natural environment, and the promotion of sustainable communities. The objectives of the Treaty of the European Union underpin the EIB standards and its general approach, i.e. regarding “preservation of the environment, protection of human health, rational utilisation of natural resources and promotion of measures at international level”. In particular climate change, biodiversity and ecosystem considerations are integrated into the lending policies and practices of the Bank. This reflects EIB’s contribution to the UN Framework Convention on Climate Change, the UN Convention Biological Diversity (CBD) and the UN Millennium Development Goals (MDG).

To qualify for EIB funding a project should promote one or more of the following EU policy objectives:

- Provide an appropriate response to the threat of climate change
- Contribute to sustainable natural resource management
- Improve urban quality of life
- Safeguard human health by enhancing the natural and build environments

[4] For the purposes of this assignment, AFD has adopted the EIB standard.

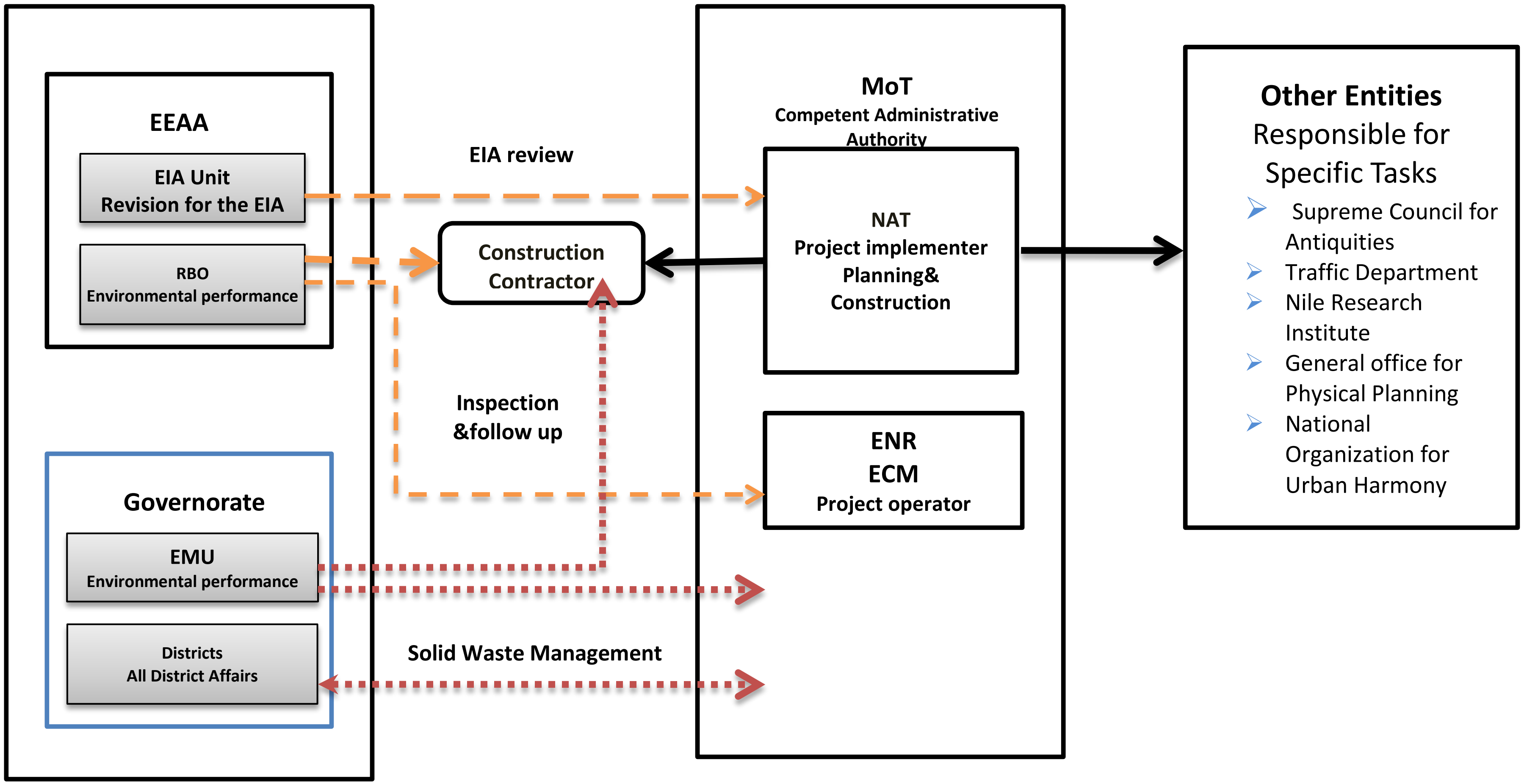

Figure 2-1: Institutional Setup and Inter-Relations flow chart (Actors- Metro line 3)

While all projects should give an overall positive contribution to sustainable development in order to be considered for funding, EIB still requires that projects comply with the environmental and social requirements of the Bank. The Bank pays particular attention to the rights of disadvantaged groups and the impacts that a project might have on people in the workplace and in the local community. The principles and standards are derived from European Union policy and law and in addition to the EU Treaty include:

- The fundamental human rights referred to in the EU Charter
- Relevant EU environmental and social legislation
- Internationally recognised good environmental and social practices from a number of sources
- A set of social standards equivalent to the common requirements of the Multilateral Financial Institutions (MFIs)

The principles and standards guide all projects financed by EIB. Within the EU, projects shall comply with EU law unless EIB considers higher standards are appropriate. In the rest of the world, the legal principles and standards of the EU are used as the benchmark, though with the possibility of derogation if deemed justifiable.

EIB does not finance projects that do not comply with appropriate national environmental and social legislation in force at the time. In the Statement, the promoter is made responsible for the application and enforcement of the EIB requirements including compliance with relevant laws and other obligations placed on the promoter by the Bank which are typically reflected in legal undertakings.

The following principles underlie EIB's approach to managing the environmental and social issues of projects:

- Integration – principle that environmental considerations be merged into all EIB work
- High level of environmental protection – principles of applying a precautionary approach, taking preventive action rather than damage control, environmental damaged to be rectified at source and the polluter should pay
- Rights based approach to considering the social aspects of a project, by following the Charter of Fundamental Rights of the European Union, and the UN Universal Declaration on Human Rights

The environmental and social performance standards ensure compliance with Bank requirements and include:

- Emission standards: projects should include measures to prevent, reduce or eliminate pollution that arises directly or indirectly from their activities
- Ambient standards: projects are required to ensure that they meet the relevant ambient standards, including national standards
- Procedural standards: e.g. projects for which the EIB requires an EIA, the process and content must be consistent with the requirements of the EU Directive
- Human rights: financing restricted to projects that respect human rights as defined by Charter of the Fundamental Rights of the European Union and international good practices

- Involuntary resettlement: people whose livelihoods are negatively affected by a project should have their livelihoods improved or at a minimum restored, and losses should be compensated for. Management of resettlement includes need for an Action Plan and culturally appropriate consultation of affected communities
- Indigenous people and other vulnerable groups: covers indigenous groups, ethnic minorities, women, migrants, the very young and the very old. The promoter should pay special attention to these groups when affected by the project
- ILO core labour standards: core labour standards are to be adhered to/reached during the project implementation
- Occupational and community health and safety: seeks to avoid and minimise risks and impacts to the health and safety of workers and communities
- Cultural heritage: respecting cultural heritage and not financing projects that threaten the integrity of sites that have a high level of protection for reasons of cultural heritage, e.g. UNESCO World Heritage sites
- Consultation, participation and public disclosure: based on the Aarhus Regulation promoting transparency of environmental information and the inclusion of stakeholders in projects through consultation in order to identify and manage public concern at an early stage. Includes provisions for the public disclosure of key project information such as the Non-Technical Summary and the ESIA.
- Biological diversity: reducing the biodiversity impacts of projects in line with core international conventions such as HELCOM, OSPAR and Ramsar.
- Climate change: seeks to reduce contributions to climate change through energy efficiency measures, clean technology and promoting projects that lead to reductions in carbon emissions.

<u>Environmental and Social Practices Handbook</u>
The Environmental and Social Practices Handbook (the Handbook) translates the environmental and social principles and standards described in the statement into the operational policies followed by EIB staff. It explains how Bank staff conducts routine work on environmental and social matters through the project cycle.

Pre-appraisal stage
- Identification of environmental and social issues
- Screening according to different loan types
- Categorisation of project according to severity of environmental and social impact
- Identification of the legal requirements for project compliances
- Assessment of the project’s climate change implications
- Sharing of environmental information for the opinion of DG Environment
- Publication on project website

Appraisal stage
- Environmental and social assessment
- Assessment of EIA process
- Assessment of biodiversity and natural resource management
- Climate change

- Appraisal of social issues including Resettlement Framework and Resettlement Action Plan
- Appraisal of the environmental and social capacity of the promoter
- Public consultation
- Disclosure of information and documents
- Final environmental and social impact rating
- Identification of monitoring requirements

Monitoring stage

- Follow-up during implementation and during operation

The Handbook also includes a range of Guidance Notes for use in the assessment of social impacts of a project covering:

1. Involuntary resettlement
2. Rights and interests of vulnerable groups
3. Labour standards
4. Occupational and community health and safety

2.3.2 World Bank Operational Policy 4.12

OP 4.12 (2001, updated 2011) has been used to guide the planned management of involuntary resettlement within the framework of the ESIA[5]. OP 4.12 seeks to address and mitigate the risk of impoverishment derived from the potential economic, social and environmental impacts of involuntary resettlement in development projects. It identifies a need for careful planning and then the implementation of appropriate measures.

OP 4.12 is based on a hierarchy of objectives:

1. Involuntary resettlement should be avoided or minimised where feasible by exploring alternative project designs
2. Where involuntary resettlement cannot be avoided, those displaced should be consulted and have the opportunity to participate in the design of resettlement programmes
3. It should be ensured that displaced persons should have their livelihoods or standards of living improved or at least restored to pre-displacement levels

It is drawn up within the general human rights framework in recognition for the protection of the ownerships and also safeguarding the interests of the poor and vulnerable groups in particular.

Its main guiding principle is that: where physical or economic displacement is unavoidable, the funding agency requires the promoter to develop an acceptable resettlement tool (this may include a Resettlement Policy Framework or a Resettlement Action Plan). The plan should incorporate and follow the right to due process, and to meaningful and culturally appropriate consultation and participation, including that of host communities.

[5] The Terms of Reference for the Resettlement TA gave the option of either using EIB or World Bank OP 4.12 to guide management of resettlement related issues. The consultant elected to work with the latter standard since it had the most experience with OP 4.12.

2.4 Comparison between National and International Standards and Guidelines

Table 2-2: Comparison of Egyptian regulations with the World Bank policies and European Investment Guidelines

Topic	**Egyptian legislative requirements**	**WB and EIB policy requirement**	**Practical Implication**
Property Valuation/compensation	The unit rates used for compensating farmers for loss of agricultural income due to the temporary acquisition of land for implementing irrigation and/or drainage works are updated in accordance with procedures described. However more frequent updates (e.g. on an annual basis) of unit rates used for valuating crop compensation amounts is proposed.	Compensation should be paid in a full market price according to the WB. The EIB declares that those people whose livelihoods are negatively affected by a project should have their livelihoods improved or at minimum restored and/or **adequately compensated for any losses incurred. As such, where physical or economic displacement is unavoidable**, the Bank requires the promoter to develop an acceptable Resettlement Action Plan. The plan should incorporate and follow the right to due process, and to meaningful and culturally appropriate consultation and participation, including that of host communities.	Both the Egyptian regulations and the World Bank Operation Policy (WBOP) 4.12 agree on the need to compensate at full cost any structure affected by a Bank financed project. According to Egyptian law the value of structures to be demolished because of a proposed action by the project is to be assessed by professional valuators, either from the Egyptian General Organization for Surveying "ESA", or from private offices certified by ESA. Similarly, OP 4.12 clearly provides methods to be used to calculate land and/or structure compensation rates, and requires evidence these rates are consistent with the policy principle of "full replacement value." **However, the evidence suggests all previous Egyptian practices of valuation have been substantially below the market full replacement value. This implementation problem emanated mainly from: (i) lack of valuation experience in ESA and (ii) absence of real market rate due to taxes and fees charged on properties.**
Temporary acquisition of land	The Egyptian law provides no compensation for temporary occupation of land	The World Bank policy suggests people affected by the project be paid compensation (i) equivalent to the net average income that would have been obtained from the land during the period of temporary acquisition and (ii)	The non-existence of Egyptian law to protect people affected by the project from temporary occupation of their land is contrary to the objective and principles of OP 4.12; and can cause implementation difficulties both for the World Bank and the Egyptian government.

Topic	Egyptian legislative requirements	WB and EIB policy requirement	Practical Implication
		restoration of the land to its original productive use or full compensation of the cost of restoration.	However for temporary acquisition of agricultural land for the implementation of irrigation and drainage works, Egyptian guidelines through the relevant Ministerial decrees include clear guidelines with regards to the application and payment of crop compensations. These crop compensations are intended to provide affected farmers with the full net value of income that would have been generated from agricultural production of the affected land. Additionally, any affected land is restored upon the implementation of irrigation and/or drainage works to its original condition as part of the contractor's obligations stipulated in the contract. In this regard, national crop compensation procedures are aligned with the World Bank's policy and will be applied in the project.
Temporary occupation of structure	In compensating temporarily occupied structure, Egyptian law requires determination of the price per room or area to arrive at the market value. The law also provides tenants with an option to acquire alternative shelter but requires them to pay the difference, if any, in price.	The World Bank's policy in involuntary resettlement requires: (i) Compensation to restore the structure to its original condition, (ii) inconvenience allowance if the temporary land acquisition produces minor difficulties and, (iii) alternative comparable accommodations, rental allowance for equivalent temporary housing, or payment for constructing temporary housing of a reasonable equivalent standard can be provided. If structures themselves are temporarily acquired, or use of the structure is precluded, compensation for moving and restoration expenses are covered.	Egypt practices suggest that people affected by projects are usually compensated below market price. This may be caused by capacity constraints both at individual and institutional staff levels of the (i) Real Estate & Authentication Offices and the (ii) Egyptian General Organization for Surveying "ESA."
Temporary loss of business	Egyptian law stipulates that	The World Bank policy recommends	The application of the provision in Egypt is far

Topic	Egyptian legislative requirements	WB and EIB policy requirement	Practical Implication
	compensation for temporary losses of business is determined by a consensus of a committee. Where people affected by a project lose their business temporarily.	that: (a) the owner of the business is paid an equivalent amount to the estimated net loss and (b) if an affected business cannot continue in its current location, the business will be provided with new premises or rental allowance for new premises and, (c) the business should be compensated for the cost of relocation, business personnel and equipment from and to the new premises.	from what is stated by Egyptian law and the World Bank's policy. In many cases compensation paid to businesses for temporary loss of income is usually below market price. This is an issue related mainly to the capabilities of the committee involved and to the institutions facilitating the process; they include representatives of (i) ESA, (ii) the local government unit within whose jurisdiction the project is located and, (iii) the treasurer of the local impacted area.
The right of squatters	Egyptian legislation does not recognize the rights of squatters. There have been resettlement cases in which the Egyptian government compensated squatters because of political sensitivity to the problem rather than because of provisions in the law or in compliance with the World Bank's policy.	The World Bank's policy requires squatters be provided with resettlement assistance when their residences are affected by projects financed by the World Bank, but no compensation for the land the squatters are occupying.	Egyptian practice in dealing with squatters' right has reflected that because of political pressure and the "social dimension", the government has been forced to provide an alternative for those groups of households either in terms of alternative shelter or cash.
Resettlement in a new site	According to Egyptian law, PAPs who are physically displaced are to be provided with replacement residential housing. However, they do not have the right to object to the location of the resettlement but only to the suitability of the housing in terms of area, design or relevant occupying issues.	Moreover, the OP 4.12 requires (i) preference is given to land-based resettlement for displaced persons whose livelihoods are land-based, (ii) affected people should be offered various options for resettlement and not only one option as stated in Egyptian law, (iii) affected people should be at least resettled in an area equivalent to the old property or site and, (iv) affected people should be supported with a soft-loan that compensates the difference in	The Egyptian legislation notion that PAPs do not have the right to object to the location of the resettlement but only the housing suitability in terms of area, design or relevant issues is contradictory to OP 4.12 paragraph 3(a) which states PAPs should be "consulted on, offered choices among, and provided with technically and economically feasible resettlement alternatives.

Topic	**Egyptian legislative requirements**	**WB and EIB policy requirement**	**Practical Implication**
		value between the old and new property. OP 4.12 states that PAPs who are physically displaced are to be provided with residential housing, or housing sites, or, as required, agricultural sites at least equivalent to the old site.	
Resettlement assistance	The Egyptian law makes no provision to provide resettlement assistance to project affected people	OP 4.12 offers support for a transition period. The OP 4.12 further requires that the cost of this assistance should be included in the overall Resettlement Action Plan (RAP).	Without equivalent practices between Egyptian law and the Bank's OP 4.12 it would be difficult to provide assistance to project affect people at their new resettlement site. It would be hard to ensure opportunities for project affected people to restore or improve their income and as well as being provided temporary income support if required.
Calculation of Compensation	According to prevailing prices in the affected area and assessed by a specialized committee for that purpose	Full replacement cost	This issue is crucial since all previous Egyptian practices of valuation have been substantially below the market rate due to: Lack of valuation experience in ESA No real market rate is defined due to taxes and fees charged on properties
Disturbance allowance	Egyptian regulations do not specify income disturbance allowances where the PAPs incurred losses of business income.	OP 4.12 requires in addition to total business income loss compensation, a disturbance allowance of 10%.	The lack of disturbance allowance provision is not in line with the OP 4.12, paragraph 12.
Asset value increased due to previous public interest project	The Egyptian law states that should the value of the expropriated property increase due to public interest work in a previous project, such increase shall not be calculated in determining the compensation value if expropriation is exercised within 5 years from the date of executing the previous public	OP 4.12 requires PAPs be "provided with prompt and effective compensation at full replacement cost for losses of assets attributable directly to the project."	The Valuation Committee should consider any rise in the prices in order to fulfil the requirement of paying compensation in a market price

Topic	Egyptian legislative requirements	WB and EIB policy requirement	Practical Implication
	interest project.		
Vulnerable groups	Egyptian regulations have not addressed how vulnerable groups affected by expropriation of property should be treated	OP 4.12 in paragraph 8 states the need to give special attention to the rights of vulnerable groups.	It is the responsibility of government and the Bank underwritten project to ensure that vulnerable people are not excluded from redress measures within the overall resettlement actions. It further demands that Bank financed and other development projects pay particular attention to vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, indigenous peoples and ethnic minorities. The PMU and Upgrading unit in each informal settlement should pay considerable attention for those groups and give them priority in selecting resettlement options and receiving financial support.
Access to timely and relevant information	Egyptian law stipulates that PAPs be provided with timely and relevant information.	This legal provision is in line with OP 4.12, which specifies that project affected persons and their communities be (i) provided with timely and relevant information, (ii) consulted on resettlement options, and (iii) offered opportunities to participate in planning, implementing and monitoring resettlement. EIB pays due attention to Public consultation and participation as it is a requirement not only of the EIA Directive but also of a number of other EU environmental laws. The EIB recognizes the added value that interested and well-informed members of the public,	Despite the harmony/equivalency between Egyptian law and OP 12 regarding the importance of relevant information sharing in timely fashion, implementation experience in Egypt suggested that PAPs: (i) have not been consulted on resettlement options and (ii) have not been able to participate in planning, implementing and monitoring resettlement. In the absence of access to information by PAPs, realizing the Egyptian law and the Bank's policy into practical and participatory fashion will be difficult. For crop compensation procedures however, the long established national procedures applicable include clear guidance for providing PAPs with timely information as presented in Sections 2.6 and 2.8 above. The implementation experience of

Topic	**Egyptian legislative requirements**	**WB and EIB policy requirement**	**Practical Implication**
		especially those people affected by a project in the host country, can bring to the project environmental assessment process. Consultation and participation of concerned stakeholders during project preparation are expected to enhance sustainability and contribute to project success. Stakeholder concerns should be considered as early as possible in the project assessment process in order to reduce risks and provide for timely resolution of conflicts. For all projects for which the EIB requires a formal EIA, the promoter should conduct a meaningful, transparent, and culturally appropriate public consultation of affected communities and provide for a timely disclosure of appropriate information in a suitable form; there should be evidence that the views expressed have been considered. For all other projects, the Bank requires promoters to engage stakeholders in meaningful dialogue, as a citizens' right and to build support for efficient and timely project implementation. Outside the EU, national law sets the minimum disclosure, consultation and participation requirements of the Bank.	these crop compensation procedures has been successful in the mobilization of farmers' participation. In order to maximize benefit from the workshops/consultations regularly conducted by EPADP and described in Section 2.4.2 above, it is proposed that the scheduling of workshops/consultations be done in coordination with the expected work plan for execution of drainage works.
Grievances & redress mechanisms	Egyptian law allows the creation of "Specialized Committees" to address grievances originating from misunderstandings of project policy, or resulting from conflicts among neighbours. The law	OP 4.12 advances a "first tier grievance management mechanism", which will be a function of the Project, to provide aggrieved people with an avenue for amicable settlement without necessarily pursuing a court case.	The absence of a first tier grievance mechanism in Egyptian law means there are difficulties to access grievance mechanisms addressing minor issues that otherwise should be resolved within a short period of time. The absence of such mechanism denies project

Topic	**Egyptian legislative requirements**	**WB and EIB policy requirement**	**Practical Implication**
	allows one month objecting to the decision of resettlement, four months seeking redress to the compensation value and three months in case of dispute between several individuals or parties on a single property. Court cases in Egypt are known to require long periods of time before settlements can be reached. With intent to address the lengthy time the Egyptian court may require to process and resolve disputes.		affected groups the direct channel for grievance and delays resolution of disputes in an appropriate time prior to resettlement. In order to avoid delay in dispute resolution, it is essential for the government to consider adopting the first tier grievance redress mechanism advanced by the Wold Bank OP 4.12. If need arises, aggrieved people would however remain free to open a Court case without having registered their grievance with this first-tier mechanism.
Rights of displaced people	Displaced persons are provided timely and relevant information. Not consulted on resettlement options Not able to participate in planning, implementing and monitoring resettlement	Appropriate and accessible grievance mechanisms to be established.	Affected groups should get access to full information about the resettlement process and options for compensation. Participatory planning and decision making should be applied in resettlement options and compensation There is a need for ensuring that affected groups are offered the direct channel for grievance and receive redress in proper time prior to resettlement. The receiving of full compensation should be prior to resettlement.
Monitoring and Evaluation	Egyptian regulations do not require any monitoring or evaluation measures.	OP 4.12 does. It embraces monitoring and evaluating the social and economic impact on the affected groups. It requires measurement of the amounts of compensation paid, time taken to ensure compensation payment, number of grievances and redress cases received	The OP 4.12 explains procedures for a monitoring and evaluation process which should be incorporated into the Egyptian law. The current activities undertaken by the DAS include post-implementation interventions that involve close interaction with farmers. The natures of these interventions however are

Topic	Egyptian legislative requirements	WB and EIB policy requirement	Practical Implication
		and addressed and objective feedback on the overall impact of the resettlement action on the affected group.	oriented towards raising farmers' awareness with the benefits of the drainage systems as well as training them on simple maintenance activities. The absence of monitoring and evaluation measures in Egyptian laws illustrates differences between the two systems. The lack of legally authorized resources can constrain accountability and governance mechanisms of Bank financed projects. The lack of equivalency between the World Bank's and Egyptian policy can negatively impact on the very idea of the consultation, decision making and disclosure principles charted in the World Bank's OP 4.12.

3 PROJECT DESCRIPTION

This project comprises the Phase 3 of the Cairo Metro Line 3. The proposed Phase 3 project[6] will lead to the construction of approximately 17 km of dual track line and 15 stations (Basic Design Horizontal and Vertical Alignment Phase 3 drawings, NAT, 1 April 2012). The Cairo Metro Line 3 was initiated in 2005 to connect Cairo International Airport in the east of the city, with Imbaba - Mohandiseen and the Doqqi/Boulaq El Dakrour/Cairo University area in the west (EQI 2012: 28).

The project description presents the details of the project and current information on the construction and operational aspects. The ESIA has been conducted in parallel with the on-going detailed design and a number of qualified assumptions have therefore been made. The organisation and size of the construction sites has not yet been clearly defined in the detailed design and therefore assessments have had to be made with respect hereto. The traffic management plans will be updated to take this into account, once the construction area parameters have been finalised.

The estimated daily boarding and passengers per hour per direction (PPHPD) for the Line 3 in 2022 were calculated by SYSTRA in the 2009 Feasibility Study and are presented in Table 3-1.

Table 3-1: Daily boarding and PPHPD of Line 3 in 2022

Year	**Line**	**Daily pax (pax/day)**	**Busiest section**	
			Location	PPHPD
2022	Line 3	1,580,000	Maspero-Zamalek	59,000
	Phase 3A	300,000	Maspero-Zamalek	59,000
	Phase 3B	416,000	Kit Kat Square – Sudan	34,400
	Phase 3C	255,000	Kit Kat Square - Tawfikia	22,700

Source: SYSTRA, Feasibility Study for Cairo Metro Line 3 Phase 3, 2009

3.1 Cairo Metro Line 3 - Phase 3

The total length of the Cairo Metro Line 3 - Phase 3 will be approximately 17 km of dual track line and will comprise 15 stations, including 8 underground stations, 5 elevated stations, and 2 at-grade stations. Approximately 9 km of the total length will be underground, 5.7 km will be elevated, 1.9 km will be at-grade, and the remaining will be transitional sections between underground and at-grade sections. The rail level at underground stations will be about -20.00m from the ground level. The operational headway or interval between trains is expected to be 2 minutes and 30 seconds for Phase 3B and 3C (SYSTRA 2011) and 1 minute and 15 seconds on Phase 3A.

The eastern extremity of Line 3 Phase 3 will connect with Line 2 and Line 3 Phase 1 at Attaba Station. West of Kit Kat square the Line 3 Phase 3 will split in two branches one veering north and west with the north western station being located at the planned Rod El Farag Corridor in El Bashteel and the other turning southward interconnecting with Line 2 at Cairo University Station.

[6] The description of the project is based on the EQI 2012 ESIA, the SYSTRA Feasibility Study for Cairo Metro Line 3 Phase 3, 2009, the SYSTRA, New Feasibility Study for Cairo Metro Line 3 Phase 3B and 3C, Vol. 1-7, November 2011, and the modifications as presented in the Basic Design Horizontal and Vertical Alignment Phase 3 drawings, NAT, 1 April 2012.

The estimated time to travel between Attaba Station (Line 3 Phase 1) and Rod El Farag Station will be an estimated 18 minutes including 3.5 minutes of waiting time at stations and the estimated time to travel between Attaba Station and Cairo University will be 16.5 minutes including 3 minutes waiting time at stations (based on SYSTRA 2011: 90ff). The Line 3 Phase 3 is divided into the three sub-phases 3A, 3B, and 3C as presented in Figure 3-1.

A total of 15 stations will be established on Line 3 Phase 3, including 8 underground stations, 5 elevated stations, and 2 at-grade stations. Where the distance between underground stations exceeds 800 meters Emergency Escape Points (EPPs) will be established for emergency evacuation and Civil Defence access from the surface to the underground tunnel level (EQI 2012: 45).

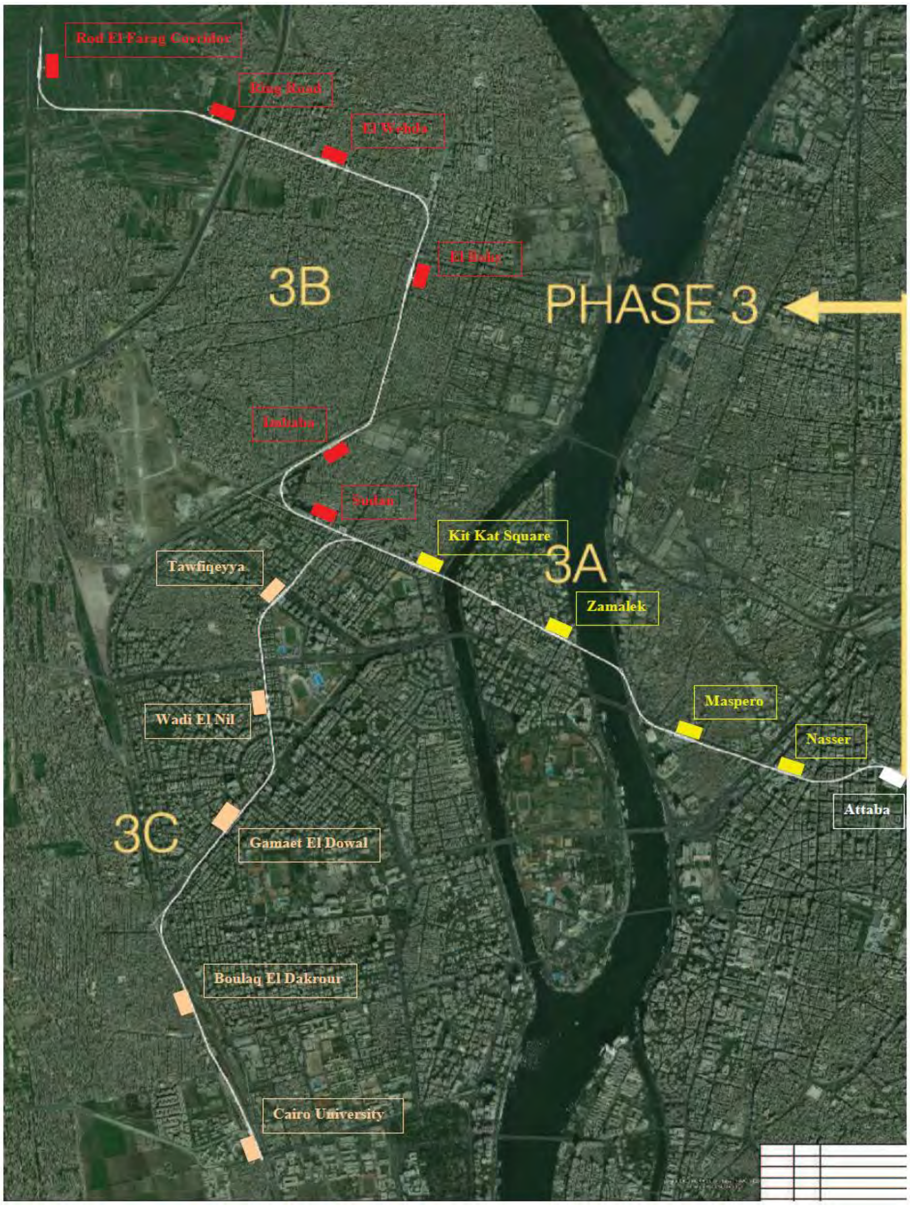

Figure 3-1: Cairo Metro Line 3 Phase 3 – proposed route.
Source: EQI 2012: 32

3.2 Cairo Metro Line 3

Cairo Metro Line 3 [..] will be an entirely new construction, totalling approximately 43.5 km in length, and serving 34 stations. Most of the Metro railway will consist of a tunnel, with shorter elevated/at-grade sections in the north-western and south-western extremity of the project area, in Imbaba and Boulaq El Dakrour. It will cross under the two branches of the River Nile that surround Zamalek, as does Line 2. Power will be fed by a third rail [..]

The underground sections of the Metro Line 3 alignment will be excavated with Tunnel Boring Machines (TBMs). The transitional sections (between underground and at-grade sections) and underground stations will be built through the cut-and-cover method, which will require the demolition of buildings lying atop the areas planned for construction. Some of the planned elevated sections and stations will also require expropriations and land acquisitions.

The 4 phases of Line 3 are:

- *Phase 1: Abbassiya – Attaba:This Phase covers a distance of approximately 4.3 km. It consists of a bored tunnel, five underground stations and a cut-and-cover tunnel section connecting the main line with at-grade light maintenance facilities at Abbasia. The bored tunnel is a single bore, twin track tunnel of 8.35 m internal diameter, lined with pre-cast concrete segments, lying at a depth ranging between 16 m to 37 m below ground level.*
  The design of Phase 1 had to take into consideration the safe crossing of two major underground structures: the Line 2 tunnel at Attaba and the wastewater spine tunnel north of Attaba. Some of the underground stations will be extensively used as commercial centres. Works underground at the Attaba station have been running since 2007 to divert water pipes, electricity grid and sewage network. Work in that station which also connects to Line 2 began in early 2009.
  Attaba station consists of five underground levels, and includes interchange facilities with the Greater Cairo Metro Line 2, which is in operation. The other four stations are of three underground levels (ticket hall, intermediate technical level and platform level), and have their own mechanical access facilities, escalators and elevators for the handicapped and elderly.

- *Phase 2: Abbassiya - Al Ahram (Heliopoli): Construction started in 2009, and due to be finished by the end of 2013. This Phase runs for a total distance of about 7.12 km. It lies entirely underground, and excavations using TBM's are currently underway. There are a total of five stations in this phase. All of them are underground and are being constructed by the cut- and- cover method. The bored tunnel is a single bore, twin track tunnel of approximate 8.35 m. nominal diameter, lined with pre-cast concrete segments, and on a depth ranging between 12m to 30m below the ground level.*

- *Phase 3: Attaba – Rod el Farag Corridor (Bashteel/Imbaba) and Cairo University: This Phase is the focus of this ESIA study and is consequently described more extensively in the following section.*

- *Phase 4: Al Ahram (Heliopolis) - Cairo International Airport: The alignment has been planned and engineering design has begun (EQI 2012: 28).*

3.3 Description of the Alignment and Stations

The Cairo Metro Line 3 Phase 3 is divided in the three sub-phases 3A, 3B, and 3C summarised in Table 3-2 below and further described in the respective sections below.

Table 3-2: Overview of Sub-Phases 3A, 3B, and 3C

	Sub-Phase 3A	**Sub-Phase 3B**	**Sub-Phase 3C**
Total length /km	4.389 km	6.771 km	6.063 km
Bored tunnel /km	3.395 km	0.573 km	3.238 km
At-grade /km	-	1.380 km	-
Viaduct /km	-	3.502 km	-
Cut and Cover Tunnel	-	0.211 km	-
Open Cut Tunnel	-	0.234 km	-
Cut and Cover, Ramp	-	-	0.384 km
Diversion Structure (cut and cover)	0.336 km	-	-
At-grade stations /No.	-	1	1
At-grade stations / km	-	0.144 km (1x144m)	0.144 km (1x144m)
Elevated stations /No. and km	-	4	1
Elevated stations / km	-	0.576 km (4x144m)	0.144 km (1x144m)
Cut and Cover stations /No. and km	4	1	3
Cut and Cover stations /km	0.658 km (1x194m + 2x150m + 1x164m)	0.150 km (1x150m)	0.450 km (3x150m)
TBM exit shaft	0.022 km	-	0.025 km

Source: Basic Design Horizontal and Vertical Alignment Phase 3 drawings, NAT, 1 April 2012

In the design stage, the following principles have been considered in the selection of at-grade, bored tunnel, and elevated sections.

At-grade:

- Opportunities provided by median strip of motor ways or empty spaces (outside urban areas or along ENR tracks)

Figure 3-2: Example Tunnel and At Grade Alignment 3C
Source SYSTRA Presentation May 2012

Bored Tunnel:

- Where construction of an independent structure from the surface is not possible (river crossing, below buildings).
- If geotechnical conditions are acceptable.

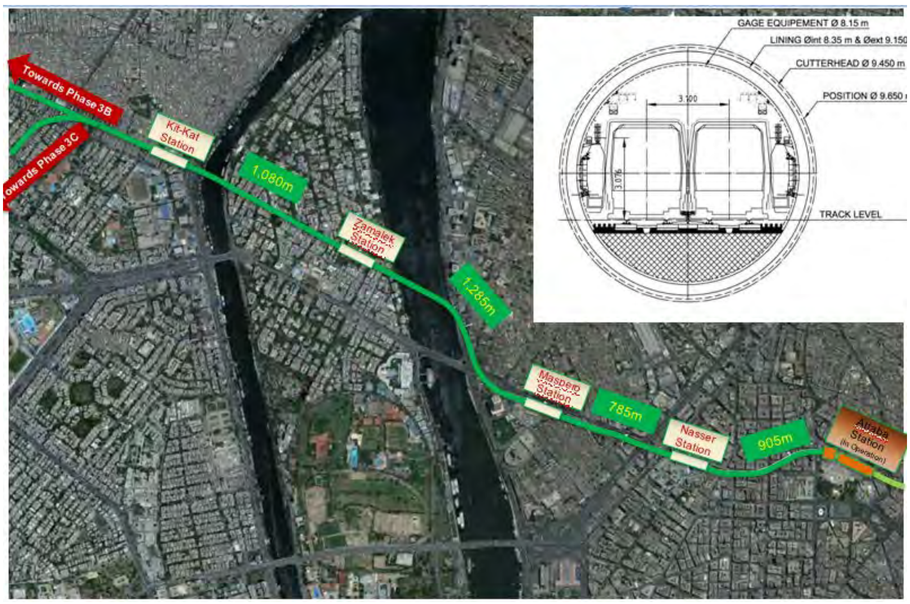

Figure 3-3: Example Tunnel Alignment 3A
Source SYSTRA Presentation May 2012

Elevated:

- Where boring is hindered by interference with public utilities in the ground
- Where cost economic reasons are applicable and the elevated part has sufficient room

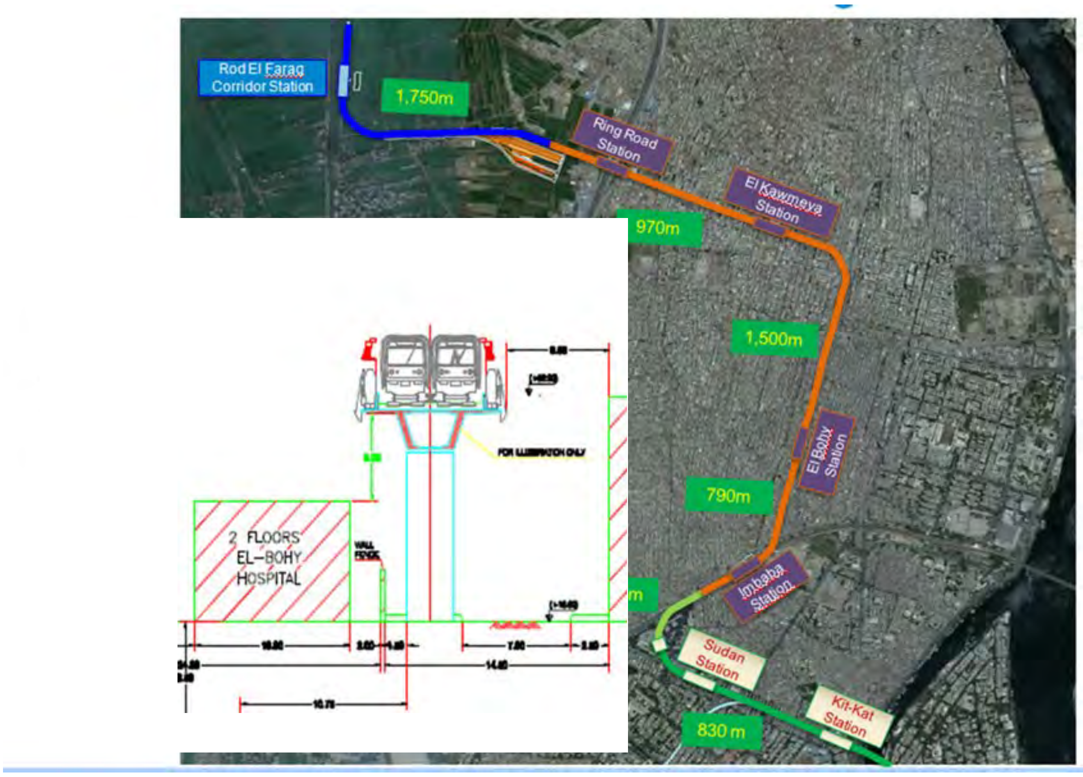

Figure 3-4: Example Elevated Alignment 3B
Source SYSTRA Presentation May 2012

3.4 Project Components Description

In the following a short description of the project components, including sub-phases 3A, 3B, and 3C, station design types, track works, stabling area, power supply and distribution, centralised operation, traction and power SCADA, and the rolling stock.

3.4.1 Description of the Sub Phases

The following figure provides an overview on the location of the viaduct, at grade and tunnelling sections.

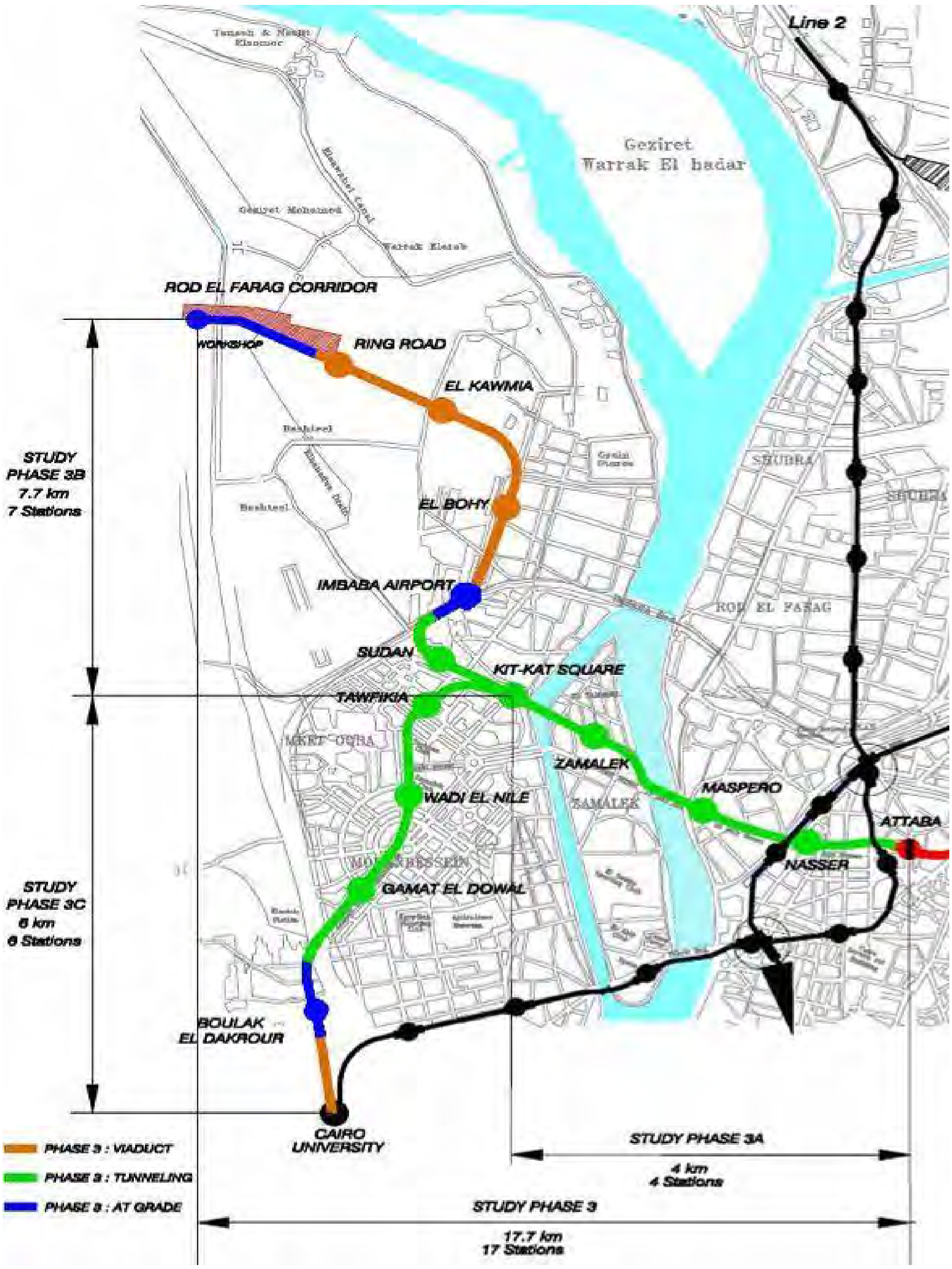

Figure 3-5: Location of Components
Source: NAT modified by EQI

Sub-phase 3A

Sub-phase 3A is nearly 4.4 km long and comprises 4 underground stations. It will consist of 3.395 km of bored tunnel, a 336 m underground diversion structure with two dual track sections, and 658 m of cut and cover underground stations.

Table 3-3: Overview of Sub-Phase 3A stations

Station	**Type**
Nasser Station	Underground station, type: Mayor Interchange Hub, – interconnection with Line 1
Maspero Station	Underground station, type: Normal
Zamalek	Underground station, type: Normal
Kit-Kat Square	Underground station, type: Intermodal Station

Source: Transport Planning Study , Systra 2009

The eastern extremity of Phase 3A begins west of the existing Attaba station. This station is already part of Line 2, but there will be an interconnection with Line 3. Within the context of Line 3, Attaba is part of Phase 1. The tunnel will thus extend westward from Attaba station to Nasser under 26th of July St. The easternmost station in Phase 3A is Nasser, near the Cairo High Court and existing Line 1 station. Line 3 will pass under Line 1 and under 6 October Bridge at the intersection with El Galaa Street, following 26th of July St north-westward towards Maspero Station, in the vicinity of the Foreign Ministry building. It will then veer northward to near Kornish El Nile, then passing under district buildings under the Nile east branch (avoiding the foundations of 15th of May Bridge) into Zamalek (EQI 2012: 28).

Zamalek Station will be located beneath Ismaïl Mohammed St., and the alignment will follow its course in a north-westerly direction under that same street. This is the only station that will be located in such a small, one-way street. The alignment will then cross under the smaller western branch of the Nile to reach Kit Kat Station in Sudan St., which separates Imbaba from Mohandiseen in this general area. From Kit-Kat Square station to the west, Line 3 splits into two branches: one veering north and west through Imbaba (Phase 3B); and the other turning southward, through Mohandiseen and Boulaq El Dakrour (Phase 3C). A diversion structure shall be constructed under Sudan St immediately west of Kit Kat Station, allowing the railway branching into two directions (EQI 2012: 28f).

Sub-phase 3B

The Sub-Phase 3B is the north-western branch of Phase 3, to the west of the diversion structure and Kit-Kat square. It is nearly 6.8 km long and comprises 1 underground-, 4 elevated-, and 1 at-grade stations. It will consist of 0.573 km of bored tunnel, a cut and cover and pen cut tunnel of 0.445 km, and at-grade section of 1.380 km, and 3.502 km of viaduct. In addition there will be 0.150 km of cut and cover underground stations, 0.576 km of elevated stations, and 0.144 km of at-grade stations.

Table 3-4: Overview of Sub-Phase 3B stations

Station	**Type**
Sudan Station	Underground station, type: Normal
Imbaba Station	Elevated station, type Normal
El Bohi Station	Elevated station, type Normal
El Kawmeya Station	Elevated station, type Normal
Ring Road Station	Elevated station, type Mayor Interchange Hub
Rod El Farag Station	At-grade station, type Mayor Interchange Hub

Source: Transport Planning Study , Systra 2009

The alignment of [the] sub-phase [3B] is divided into 3 sections running first underground, then on a viaduct, and finally at grade. The sub-phase starts [west of the diversion structure] with tracks lying underground, beneath Sudan Street, north-west from Kit-Kat Square. The alignment reaches Sudan Station near the Giza High Court, before turning north and east with the [Cairo – Aswan] Egyptian National Railway (ENR) tracks that border Sudan Street. Passing beneath the ENR, the Metro line will emerge [and rise on a ramp] to the [elevated] Imbaba Station, in the vicinity of Matar St (EQI 2012: 29).

Imbaba Station [is elevated and will be built] on the ENR right of way, after carrying out the necessary diversion of ENR tracks. After Imbaba Station, the line will rise [further] on [the] viaduct along the ENR, and turn northward over Matar St. into El Bohy St. The viaduct will then take a more northerly course through El Bohy St. The viaduct will be built over El Bohy's extensive central reservation, as will be El Bohy Station (EQI 2012: 29).

After El Bohy Station the viaduct will veer to the east and be constructed over the north going traffic lane of El Bohy Street adjacent to the central reservation. Before the roundabout at the northern end of El Bohy Street the viaduct will veer north-west along El Kawmeya El Arabya Street where El Kawmeya Station will be located. On the western edge of Imbaba and at the western end of El Kawmeya El Arabya Street, the viaduct will cross over the Ring Road.

The elevated Ring Road Station will be built over the Ring Road. After the Ring Road station the line will descend to at-grade and go west through agricultural land before turning north till it intersects with the future Rod El Farag highway where the Rod El Farag Station will be located (NAT Basic Design, 2012).

<u>Sub-phase 3C</u>

This sub-phase 3C branches out south-westward from the diversion structure and Kit-Kat Square, at the western extremity of Phase 3A. It includes 3 underground stations, 1 at-grade, and 1 elevated stations over nearly 6.1 km, including 3.2 km of bored tunnel, 200 m at-grade, 400 m of cut-and-cover transition zone, 450 m of cut and cover underground stations, 144 m at-grade station, 144 m elevated station, and 1.5 km of viaduct.

Table 3-5: Overview of Sub-Phase 3C stations

Station	Type
Tawfikia Station	Underground station, type: Intermodal Station
Wadi El Nil Station	Underground station, type: Normal
Gamaet El Dowal Station	Underground station, type: Intermodal Station
Boulaq El Dakrour Station	At-grade station, type: Normal
Cairo University	Elevated station, type: Mayor Interchange Hub – Interconnection with Line 2

Source: Transport Planning Study , Systra 2009

The metro railway alignment for [the sub-phase 3C] will start underground from the diversion structure west of Kit Kat Station, very briefly following Sudan Street, before veering south-west under some buildings into Galal El Deen El Hamzawy St. and up to Tawfiqeya station, at the crossing between Ahmed Oraby St. and Wadi El Nil St. The alignment will then follow a southerly course beneath Wadi El Nile St. with a station south of the tunnel crossing beneath 26th of July Corridor.
The station will be built in the middle of the road, close to the crossing with Shehab St. The line will continue south towards Mostafa Mahmoud Square and Gamaet El Dowal Al Arabeya Street.
Upon reaching Mostafa Mahmoud square, the alignment will follow Gamaet El Dowal St. until Sudan St. Gamaet El Dowal station will be located at the Gamaet El Dowal/Shehab St. crossing.
The railway will emerge in Boulaq El Dakrour, after having crossed beneath the ENR for Upper Egypt and Sudan St. Boulaq station will be at-grade, but the [..] alignment will then rise immediately after the station, running parallel to the ENR track and east [of] El Zomor Canal S., passing over Tharwat Bridge, Saft El Laban Bridge, and the existing Line 2 station of Cairo University. The Line 3 Cairo University Station will be located to the south of the Line 2 station. Connection between the two lines will be established (EQI 2012: 30).

3.4.2 Station Design Types

Underground Stations (Kit Kat, Sudan, Tawfiqeyya, Wadi El Nil, Gamaet El Dowal)
The underground stations will have three Levels, with a rail level of about -20.00m from the ground level. This rail level must be deep enough to ensure soil stability above the bored tunnel. The first underground level is the ticket hall level. The second underground level is the technical level, which accommodates the majority of the equipment. The Third underground level is the platform level. The size of the station box is 21x150 m [equal to] 3,150 m² (EQI 2012: 44).

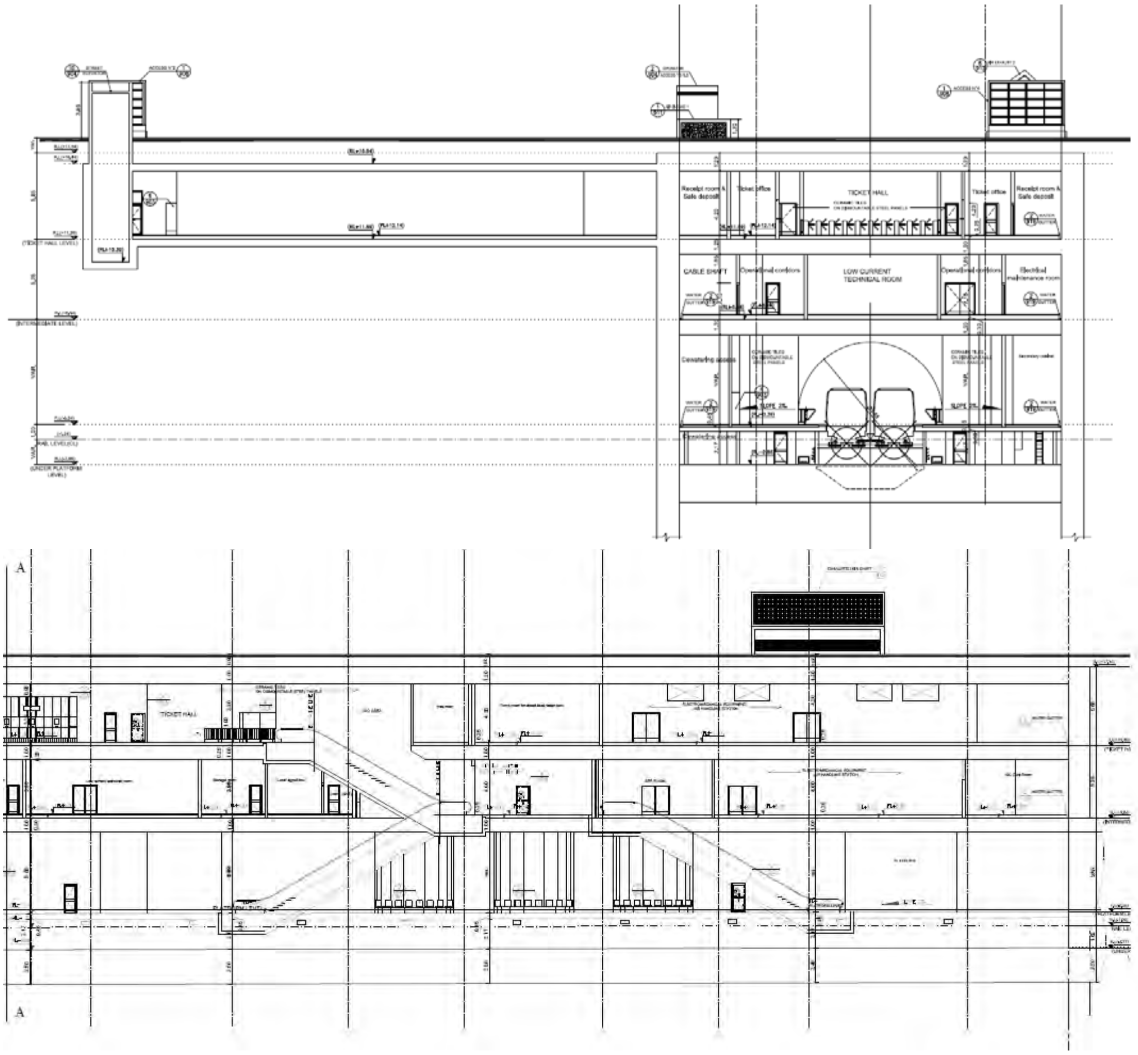

Figure 3-6: Typical underground station, cross section and longitudinal section (Gamat El Dowal)
Source: SYSTRA, Drawings provided May 2012

Elevated Station Type 1

The elevated station Type 1 is a three levels station with a rail level at about 9.00m above ground level. The first level is the ticket hall level which is at grade. The second higher level is the intermediate which distributes the passengers from ticket hall level to platform level. The highest third level is the platform level. The platform is 144m long and the station building about 100 m long and 18.5 m wide (EQI 2012: 44).

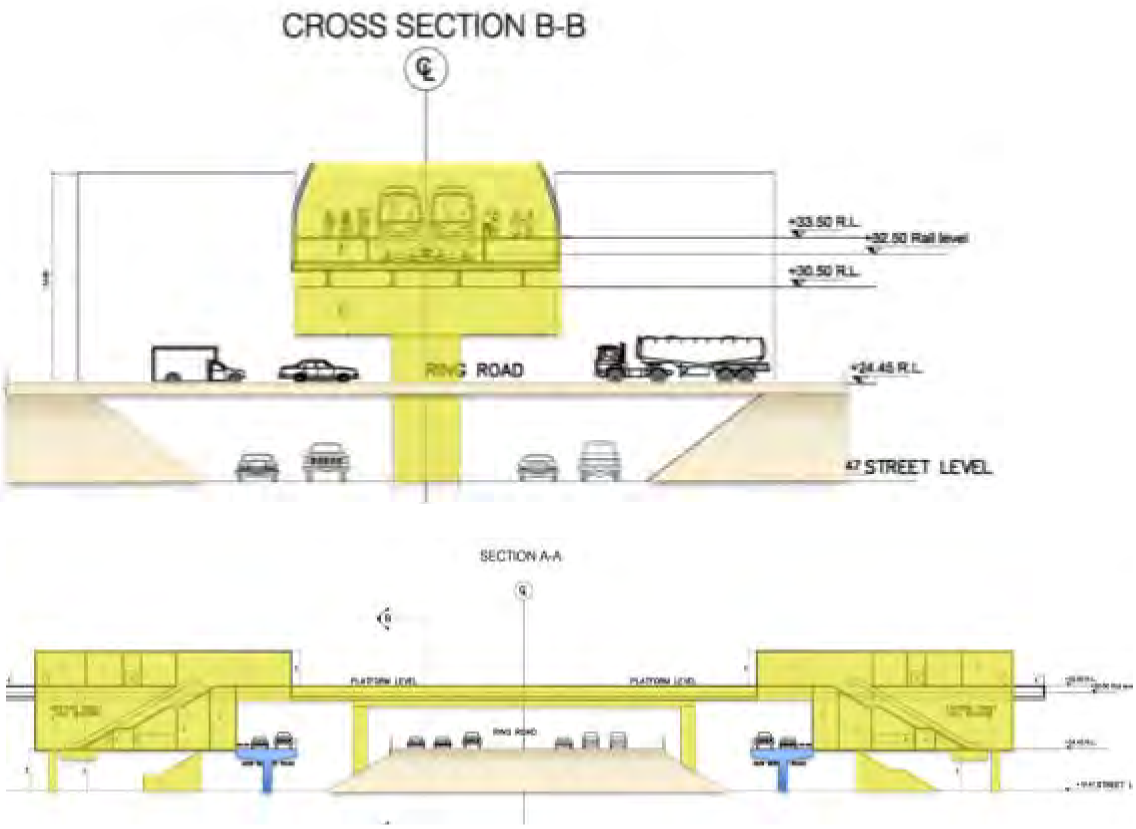

Figure 3-7: Elevated station, type 1, cross section and longitudinal sections (Ring Road)
Source: SYSTRA, Drawings provided May 2012

*Elevated Station Type 2 (El Bohy Station and El Kawmeya Station, Cairo University)
The elevated station Type 2 is two levels station with rail level of about 15.00 m above ground level. The first level is the ticket hall level which is at about 7.00 m above ground. The second level is the Platform level which is above the ticket hall level. These stations are also 144 m long and 18.5 m wide (EQI 2012: 45).*

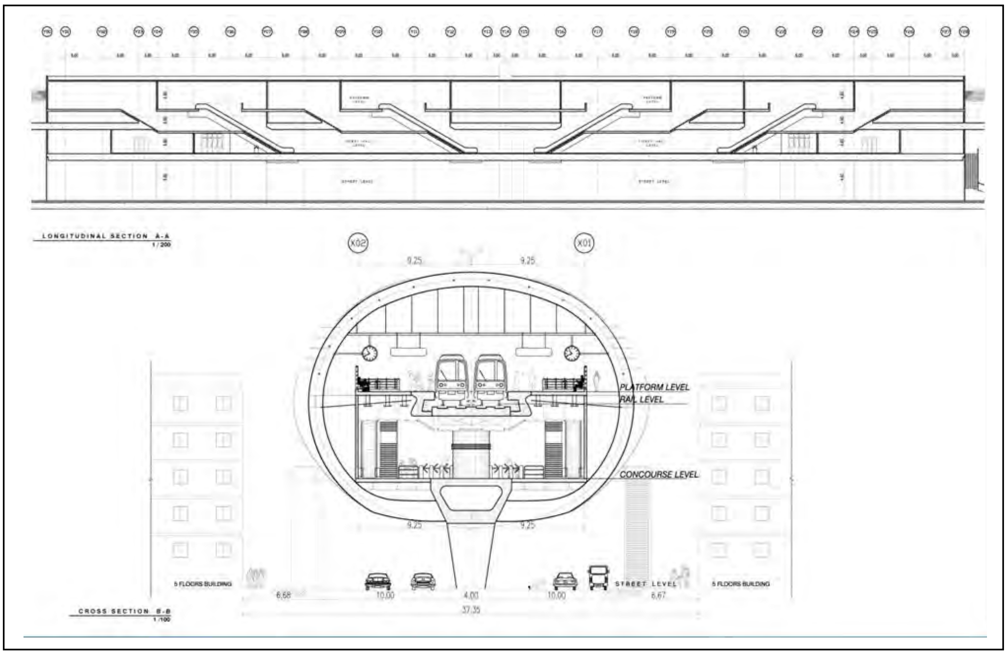

Figure 3-8: Elevated station, type 2, cross section and longitudinal section (El Bohi)
Source: SYSTRA, Drawings provided May 2012

At-grade station (Rod El Farag, and Boulaq El Dakrour)
At-grade stations are two levels stations with rail level almost at ground level. The first level is the Platform level. The second level is the ticket hall level which is at about 7 m above rail level. The platform is 144 m long and the station building about 90 m long, and 18.5 m wide (EQI 2012: 45).

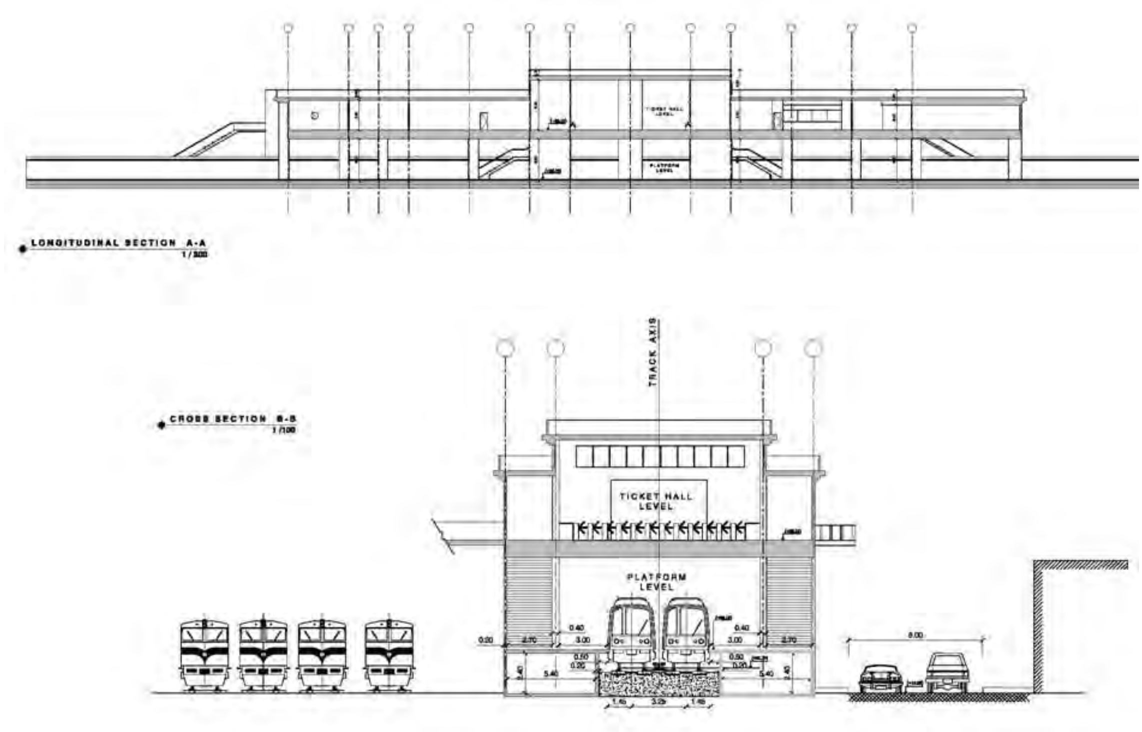

Figure 3-9: Typical at-grade station, cross section and longitudinal section (Boulaq El Dakrour)
Source: SYSTRA, Drawings provided May 2012

3.4.3 Track Works

The design of the railway tracks will include:

- *Conventional ballasted track on the parts of line that at grade and the transitional sections, including the laying of the third rail.*
- *Unballasted track inside the tunnels, with suitable turnouts and crossovers where required, and laying of the third rail.*
- *Suitable type of track of unballasted track on viaduct section*
- *Track elements will comprise concrete sleepers, wooden sleepers, fastenings, third rail for traction current including insulated supporting brackets, complete turnouts and crossovers, necessary equipment, and thermic welding charges together with the necessary ballast and concrete wherever needed (EQI 2012: 45)*

3.4.4 Annex Structures

Various annex structures necessary for the operation of Line 3 will have to be installed along its alignment. Among these are structures for ventilation/cooling, dewatering power supply, telecommunications, and signalling. The line is to be provided with a smoke exhaust system and a ventilation system consisting of air conditioning in stations and ventilation in the tunnel. They also ensure the connection between the tunnel dewatering station and the surface.

In case the inter station length exceeds 800 m the annex structures will be furnished with EEP "Emergency Escape Point" required for the emergency evacuation and the Civil Defence access from the surface to the underground tunnel level.

For sub-phase 3A, two annex structures are foreseen: between Maspero Station and Zamalek Station, and in Zamalek.

For sub-phase 3B, only one annex structure is foreseen, between Sudan Station and the exit TBM shaft. The latter will replace the annexed structure and all the functions of the concerned structure (Tunnel ventilation as well as maintenance access) will be in integrated in the TBM exit shaft.

For sub-phase 3C, two types of annex structures will be implemented: Type 1, which allows for ventilation and dewatering only; and Type 2, which all ventilation, dewater and Civil Defence access. Thus, in addition to the TBM exit/entry shaft, three annex structures are foreseen to be implemented: one type 1 and two type 2. These permanent installations will cover approximately 600 m² along the 3 sub-phases of Line 3 – Phase 3 (EQI 2012: 45).

3.4.5 Stabling Area

A maintenance workshop was initially planned in Rod El Farag Station but has been transferred to a desert area in Phase 4, near Cairo Airport, to preserve agricultural land west of Imbaba. This maintenance workshop will include all necessary facilities for the cleaning, storage and heavy repairs of the rolling stock, but is not part of this study. Instead of this maintenance workshop, there will be a side-tracking, shunting area, and a train depot in the agricultural area in the vicinity of Rod El Farag Station. This will cover about 25 – 30 feddan (EQI 2012: 45).

3.4.6 Power Supply and Distribution

The power supply and distribution will be a 20kV supply, distributed to the system via a number of 20kV AC / 750 V DC rectifier stations integrated within the underground stations. The power supply will be provided through a 220kV/20kV High Voltage station, which is constructed in Rod El Farg. The traction current at 750V DC rated voltage will be distributed via a third rail. Close to each station, an area of around 50 m² for the implementation of a generator room should be envisaged (EQI 2012: 45f).

3.4.7 Centralized Operation, Traction Control and Power SCADA Systems

The centralized operation, traction control and power scada systems have already been erected, and will be operated from control offices located in Attaba station. The signalling system will be a modern design with 2 or 3 aspect signals and track circuited and will be capable of supporting a number of driving modes. The signalling & driving modes systems will be compatible and interfaced with the systems installed for phases 1 & 2.

The telecommunications network for the line will consist of an automatic and direct telephone network (electronic PABX with stored programme control), a radio telephone network, a station public address, a closed circuit TV network and a time distribution system (EQI 2012: 46).

Line 3 will be equipped with signalling and driving modes, centralized control telecommunications, such as:

- Signalling Systems: one for normal operation of the Metro with display of information in the driving cab for spacing zones and another one for an integrated shunting signalling system.
- A Centralized Control system for controlling and monitoring of the traffic, traction power supply of the line.
- A comprehensive and integrated telecommunications system comprising a data transmission system, a radio-communication system, a telephone system, a closed circuit TV system, a time distribution system, a station public address system, a fire detection system, a dynamic display system and, a recording system and VPS intercom (EQI 2012: 46).

3.4.8 Rolling Stock

The rolling stock will consist of motor coaches and trailer cars, both with or without driving cabs, assembled into trains of eight cars. [..] The [total] rolling stock fleet of the Greater Cairo Metro Line N° 3 will consist of 36 trains, each comprised of 8 cars, with a 750 V DC power supply system (EQI 2012: 46).

The rolling stock type for the Greater Cairo Metro Line 3, supplied with a 750 VDC power supply system, will have the following characteristics:

- Length: around 140m
- Width: 2.69 m
- Number of cars: 8
- Capacity: 1752 passengers (7 passengers per m²)
- Trains shall be air-conditioned
- Power collection: Shoe collector, bottom type (SYSTRA Feasibility Study Report 2009: 96)

3.5 Project Implementation Programme

The duration of the works for Phase 3 is estimated to be 84 months (7 years) (EQI 2012: 47).

The construction of Phase 3 is placed within the overall framework of the implementation of the Cairo metro Line 3, which consists of four phases in total. The strategy for implementation of Line 3 follows a faced approach as presented in the figure below.[7]

[7] The presented strategy of implementation of Line 3 considers the changes presented by NAT (Systra-NAT meeting – SYS-NAT-53M-0908-051-ACH).

Figure 3-10: Implementation Strategy
Source: SYSTRA, GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, FEASIBILITY STUDY REPORT, Update according to NAT comments on 20.12.2009, 06.01 14.01 and 17.01.2010

With this strategy of implementation, the Line 3 could be partially operated on different phases:

"3A – 1 – 2 – 4A" from Kit Kat to Alf Maskan.
In this phase, operation of sub-phase 3A commences.

"3B - 3A – 1 – 2 – 4A" from Imbaba to Alf Maskan.
In this phase, operation of sub-phase 3B commences. The consultant carried out traffic forecasts for this partial opening in 2022.

- "3C - 3B - 3A – 1 – 2 – 4A" from Cairo University/Imbaba to Alf Maskan.
In this phase, operation of sub-phase 3C commences. The consultant carried out traffic forecasts for this partial opening in 2022.

3.6 Preconstruction Activities

3.6.1 Utilities Diversion

Preconstruction activities include:

- *Rerouting all services ducts such as potable water and sewerage networks, electric cables, telephone lines and gas pipes which coincide with the Metro structure.*
- *Removing structures and buildings which obstruct the Metro Structure if necessary.*
- *Traffic diversion planning must provide sufficient alternatives [..] to ensure as much vehicular movement as possible within vicinity of the construction sites.*

This stage involves obtaining accurate maps of the passenger and ventilation station areas to collect sufficient information on the routes and depth of existing underground infrastructure from different authorities (water lines, sewage lines, electric cables, telecommunication lines and gas lines). In cases were no accurate mapping is available for underground structures, trial pits shall be manually excavated to locate underground pipes.

It is anticipated that majority of the necessary diversions of public utilities will be completed or in progress by local contractors before the commencement of the main works contracts, but some of the diversions may remain to be carried out as a part of the contract (EQI 2012: 38).

3.6.2 Preparation of Construction Sites

Construction sites will be enclosed with a fence. The construction area will be cleared of all superstructures or plantations. After utility diversion, the soil of the station area is injected with a soft gel to decrease its permeability to a k factor of 1x10-6. This will ensure excavation of almost dry soil.

The neighbouring structures are assessed and rated according to their structural integrity pre-construction. These structures are monitored for structural integrity and settlement during all construction phases. Monitoring is done 30m at either side of the tunnel and 50m around the stations boundaries. The contractor normally occupies a location for storing materials and equipment which is to be approved by the local authority. This space will be used to include excavation and construction machinery, raw material, generated waste and management caravan for the site engineers and staff. There will be no workers camp in this case as the project is located in Greater Cairo and the workers are expected to be from the city (EQI 2012: 39).

3.7 Construction Activities

The underground sections of the Metro Line 3 alignment will be excavated with Tunnel Boring Machines (TBMs). The transitional sections (between underground and at-grade sections) and underground stations will be built through the cut-and-cover method, which will require the demolition of buildings lying atop the areas planned for construction (EQI 2012: 28).

These construction methods are further outlined below:

<u>TBM (Tunnel Boring Machine) method:</u> this will avoid some of the superficial constraints, and ensure minimal disturbances to the structures above. The use of pressurized faces (either Earth Pressure Balance - EPB or slurry shields) will reduce to a minimum the settlement trough observed on the surface (i.e. the shape of the ground surface after the settlement has taken place. The settlement created by tunnelling generally dips along the centre of the tunnel axis).

<u>Cut and cover method:</u> will be used for [..] underground stations, the diversion structure and transitional areas, where the use of TBMs is precluded, or when this technique is advantageous from a schedule/cost point of view.

Viaduct: Approximately [5.7] Km of viaduct [will be constructed]. The part of the route between Boulaq El-Dakrour station and Cairo University station shall be executed at high elevation from the ground level and passing over Tharwat and Saft bridges (EQI 2012: 40).

3.7.1 Tunnelling

Bored tunnel in urban areas have been developed during the last 30 years. Boring tunnels with TBMs is now the most commonly used method in soft soil for tunnels longer than 1000 m, especially under the water table. The method consists of carrying out the following tasks:

- *Excavating*
- *Ensuring stability of the front by means of a fluid*
- *Ensuring evacuation of the muck*
- *Laying the permanent lining*
- *Grouting the cavity void*

Two main types of TBMs exist: the Slurry Shield type and EPB type. Each has the following characteristics:

Slurry Shield
- *Suitable for sandy soil*
- *Not suitable for clayey (problem of desanding)*
- *Rate of progress limited by the desanding plant capacity*
- *Good control of settlement*
- *Important plant for desanding,*

EPB
- *Suitable for clayey soils*
- *Not suitable for sandy soil with few fine particles*
- *Good rate of progress*
- *Control of settlement not as good as slurry*
- *Installation less important*

TBMs typically consisting of one or two shields (large metal cylinders) and trailing support mechanisms. At the front end of the shield is a rotating cutting wheel. Behind the cutting wheel is a chamber where the excavated soil is mixed with slurry. Behind the chamber there is a set of hydraulic jacks supported by the finished part of the tunnel which push the TBM forward. The rear section of the TBM is braced against the tunnel walls and used to push the TBM head forward. At maximum extension the TBM head is then braced against the tunnel walls and the TBM rear is dragged forward.

Behind the shield, inside the finished part of the tunnel, several support mechanisms which are part of the TBM are located: dirt removal, slurry pipelines if applicable, control rooms, and rails for transport of the precast segments. The cutting wheel will typically rotate at 1 to 10 rpm (depending on size and stratum), cutting rocks into chips or excavating soil (muck). The muck will be mixed with bentonite slurry and pumped back to the tunnel entrance. The tunnel will be cased with precast concrete sections that are jacked into place as the TBM moves forward (EQI 2012: 40f).

Mud treatment units

A soil treatment station separates the soil bentonite mixture resulting from tunnel boring operations. The [soil treatment] station should always be located behind the stations as the TBM machine pushes back the resulting mud/soil for treatment. The treatment facility separates the excavated soil from the bentonite by a series of physical processes. The soil first enters a rotary screen which separates soil size 7 mm. The fine soil is then transferred by belt conveyors to desanding units which separate the soil of 70 µm size using a series of cyclones. The very fine soil consists mainly of bentonite which will be recycled back to the TBM machine after going through material testing and mixing with fresh bentonite and water if needed to maintain its material properties. The waste soil is then trucked (at night) to a designated disposal site. The wasted bentonite should also be disposed in a separate designated cell.

Water for the soil treatment facility will be supplied through the main local network and electricity will be generated by on-site generators. Other components of the soil treatment facility are operation room, laboratory, office and worker toilets (EQI 2012: 41).

Figure 3-11: TBM arriving at station and crossing a station

Source: SYSTRA, Feasibility Study for Cairo Metro Line 3 Phase 3, 2009

3.7.2 Construction of Cut and Cover Tunnel Section

This method consists in excavating a tunnel from surface under the protection of a screen made of soldier piles, bored piles or diaphragm walls. The choice of the protection structure depends mainly on the level of the water table with respect to the level of the excavation bottom. The width of the area cut during excavation is expected to be in the range of 12-30 m (from the plan view) depending on the local conditions, and the depth of the retaining walls will be determined to satisfy the criteria for vertical and lateral stability as well as stability during excavation (expected to be in the range of 10-15 m). If sheet-piling methodology is applied, the area cut will be minimized, possibly to 10 m. The final structure will be an underground single-tunnel with twin track. Cut and cover operations will be necessary for the transition zones where the trains emerge at-grade from the underground sections. These transition zones, which occur in sub-phases 3B and 3C, total about [800 m] of track (EQI 2012: 41f).

3.7.3 Construction of Cut and Cover Underground Stations

Open cut stations are the most widely used, because of the simplicity of the works involved, the construction speed and the low level of risk. The speed of execution allows for the quick restoration of traffic circulation at ground level. The basic procedure starts with the establishment of a watertight outer wall surrounding the station box. Next, the actual construction pit is excavated within the reinforcements. This ensures that the construction work occurs in a stable, dry pit that is impervious to water penetration. Soil injection is used to form a low permeability plug, 7 m in thickness, at the base of the walls.

Construction follows the following phases:

- *Vertical retaining diaphragm walls along the perimeter of the excavation are constructed from the surface,*
- *An excavation is initially carried out up to the level of the roof slab of the structure. Depending on the excavation depth, a light retaining of the slopes may be needed,*
- *The roof slab on the excavation bottom is concreted. The slab is connected with the perimeter retaining and it is supported on it,*
- *Backfilling works are carried out over the slab and the surface of the soil is reinstated,*
- *The excavation works for the station or the tunnel commence underneath the roof slab by means of the ramp which has been left at a certain point. The excavation is executed in phases, while the required retaining elements (e.g. anchors, struts) are installed gradually.*
- *Upon completion of the excavation of the entire trench, works related to the construction of permanent bearing structure elements commence. These elements usually consist in the raft (foundation slab) and the lateral walls, while in case of a station it is also the construction of intermediate floor slabs. In case diaphragm walls are used as a lateral retaining means, other permanent walls are not constructed, since the same diaphragm wall act as a final perimeter structure.*

Diaphragm Walls are used to support the sides of the excavation during the phases of construction and become part of the structure by being joined to the raft and roof , thus forming the cross-section of the tunnel and stations. Precast walls are usually used in the tunnel section and cast in-situ walls are used in the stations. Trenching for the walls is done using cement/bentonite slurry for the precast walls and bentonite slurry for the cast in-situ walls. A grouted plug is used between the diaphragm walls at their toes. The grout consists of cement/bentonite followed by soft silica gel. The function of the plug is to reduce the permeability of the soil to permit dewatering of the excavation with limited discharge and without affecting the level of the groundwater outside the walls to ensure the stability of the adjacent buildings.

Other related activities include:

- *Construction of a high pressure station and testing transformers building*
- *Construction of washing station equipped with the necessary sets to wash the movable units*
- *Construction of electric powers stations distributed equally along the tunnel to provide the electrical power necessary for operation.*
- *Construction of cooling stations to control the temperature inside the tunnel*

The stations should be located under public spaces such as roads. In order to minimize the impact on road traffic, the cut and cover method for the station construction with the road decks is applied in principle. Besides, the station would be constructed by the top-down method so that the concrete slab is cast from top to bottom so as to minimize the construction area and mitigate ground deformation (EQI 2012: 42f).

Figure 3-12: Cairo Line 3 Top Down Technique
Source: SYSTRA, Feasibility Study for Cairo Metro Line 3 Phase 3, 2009

3.7.4 Diversion Structure West of Kit Kat Square

West of Kit Kat station [..] the Imbaba main branch [the sub-phase 3B] and [the sub-phase 3C] the Mohandiseen branch [connect with sub-phase 3A]. Given the amount of traffic foreseen to be carried by these two branches, it is not possible from a train operation point of view to have the branch tracks crossing each other at the same level. The increased headway resulting from such track crossing would make it impossible for the line capacity to meet the customers forecast. The line after the station is extended under Sudan Street in cut and cover where it is branched in 4 tracks, 2 tracks to Mohandiseen (3C) branch and 2 tracks to Imbaba (3B) branch. The branching is done using 1/14 Tg track connections to allow the required speed on the line at the zone of branching.

The tracks for Mohandiseen [the sub-phase 3C] start to descend, while the tracks for Imbaba [the sub-phase 3B] climb upwards until the difference in rail levels allows the free intersection of both lines. This will lead to the construction of a special crossover structure of an exceptional length of around 800 m. The diversion structure will be constructed with diaphragm walls and cut and cover methods. Its length is anticipated to be around 500 m (more than 3 stations in length), with a wider section than one single station. It is a major structure, therefore its construction programme will lie on the critical path, as it is intended to be a stop point of the TBM arriving from Zamalek, and starting point, later on, for the construction of the line continuing on the southern section (EQI 2012: 43).

Figure 3-13: Diversion Structure in Sudan Street West of Kit Kat Square
Source: SYSTRA, Feasibility Study for Cairo Metro Line 3 Phase 3, 2009

3.7.5 Viaducts

Sub-phases 3B and 3C will both have significant elevated alignment sections, covering a combined total distance of [5.7] km. Since the top soil layers are soft in the project area, reinforced concrete piles will be used (bearing piles/friction piles). These piles will be cast in place. Pile caps are then installed over them as a foundation for the viaduct reinforced concrete columns, which are constructed before final placement of the superstructure. The superstructure will mainly be made as concrete box sections; there will be erected steel sections in locations crossing over railways (EQI 2012: 44).

3.7.6 At-grade and Elevated Stations

Ground level or elevated stations are built like any other building and do not necessitate any specific construction method, as underground stations do (EQI 2012: 44).

3.8 Operational Characteristics

The basic objectives of the Greater Cairo Metro project are to serve communities under the best possible conditions and at the lowest cost. The public transport systems must simultaneously be safe, comfortable, time-efficient and reliable (EQI 2012: 47).

3.8.1 Phase 3 Capacity and Characteristics

The maximum line capacity is defined as the number of passengers per hour per direction (pphpd) that can be carried out past any point on the system in the peak period in fully loaded trains (at 7 passengers/m²). The ultimate Line capacity of the Metro Line 3 will be around 60,000 pphpd.

Operational headway
The system, in its final configuration, will be designed to achieve an operational headway of 1 min 45 sec.

Dwell time
The dwell time, which is the duration from the stopping time of a train at a station (confirmed by Automatic Train Protection subsystem) until its departure from the same station, will be kept at a minimum of 25 seconds. The maximum dwell time at station will be determined, according to the headway on the line and the signalling system's possibilities.

Acceleration and deceleration
The acceleration and deceleration characteristics of the rolling stock help to determine the best possible run times. The braking capabilities of a rolling stock running on rails is limited only by the available wheel/rail adhesion rate and the tolerance of riders (especially standing passengers) as far as high deceleration rates are concerned. Passenger discomfort can also result from high acceleration rates especially, high jerk rates (i.e. rapid changes in the acceleration or deceleration rate).

The maximum acceleration rate will be 0.9 m/s² at start-up, while the operating braking rate will be 0.65 m/s².

Speed and trip duration
Speed is an important factor to attract passengers from other transportation modes. Increasing the maximum speed of vehicles will increase the commercial speed by only a small amount. More decisive factors determine the commercial speed of a system, i.e. the number of curves along the line, the amount of manoeuvres required within terminals, and other physical factors affecting train operation. Therefore, rail line constraints and restrictions will be avoided wherever possible during the system design, careful attention to these types of considerations will minimize point-to-point run times and will increase the attractiveness of the service.

The maximum authorised line speed is 80 km/h, which determines the horizontal alignment. The line speed is subjected to restrictions on curves.

Considering the above characteristics the expected commercial speeds for phase 3 [are presented in …] (EQI 2012: 47f).

Table 3-6: Line 3 Commercial Speed

		Length	Running time	Commercial speed
Phase 3	Al Ahram to Rod El Farag	21,618.960 m	2,129.3 s	36.55 km/h
	Rod El Farag to Al Ahram	21,618.960 m	2,120.3 s	36.71 km/h
	Al Ahram to Cairo University	20,861.773 m	2,022.9 s	37.13 km/h
	Cairo university to Al Ahram	20,861.773 m	1,997.3 s	37.60 km/h

Source: SYSTRA, New Feasibility Study for Cairo Metro Line 3 Phase 3B and 3C, Vol. 3 2011

3.8.2 Operating Strategy

Operating mode
The normal and degraded operating mode for the Greater Cairo Metro Line N° 3 phases 1 and 2 will be maintained for the Phase 3. The trains will operate on separate tracks, and will always stop at all the stations. The running direction driving side will be the left. At the terminal station, the trains shall crossover to the other track for the reverse run in the shunting area, the trains being double-ended, this manoeuvre will be done via the classic system of crossover between two tracks (EQI 2012: 48).

Peak hour load diagram
SYSTRA has on the basis of traffic studies conducted for Line 3 Phase 3 forecasted the following peak hour load data presented in Figure 3-15.

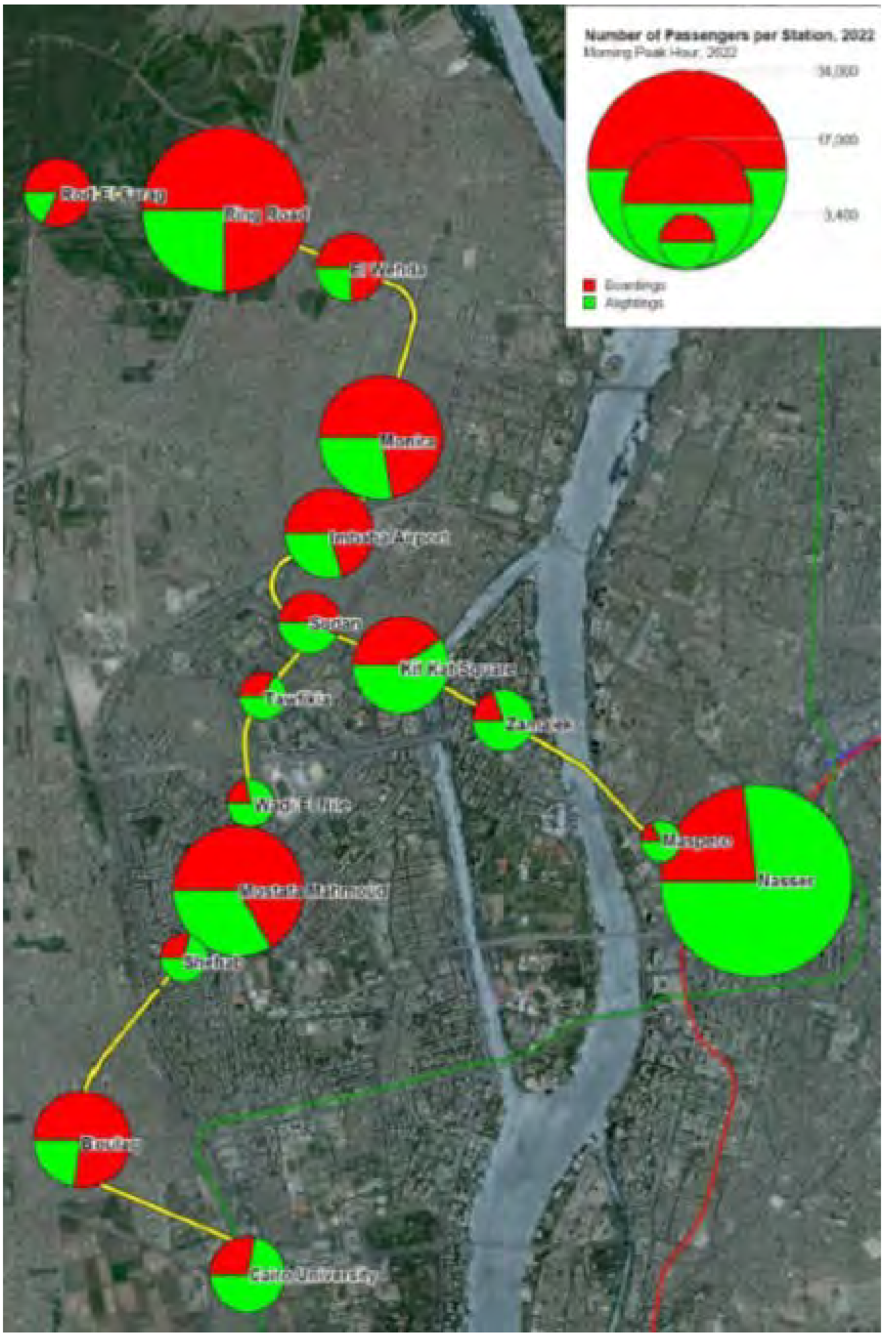

Figure 3-14: Peak hour load forecasts for Line 3 , 2022
Source: SYSTRA, New Feasibility Study for Cairo Metro Line 3 Phase 3B and 3C, Vol. 3 2011

3.9 Work Space Requirements

The work space required for each station construction site depends on a number of factors, the main ones being:

- The category of the station
- The availability of space in the particular street/area
- The type of construction.

Based on a consideration of these factors the estimated size of the constructions sites is generally estimated to be in the range of 600 – 800 m^2. Since the organisation and size of construction sites has not yet been clearly defined in the detailed design this figure is based on an assessment of facilities to be located at the site. The figure does not include storage space for construction material, which has been assumed to be located off-site. Other facilities assumed to be located on site are presented below. The traffic management plans presented in this ESIA will be updated to take changes in the organisation and size of construction sites into account, once these have been finalised. are based on the figure presented.

Other facilities, including facilities for the construction crew, which have been considered to be located on site include:

- *Temporary fencing;*
- *Camp security point(s);*
- *Transport Services;*
- *Light maintenance and storage facilities for vehicles and equipment;*
- *Office spaces;*
- *Access to infrastructure;*
- *Waste management and stand-alone sanitary facilities;*
- *First aid and fire protection facilities;*

All workers shall be identifiable by the surrounding community by their safety clothing (high-visibility jackets) and name tags. Workers shall follow the HSE standards complying with national law and international guidelines. Numbers of workers vary widely over the years of station construction. However, most land area occupation occurs in the first few months during the construction of the diaphragm wall, and the fenced area is then decreased after installation of the Road Deck and the top Slab. (EQI 2012: 47).

4 CONSIDERATION OF ALTERNATIVES

4.1 Selection Process of Alternatives during the Design Phase

The selection of the routes for the alignment and the location of the station for the Metro Line 3, Phase 3 were done in several stages and considered several alternative designs based on feasibility studies implemented by the consultant SYSTRA. The latest report with the final design proposal for the alignment and stations was the fifth deliverable of the “Update of the Metro Transport Planning and Feasibility Studies” of Greater Cairo Metro Line 3 phase 3[8].

This transport planning study from the year 2009 is an update of the 2001 Feasibility Study and is based on the previous studies carried out by the consultant. It deals only with the committed part of route of line 3 phase 3. The remaining parts, called “Extensions” were studied in the 3rd SYSTRA report “Selection of the alignment of phase 3”. In addition, to establish the project basic characteristics, the consultant followed the main principles applied to line 3 phase 1 and 2, in order to be consistent with the on-going project construction.

The feasibility studies based their findings on several investigations. As the most important ones can be mentioned::
Reorganisation Study of PT

- Traffic forecast
- Environmental investigations
- Choice of methods for the construction
- Designs and identification of “Hard Points”
- Cost Benefit Analysis of the Line 3

Reorganisation of Public Transport
One of the important considerations in this study – which has two horizon years 2022 and 2032 – is the reorganisation of the existing public transport, which is in direct connection to the planned Metro Alignment. The objective of the Public Transport (PT) reorganization in the study was double, to:
integrate the other transport modes and connect them with the metro at the main multimodal stations,
carry out the traffic forecast which requires to reorganize the other networks.

Based on these objectives, the routes of different public transports lines (bus, minibus and shared taxi) were assessed, by recommending three treatments:

1. Some routes had their service to be cancelled, because they are in direct competition with Metro line 3,
2. Some routes were modified in order to avoid competition with Metro line 3, feeding the line and limiting the proportion of ground public transport,
3. Some routes remained unchanged because they offered a complimentary service to Metro line 3.

[8] SYSTRA, New Feasibility Study for Cairo Metro Line 3 Phase 3B and 3C, Vol. 3 2011

Traffic Forecast
Another important basis for the decision of the alignment route and the stations was the traffic forecast for the Phase 3, Line 3. In this study, the trip demand was estimated through a transport demand forecast model described in the Transport Master Plan Update Report Edition 2" (December 15, 2009). This Transport Demand Forecast Model is based on a traffic survey campaign carried out during the data collection process. The trip demand forecast was carried out for the years 2022 and 2032.

Environmental investigations
A deep knowledge of the local environment is critical to choose the optimum alignment and start the design of the Metro. Thus during the stage to obtain general features, knowledge was acquired through preliminary investigations regarding:

- Topographic surveys
- Preliminary geotechnical surveys
- Categorization of existing buildings
- Public utilities identification.

Construction_Method
The results of the investigations combined with in depth parameters determined the choice between the various methods of construction (see Chapter 3.3.2) for the alignment and the stations. As parameters, a variety of characteristics were chosen, of which the main relevant are:

- Geotechnical characteristics
- Project environment (integration with the urban environment, ground allocation, etc.)
- Cost optimization
- Local practice (implementation of the first 2 phases of line 3, local contractors know how, etc.).

Designs and identification of "Hard Points"
Based on the previous experience from the construction of the Metro Line 3 and the previous investigations the design of the alignment and the stations were done. Special attention was given to potential design constraints that were taken into account in the design process. These "hard points" which were investigated in more detail are the design for the:

- Crossing line 1 at Nasser station
- Crossing line 2 at Attaba
  Crossing 6 October bridge
- Intersecting with foundation of connection bridge between 6October and 15 May bridges
- Zamalek station implementation
- Branching structure at Kit Kat square
- Mohandeseen branch - crossing under Wadi El Nile road tunnel and Wadi El Nile deep station
- Mohandeseen branch extension to Cairo University on Line 2

The line extension was implemented in the same functional design as in the Phases 1 and 2 were the user and operator interface remain identical. Nevertheless some materials will be different from a phase to the next, but the human interface (e.g. Interface in OCC, visual information, operator tools etc.) shall be the same.

Cost Benefit Analysis of the Line 3
Having a clear picture about the optimum alignment and the stations, an analysis evaluating the socio-economic costs and benefits of the Project Metro Line 3 was implemented. The socio-economic evaluation of a project made it possible to understand the stakes of the project and to apprehend its social and economic benefits. The socio-economic evaluation thus constitutes a decision-making aid that indicated the appropriateness of undertaking this project in a context of scarcity of public funds.

Special attention was given to the environmental benefits by evaluating savings in terms of greenhouse gases and local pollutants emissions. The methodology used here was the evaluation of the greenhouse gases and local pollutants emissions saved, linked with the number of vehicle-kilometres. The environmental benefits come from the reduction in the number of vehicle-kilometres covered by cars, taxis, shared taxis, minibuses and buses due to the implementation of the metro Line 3 Phase 3.

4.2 Alternative Discussion

Generally it can be assumed that the design for the stations and the alignments of the Metro Line 3, Phase 3 has seriously considered a range of alternatives during the design phase. The consultant therefore does not propose further technical alternatives and instead focuses on the relative environmental and social benefits of elements and activities of the selected alternative to be identified between the new and former designs.

There have been several design changes in the period from November 2009, when a feasibility study was prepared by SYSTRA, and the current final proposal. It will therefore be important to propose a design change procedure in case of new changes in the design in the future.

The discussion of alternatives within this study will concentrate on two “hot spots”, which considered a major design change with significant impacts which need to be justified also in front of the population. These two “hot spots” are:
1. the elevated alignment between Imbaba Station and Ring Road Station, passing through El Bohi and El Kawmeya Street, and
2. the new proposed location for the Zamalek station.

Beside the discussion of these areas, the chapter also outlines first the no action alternative, which should provide a general picture of the benefit that this project has for the population.

4.2.1 Alternative 1: No Action

This alternative consists in continuing with the present urban transport pattern, which does not include an energy efficient, safe, and environmentally sound mass transport system linking Downtown Cairo with Zamalek, Mohandiseen, Imbaba, and Boulaq El Dakrour. Instead, the communities in these neighbourhoods will continue to rely on microbuses, taxis and private vehicles and other inefficient public transportation services and facilities.

Result:

- *The densely populated, poorer areas of Imbaba or Boulaq El Dakrour will continue to lack adequate linkages with the main urban agglomeration in Greater Cairo. Their communities' access to health, education and cultural services, and jobs and business opportunities will remain unsatisfactory. Commuting time and road traffic-related accidents will continue to rise.*
- *Difficulties arising from traffic congestion, including increased commuting time, and environmental degradation (air quality and noise) will be exacerbated, as there will be no alternative than to use road vehicles for transport.*
- *Depriving the communities, especially those established in the poorer sectors of the project area, from the socio-economic and environmental benefits of implementing the Metro line will hinder their fulfilment and sustainable development. Many of the project's impacts can be mitigated or compensated for, or are outweighed by its benefits. (EQI 2012:Section 6.1)*

Due to the above outlined arguments, the "no action" alternative should be disregarded.

4.2.2 Alternative 2: Implementation of the Proposed Project

This alternative calls for the implementation of the proposed Metro Line 3 – Phase 3 mass transportation scheme. The project will provide a sorely needed, efficient and clean public transportation solution that will link central Cairo with some of the underserved neighbourhoods in the west. Within the framework of this alternative, however, a number of adverse impacts are expected to occur. The most important of these impacts are

- *related to the selection of the routes,*
- *the location of some of the stations, and*
- *the design of the Metro railway structure, (over which stakeholders have expressed their concern). (6.2)*

Evaluation

Minor impacts that can be tolerated or mitigated with relatively simple measures are expected to occur during the construction and operation phases of the project. However, these impacts are temporary in nature, lasting only during the construction process. Major long-term impacts related to expropriations can be mitigated in a RAP; other residual impacts such as visual intrusion, noise and vibrations, crowding, loss of agricultural land, changed nature of neighbourhoods represent the environmental cost of the project, as they cannot be entirely mitigated or compensated for. (EQI 2012:Section 6.2)

4.3 Implementation of Alternative Project Components

Project elements and activities that are expected to result in major negative impacts in the two "hot spot" areas are herein discussed. Each of the "hot spot" stations and their related alignments can be rated in terms of impact criteria. As impact criteria the following disciplines are chosen:

- Community Acceptance - expected reaction from stakeholder regarding potential social community acceptance of the Metro line.
- Noise - predicted changes in noise levels for residents/households and institutional, community and recreation features in the zone of influence

- Vibration - predicted changes in vibration for residents/households and institutional, community and recreation features in the zone of influence
- Visual Intrusion - predicted reaction towards visual images from the construction systems and stations
- Traffic Disruption - expected traffic disturbance during the construction phase, caused by the construction of the stations / alignments
- Accessibility - expected easy accessibility during the construction phase for the affected buildings especially considering elderly and handicapped persons.
- Expropriation - expected major expropriation activities and /or temporarily removal of businesses
- Construction Cost (only valid for the elevated alignments) - expected mayor construction cost due to additional fundament and works
- Utility Diversion (mainly valid for the elevated alignments) - expected mayor construction cost due to additional utility diversion works

To determine an overall rating for potential social and environmental impacts, a simple numerical scoring system combined with a short explanation of mitigation measures was employed using a 3-point qualitative scale:

- Slight negative impact: (1)
- Moderate negative impact: (2)
- Serious negative impact: (3)

This scale has been applied to determine an overall impact on the criteria for each alternative.

4.3.1 Location of Zamalek Station

Finding an adequate location for the station and cut-and-cover operations proves difficult, mainly because of the small streets and the multi-storey buildings, as well as their cultural and market value.

The main issue that arose during the impact scoping phase of this study, implemented in December 2011 was that most residents in Zamalek expressed hostility at the idea of having a Metro station in Ismail Mohammed, or in the northern part of the island altogether. Residents expressed their concern for the old, but well-maintained, buildings in the area, as well as their fear that the station and the crowding that would ensue at operation would change the nature and cultural make-up of the neighbourhood. (EQI 2012:Section 6.3.1)

The need of a station for Zamalek will not be discussed, because the advantages of this station for the area is obvious, considering the crowded parking situation caused by residents and students from the Art and Music school and other private schools in the nearby area. What should be discussed is the advantage and disadvantage of the different proposed locations within the Ismael Mohammed Street.

<u>Alternative Z1: Zamalek station in the middle of the Ismael Mohammed Street.</u>
The station was initially planned on the western side of Ismail Mohammed St. but this location was deemed impractical due to the presence of precious centenary banyan trees, which would have had to be uprooted. (EQI 2012:Section 6.3.3.1)

From all stations proposed of the Metro Line 3, Phase 3 this is the only location for a station in such a small, one-way street. It is located in the northern end of Gezira island along Ismael Mohammed street. The street intersects with Mohammed Thaked Street. The Zamalek Station will be located beneath Ismaïl Mohammed St., and the alignment will follow its course in a north-westerly direction under that same street. The alignment will then cross under the smaller western branch of the Nile to reach Kit Kat Station in Sudan St.

The area contains several schools, embassies and mainly high-income housing, the motorization rate is quite high in the area and few PT routes cross the direct surroundings of the station.

Alternative Z2: Zamalek station at the beginning of the Ismael Mohammed Street.

- The new Zamalek station is located at Ismail Mohamed street in front of the Algerian Embassy and the Spanish Embassy. During construction, Ismail Mohamed street from Brasil Street to Ahmed Heshmat Street will be completely.
- The area contains two embassies and mainly high-income housing, the motorization rate is quite high in the area along the Brasil Street and some PT routes cross the direct surroundings of the station.

Table 4-1: Alternative Discussion for Zamalek Location

Alternative	Criteria						
	Community Acceptance	Noise	Vibration	Visual Intrusion	Traffic Disruption	Accessibility	Expropria-tion
Z1: Location in the middle of Ismael Mohammed Street	Low acceptance due to fear of social intrusion	Construction noise and noise emitted by waste trucks	Moderate, due to wider area but both side residence	Old valuable tress have to be cut	Four accesses possibilities are blocked causing serious traffic disruption	Accessibility to embassy and food store (Hardy's) difficult	Minor
Z2: Location at the beginning of Ismael Mohammed Street	Low acceptance due to fear of social intrusion	Construction noise and noise emitted by waste trucks	Moderate, due to small streets with northwards residence	Minor	Easy handling traffic disruption: one street blocked, one minimized	Accessibility to embassy and northern residence difficult	Minor

Slight negative impact
Moderate negative impact
Strong negative impact

Evaluation

The evaluation of these alternatives - based on the above described criteria – show no big differences between the impacts these location will cause. These is a slight advantage for the alternative Z2, representing the newly chosen location. This choice was underlined by NAT´s negotiations with the Algerian and Spanish embassies, which could reach compromises in using some of their property space for construction purposes.

4.3.2 Alignment of El Bohi

The proposed metro line in El Bohy Street will run on an elevated structure, which is generally perceived as a highly inappropriate element that will worsen the already poor aesthetic quality of Imbaba/Monira, and deprive its residents of important amenities and services. It could degrade quality of life of the residents on that street if compensation measures are not provided.

An earlier alternative proposed the tunnelling of the line all the way El Bohi Street and Al Kawmeya Street. By extending the underground section of the 3B alignment most of the adverse long-term socio-economic, visual and environmental impacts imposed by the implementation of an elevated Metro line could have been avoided. But this version was dismissed due to economic reasons, because main utilities (including the mail gas pipe for this area) are lying in the middle of the streets and would have hampered tunnel boring. In addition it was deemed that this solution would not provide job opportunities through above ground constructions, which can be implemented by local construction firms.

<u>Alternative B1: El Bohi Alignment in the middle of the street</u>
After Imbaba Station the line starts to go up on a ramp until it reaches the required level on a viaduct where it turns, leavening ENR right of way, passing above Air Port Street and heading along El Bohy Street inside Imbaba Zone. The line is extended above El Bohy Street on a viaduct – using the middle of the street until it reaches the elevated El Bohy Station. After this station the line turns west and is elevated on a viaduct above El-Kawmia Street.
The line continues elevated till it reaches the Ring Road, at the end of El-Kawmia Street, passing above the Ring Road and reaching the location of the elevated Ring Road Station.

Utilising the middle of the street requires the demolition of existing buildings (market, hospital, school, sport centre, mosques). The possibility of passing in the middle of the road above these buildings without interference with the buildings was considered at an earlier stage but skipped due to special costly design and construction needs. Utility diversion of a major gas pipe and several other pipes has to be considered for the whole alignment.

<u>Alternative B2: El Bohi Alignment using right side of the street</u>
The El Bohi Alignment shifts after the EL Bohi Station to the right side of the street and comes by that close to the buildings alongside this street. It continues that way, until it turns westwards into El Kawneya Street, using here roughly the middle part of the street.

The reason for choosing this alternative is due to the fact that several buildings are located in the central street island of El Bohy Street and occupying its whole island width (Hospital, School, sport Centre, Mosques). Instead of elevating the line so high that it can pass above the buildings, the alternative chooses the shift to the right side of the street. By this the fundaments of the columns (located on the right side walk of the middle street island) are avoiding the interference with the public utilities in the middle underground of the street (see drawing B2). However, this final configuration of the line needs to use mono-piles, which are substituting the normal square multi piles. Utility diversion after El Bohi Station will be avoided by using mono-piles.

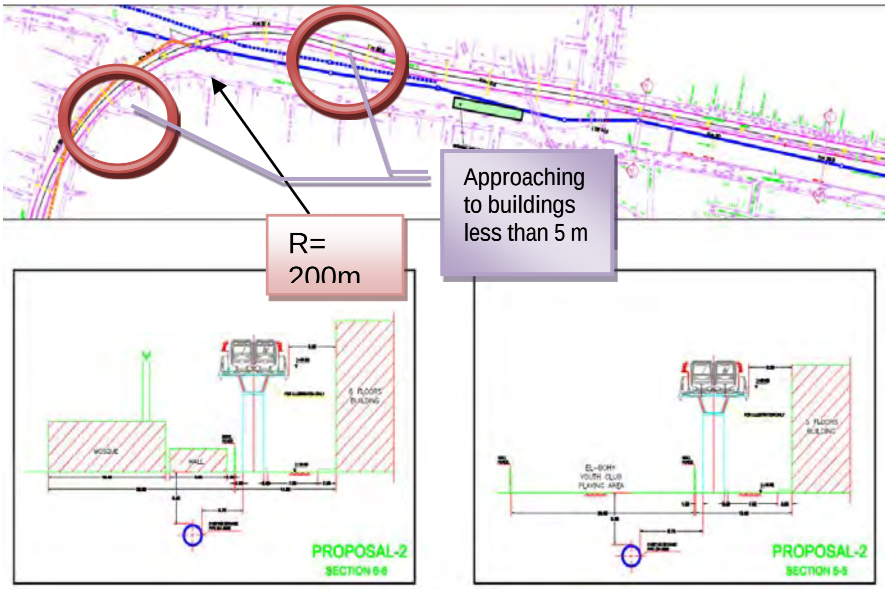

Figure 4-1: Alternative B2 Alignment and cross sections

Table 4-2: Alternative Discussion for El Bohi Alignment

Alternative	Criteria								
	Stakeholder Reaction	Noise	Vibration	Visual Intrusion	Traffic Disruption	Accessibility	Expropria-tion	Construction Cost	Utility Diversio n
B1: Location of alignment in the middle of the street	Concerns regarding noise and vibration	Noise emitted by train	Vibration emitted by train	Strong, due to elevated appearan-ce	Easy handling traffic disruption: one side of street closed	Both street sides are minimized	Demolish-ing of middle street island buildings	The "normal" construction designs can be applied	Along the whole El Bohi and El Kawmey a Street
B2: Location of alignment using right side of the street	Concerns to fear of visual intrusion	Noise emitted by train especiall y after shifts to the right building	Vibration emitted by train	Strong, due to elevated appearan-ce	Easy handling traffic disruption: one side of street closed	One side blocked during construc-tion	Minor due to temporaril y expropriati on of market	Need for Mono-Piles might increase the construction costs slightly	In parts between Imbaba and El Bohi Station

(yellow)	Slight negative impact
(light pink)	Moderate negative impact
(dark pink)	Strong negative impact

Evaluation
The evaluation of these alternatives - based on the above described criteria – show less significant impacts for the alternative B2, which represents the shift of the alignment after the El Bohi station. Nevertheless there is still a need for public consultations to discuss the pros and cons with the affected population and get them acquainted to this possible visual intrusion. First informal talks with the population in this area expressed a strong welcome to the Metro line, but people expect a serious improvement of the urban landscape, which might compensate them for negative impacts resulting from the elevated construction.

4.4 Cost of Applying Mitigation Measures

Cost of applying mitigation measures caused by changing the design depend on the actual implementation of the mitigation measures, which have to be outlined according to the above designed template.

4.5 Residual Impact after Mitigation Measures

It can be expected that even a proper application of the proposed design might leave problems in form of approaching too close to the buildings close to the radius of 200 m (see drawing alternative B2), which cannot be mitigated, if the standard radius of 200m for the curve of alignments is applied. It can be expected, that during the construction, a change of the design in this critical point may occur. Intensive monitoring is recommended, when the contractor is approaching this stage of construction and it is expected that discussions with the population will arise on how to mitigate negative impacts.

5 APPROACH AND METHODOLOGY

5.1 General Approach

This draft ESIA Report is partly based on the draft ESIA study prepared by EQI (2011) and partly on the Gap Analysis Report prepared by Grontmij / Eco Con Serv (June 2012). The general approach to this ESIA has been to focus on the gaps identified in the Gap Analysis Report and to base the assessments on the existing Baseline and exiting studies, except from the Socio-Economic baseline which will be developed further in this ESIA. The ESIA is developed based on International Standards, mainly on EIB standards.

5.2 Approach/methodology to Gap analysis

The Gap Analysis Report summarises (i) the results of an assessment of what gaps there are between the existing draft Environmental and Social Impact Assessment (ESIA) and EIB requirements and national legislation, and (ii) what supplementary documentation and activities will be needed to fill these gaps.

The Gap Analysis is based on the following key documents:

- Draft EQI ESIA (2011)
- Relevant Egyptian legislation
- EIB Statement of Environmental and Social Principles and Standards (2009)
- EIB Environmental and Social Practices Handbook (2010)
- EU Guidance on EIA (2001)

The Gap Analysis has also taken into consideration information provided by NAT in the period from May 1st to June 11th. A need for more information was identified, which has been provided in further rounds of information exchange with NAT.

During the Gap Analysis, the draft EQI ESIA report has been benchmarked against the requirements for its development provided by relevant national legislation and the EIB guidance. It was understood that if the ESIA meets the requirements of EIB, then it will also live up to AFD requirements.

A matrix format was utilised in order to benchmark the draft EQI ESIA report against the legislative and standards framework for the purpose of identifying gaps. The EIB matrix is an adaptation of the EU EIA checklist furthermore, the matrix includes the social requirements provided within the EIB Social Assessment Guidance Notes.

The matrix identifies the key requirements of each standard. It then assesses whether this area is relevant for this type of project. If relevant, it is then assessed whether the area is adequately addressed in the draft ESIA. If the area is not adequately addressed, then there is a gap. An indication is given of the significance of that Gap (low or high). The information needed to close the gap is then described in the matrix.

The significance of the gaps is described according to the following criteria:

- Potential impact of the gap-related aspect if not managed in an adequate manner
- Potential reputational risk to financial institutions

5.3 Methodology for the Impact Assessment

The impact assessment is carried out in 6 steps.

1. Identification of the potential impacts
2. Assessment and description of potential impacts
3. Evaluation of the potential impacts
4. Recommendations of mitigation measures to maximizing the positive impacts (benefits) and to minimize the negative impacts.
5. Assessment of residual impacts after implementation of recommended mitigations measures.
6. Estimation of cost of applying the proposed mitigation measures.

1. Identification of potential impacts
Identification of impacts is based on the analysis of project activities (components) and baseline information, scoping activities as well as experience and information from similar projects.

A matrix has been developed based on the Leopold matrix in order to provide an overview of the potential impacts related to the project activities (pre-construction, construction and operation). The layout of the matrix is arranged as follows:

The matrix consist of the project activities for the pre-construction, construction and operation phases as the y-axis, whereas the environmental and social aspects identified to be relevant for this project as the x-axis.

The following project activities have been defined (based on the draft ESIA study by EQI) (y-axis):

Pre-Construction
Utilities diversion Traffic diversion/reducing road capacity Land acquisition/expropriation

Construction activities
Levelling and land clearing Metro railway construction (underground, at-grade, or elevated) Tunnel boring work Cut & cover (stations, transitional sections, annex structure) Excavation work Mud treatment (bentonite separation) Foundation work (stations at-grade or underground) Concrete mixing, casting and curing (all stations, columns, viaducts) Transport of construction material Storage of construction material Operation of heavy/large equipment Storage and disposal of construction solid/hazardous waste Disposal of construction liquid waste Disposal of excavated material Construction of facilities (stations) Stations’ finishing work(painting, tiling, plumbing, and electrical, etc.) Construction/installation of signalling & communication equipment Construction/installation of transformers

Work base establishment and operation Workers' activities and construction site management

Operation activities
General operation Rolling stock (Underground, At-grade, Elevated and Coach motion) Stations (Underground, At-grade, Elevated, HVAC, Lighting) Annex structures Workshop

1. The following environmental and social aspects have been identified (x-axis).

- Soil
- Waste and hazardous waste
- Water environment
- Air quality and dust
- Noise and vibration
- Visual Intrusion
- Biodiversity and nature conservation
- Archaeological sites
- Public utilities and traffic
- Land use
- Socio-economic effect
- Occupational health and safety and Labour Standards
- Community health and safety
- Involuntary resettlements (including vulnerable groups)
- Capacity of promoter
- Cumulative impacts

2. The Assessment includes a description of the potential impacts based on the available information on the project activities and the current baseline including separate studies. All combinations of project activities (pre-construction, construction and operation) and environmental and social aspects will be assess and described with the use of the headlines of the environmental and social aspects as headlines.

Table 5-1: ESIA Matrix

	Environmental and social aspect						
Project activities	Soil	Waste and hazardous waste	etc.	Socio-economic effects	Occupational HS and labour standard	Community HS	Etc.
Pre-construction							
-							
-							
Construction							
-							
-							
Operation							
-							
-							

3. The Evaluation will be carried out following the proposed significance criteria:

- Certainty of the impact: level of certainty (likely, unlikely, unknown & likelihood) of occurrence;
- Extent of the impact: geographical range of the impacts: (household, local/district, regional or national);
- Duration and frequency of impact: temporary occurrence of the impacts (short to long term or permanent); and
- Reversibility of the impact (reversible, possible to mitigate or not possible to mitigate).

The significance of the impacts will be determined taking into consideration the public concern and perceptions. In general where an impact are certain to happen, and where the impact will be considerable for valuable and sensitive receptors (environment or people) the impact are considered to be of high significance. Whereas impacts that are unlikely to happen for non-valuable and non-sensitive receptor will be considered to have a minor impact.

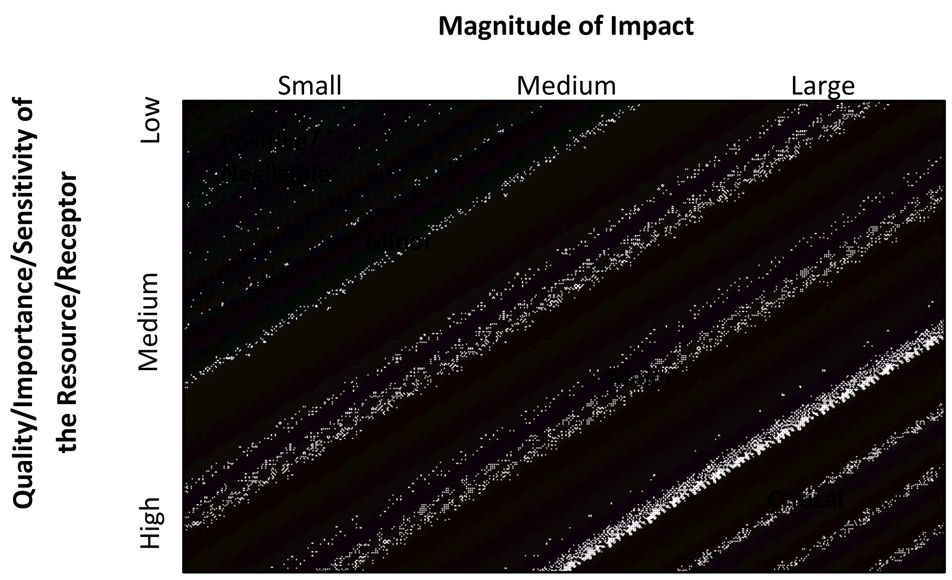

Figure 5-1: Impact Categories

For impacts that are not amenable to mitigations these will be classifies as critical.

Allocation of significant effects in intermediate situations will be a matter of expert judgment in each topic area.

Significance criteria will likely be defined as follows:

Significance	Definition
Positive or Negligible Impact	An impact that is considered to represent an improvement on the baseline or an impact with change comparable to natural variation
Minor Impact	Detectable but not significant

Major Impact	Significant but amenable to mitigation – must be mitigated
Critical Impact	Not amenable to mitigation. Possibilities for compensation or off-setting must be established.

4. Proposed mitigation measures

Mitigation measures will be identified for all impacts likely to occur, adverse in nature and significant enough to require mitigation (major impacts) in order to mitigate or eliminate such impacts.

This section will include a full description of mitigation measures to avoid, offset or reduce the significant adverse effects of a project to an acceptable level. These measures are either incorporated as an integral part of the project design or through environmental and social management and monitoring measures during pre-construction, construction and operation phases.

5. Residual impacts
After implementation of the proposed mitigation measures have potential residual impacts been identified. The impact significance will decrease one or more levels depending on the mitigation measure.

6. Cost of implementation of mitigation measure (to the extent possible)

7. Summary of potential impacts before and after mitigations

Table 5-2: Summary of Potential Impacts Before and After Mitigation

Environmental/social aspects	Project activity (source)	Potential impacts	Proposed mitigation	Residual impact

5.4 Methodology for the Management Plan

The Management Plan will contain the proposed mitigation measure from the impact assessment as well as who is responsible for implementing the mitigation measure, the timing and as well as proposed monitoring (and evaluation) indicators.

The proposed monitoring and evaluation indicators will be developed based on knowledge on the project activities and the identified mitigation measures.

The Management Plan will be summarised in the below fields:

- Description of the potential impacts (and risks) structured based on the identified Environmental/ Social Aspect
- Proposed Mitigation
- Responsible for implementing the mitigation
- Timeframe
- Monitoring

6 SPATIAL AND TEMPORAL BOUNDARIES OF THE STUDY

6.1 Spatial

The ESIA study covers the areas that are considered to be affected by Metro Line 3-Phase 3, as described in Chapter 3. Specifically the ESIA covers phases 3a, 3b and 3c of Metro Line 3. Phase 4 of Line 3 and other metro lines are not included within the spatial scope of the study, although they are included within the cumulative effects assessment.

6.2 Temporal

The ESIA covers the social and environmental impacts related to the construction and operations phases of Metro Line 3-Phase 3. As the design phase was already well advanced by the time of the ESIA study, impacts related to the design phase are not considered in detail. However, the section on alternative designs has assessed the alternative solutions that were under discussion during the design feasibility stage. A potential decommissioning phase is not considered relevant in this case, and is therefore outside the scope of the study.

7 BASELINE INFORMATION

7.1 The Physical Environment

7.1.1 Topography

The highly urbanized Greater Cairo Region and its surrounding cultivated land which includes Metro Line 3 – Phase 3's alignment occupies the lower part of the Nile Valley, in the former floodplain. The floodplain itself is more extensive on the western banks of the Nile (about 10 km).

To the east of the Nile Valley, the Eocene limestone plateau known as Gabal El Moqattam reaches an altitude of 500 m in places. It extends southwards and eastwards, remaining at a close distance from the river's flood plain, but gradually increasing in height. To the west of the river's flood plain, the desert is essentially flat, gently rising westwards from about 50 meters immediately above the flood plain, to a height of about 200 meters some 20 km west of the Nile. To the southwest the plain gives way to the Pyramids-Abou-Rawash plateau.

The entire project area along the Phase 3 alignment is therefore characterised by a relatively flat and low lying topography, lying between 17 – 40 m above sea level (asl), away from any steep slopes or environmentally fragile spots. In particular:

Sub-phase 3A: Elevations gently fluctuate in the Downtown areas between 26 m at Attaba and 20 m at the Nile Corniche, near Maspero. Peak elevation is 40 m between Attaba and Nasser stations. Elevations rise from about 23 m to 40 m from east to west across the island of Zamalek.

Sub-phase 3B: Starting at 20 m at Kit-Kat Square, elevations quickly rise to 26 m early in Sudan Street, but slowly descend throughout Imbaba to 22 m at the Ring Road. West of the Ring Road, there is a steep descent to about 19 m, followed by a milder downhill slope along the stretch to the Rod el Farag Corridor station, which sits at 17 m.

Sub-phase 3C: From Kit-Kat Square elevations quickly rise from 20 m to about 26m southward to Tawfikia, dipping along Wadi El Nil to 19 m, and reaching a peak height of 35 m halfway down Gamaet El Dowal El Arabeya Street. Elevations then descend to approximately 25 m, before rising again at Boulaq El Dakrour (32 m), and descending to 20 m at Cairo University.(EQI 2012: 50)

7.1.2 Geology

Geomorphology

The Nile Valley is a north to south trending Oligo-Miocene canyon, which filled with alluvial sediments (clay, silt, and sand and gravel) during the Pliocene-Quaternary (El Gamili, 1982; Said, 1981). The Nile valley thus formed as a graben and the meandering of the river's course throughout the Pleistocene and Holocene is the source of the soils deposited in the Cairo and Delta areas. The tectonic origin of the Nile valley is evidenced by the fault scarps bordering the cliffs of the Nile valley (El Gamili, 1982; Said 1981, 1990).

Three main geomorphic units are distinguished in the GCR:

- *The eastern Moqqatam Plateau and western Pyramids-Abu-Rawash Plateau (PARP)*
- *The sloping plain*
- *The floodplain.*

The flood plain, consisting of alluvial deposits (clay, silt, graded sand and gravel), is occupied by the sub-urban and urban areas as well as the cultivated land. The sloping plain consists of gravel and sand separating the plateaux from the flood plain.

Above the flood and sloping plains both to the east and west, the plateaus consists of Tertiary limestone beds (Eocene) covered in places with coarse gravel sheets and basalt (Oligocene), sand (Miocene), clay/sand (Pliocene), volcanic rock (Oligo-Miocene basalt) and some Quaternary deposits.

The Pyramids-Abou-Rawash plateau (PARP) lies at the boundary between the stable and unstable shelves of Egypt (Said 1962). It is bounded on the west and north by the Upper Cretaceous Syrian Arc deformation of the Abu Rawash area. The structures of the Abu Rawash area consist of east-northeast to northeast oriented folds which are dissected by several west-northwest, north-northwest, and north-south oriented faults.

The Moqqatam plateau is affected by two main fault systems, the north-west Erytherian trend and the east-west Tethian trend. The first system is the main fault system and affects the Eocene limestone plateau in the eastern part of Moqqatam area. The second trend affects mainly the Oligocene and Miocene sediments. The faults at Mokattam area are normal and dip at high angles up to 50° (Said 1962).

The Metro Line 3 – Phase 3 does not directly cut through either of the plateaus, it is confined to the Nile Valley deposits. (EQI 2012: 51)

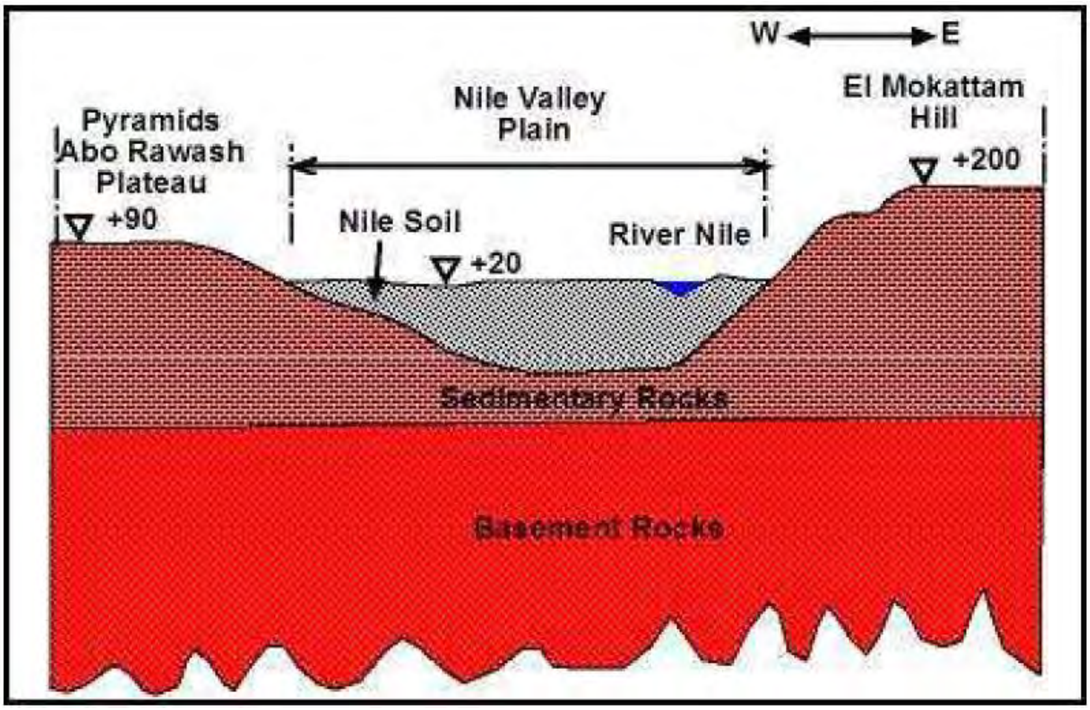

Figure 7-1: Cross-section of the Nile Valley Showing its Main Geomorphological Features
Source: JICA/NAT/Environics ESIA for Line 4, 2010

Soils in the GCR
To the north of Cairo is a uniformly flat triangle, the Delta, about 166 km long from north to south and 250 km wide across its Mediterranean front base. It is covered with Quaternay sediments deposited throughout the evolution of the Nile. The soil in the floodplain thus consists essentially of clay/silt overlying sandy loam and coarse gravel/sand. Both these layers lie atop a deep plastic clay unit. This soil complex is hundreds of meters thick in places, especially in the northern parts of the Delta. In Cairo and further south, the Nile's flood plain is very narrow, although it is substantially wider on the western side. The silt and clay content of the topsoil are more prevalent than in the Delta to the north, but there is some variation in the eastern and western regions of the valley. The loamy soil in the west has higher lime content than the soil in the east, which is sandier.

Soils along the Phase 3 alignment
All of Metro Line 3 – Phase 3's sub-phases transect areas that have relatively similar and uniform soil profiles. These soils consist of Nile Valley Quaternary deposits, as described above, where silt and clay layers are underlined by gravel and sand layers. The latter represent the main aquifer under Greater Cairo. In the project area and general urbanised areas of the GCR, there is a top fill layer, which consists of a heterogamous mixture of limestone fragments, red brick pieces, concrete chunks, sand, gravel and clay and asphalt. Along the Phase 3 alignment (all sub-phases), this layer extends to a depth of about 5 m, though in other parts of Cairo it can reach more than 10 m down.

Beneath the fill layer silty or sandy clay layers extend to a maximum depth of 17 m. The clay's consistency is generally very stiff; silt interlayeres may occur within the clay layer. The clay or silt layers are followed by a layer of generally fine to medium sand, with various percentages of silt. This layer may include different percentages of fine gravel or thick interlayers of gravel. Typically, the sand is medium dense to dense in depths up to 15m and very dense thereafter.

[..] shows the soil profile for alignment section 3A. The soil profile for sections 3B and 3C is similar to that of 3A, with the difference that the on the western banks of the Nile, the clay layer tends to dominate the silt layer. As can be seen in the diagram, Zamalek has a thicker silt layer than both the western and eastern banks of the Nile (EQI 2012: 52).

Four soil samples were taken at the planned locations of Cairo University, Nasser, Imbaba and Zamalek, as indicated in Figure 7-2. Results are shown in below *and detailed results are included in Appendix 3.* Samples were taken at three different depths at each locations and analysed as previously presented in section 5. *There are no legal standards for soil quality in Egypt as such, however, the* results were compared with two groundwater standards since the results correspond to the leachates of soil samples *(EQI 2012: 52):*

- Water quality standards for fresh water bodies (Law 48/1982)
- Law 48/82 for discharge into Underground Reservoir & Nile Branches/Canals, Nile (Main Stream)

Assuming that the soil leachate may reach fresh water bodies and as shown in Table 7-1, the following conclusions were made:

- Cadmium and chromium content are slightly higher than the allowable limits
- Copper and lead is 4-5 folds the allowable limits
- Iron and As are about 40-60 times the allowable limits.

Table 7-1: Chemical Composition of extracted Soil Sample

	Water quality standards for fresh water	Discharge into water bodies (Underground reservoir)	Zamalek	Imbaba	Cairo University	Nasser	Mean	Standard deviation
Sample depth (m)			7	5	7	4		
pH	7-8.5	6-9	8.6	8.4	8.3	8.3	8.4	0.141
EC µ S/cm	-	-	944	913	1115	1104	1019	105.360
Cyanide, mg/l	-	-	0.0036	0.002	0.0017	0.0014	0.002175	0.001
Aluminium, mg/l	-	-	0.0826	0.0976	0.08	0.0832	0.08585	0.008
Boron, mg/l	-	-	0	0	0	0	0	0.000
Cadmium, mg/l	0.01	-	0.0086	0.0086	0.0136	0.0104	0.0103	0.002
Cobalt, mg/l	-	-	0.0208	0.0208	0.0208	0.02	0.0206	0.000
Chromium, mg/l	0.05	-	0.0504	0.0556	0.0638	0.0486	0.0546	0.007
Copper, mg/l	1	-	3.638	3.67	5.506	4.55	4.341	0.884
Iron, mg/l	1	1	37.2	36.38	52.24	39.52	41.335	7.391
Manganese, mg/l	0.5	-	1.6582	1.317	2.878	2.574	2.1068	0.739
Molybdenum, mg/l	n/a	-	0.0258	0	0	0	0.00645	0.013
Nickel, mg/l		0.1	0.2536	0.2432	0.3168	0.2716	0.2713	0.033

lead, mg/l	0.05	-	*0.1252*	*0.1654*	*0.2786*	*0.219*	0.19705	0.067
Strontium, mg/l	-	-	*1.5786*	*1.6808*	*1.722*	*1.6808*	1.66555	0.061
Vanadium, mg/l	-	-	*1.7234*	*1.6846*	*2*	*1.8692*	1.8193	0.144
Zinc, mg/l	1	1	*0.6646*	*0.6704*	*0.8018*	*0.7646*	0.72535	0.069
As, µg/l	0.05	-	*3.056*	*3.156*	*2.276*	*2.568*	2.764	0.415
Hg, µg/l	-	-	*8.6*	*8.4*	*8.3*	*8.3*	8.4	0.141
Phosphorus, mg/l	-	-	*944*	*913*	*1115*	*1104*	1019	105.360

(Water extract 1:2.5) and analysis of available heavy metals and available Phosphorus at planned Zamalek, Imbaba, Cairo University and Nasser stations (EQI 2012:53)

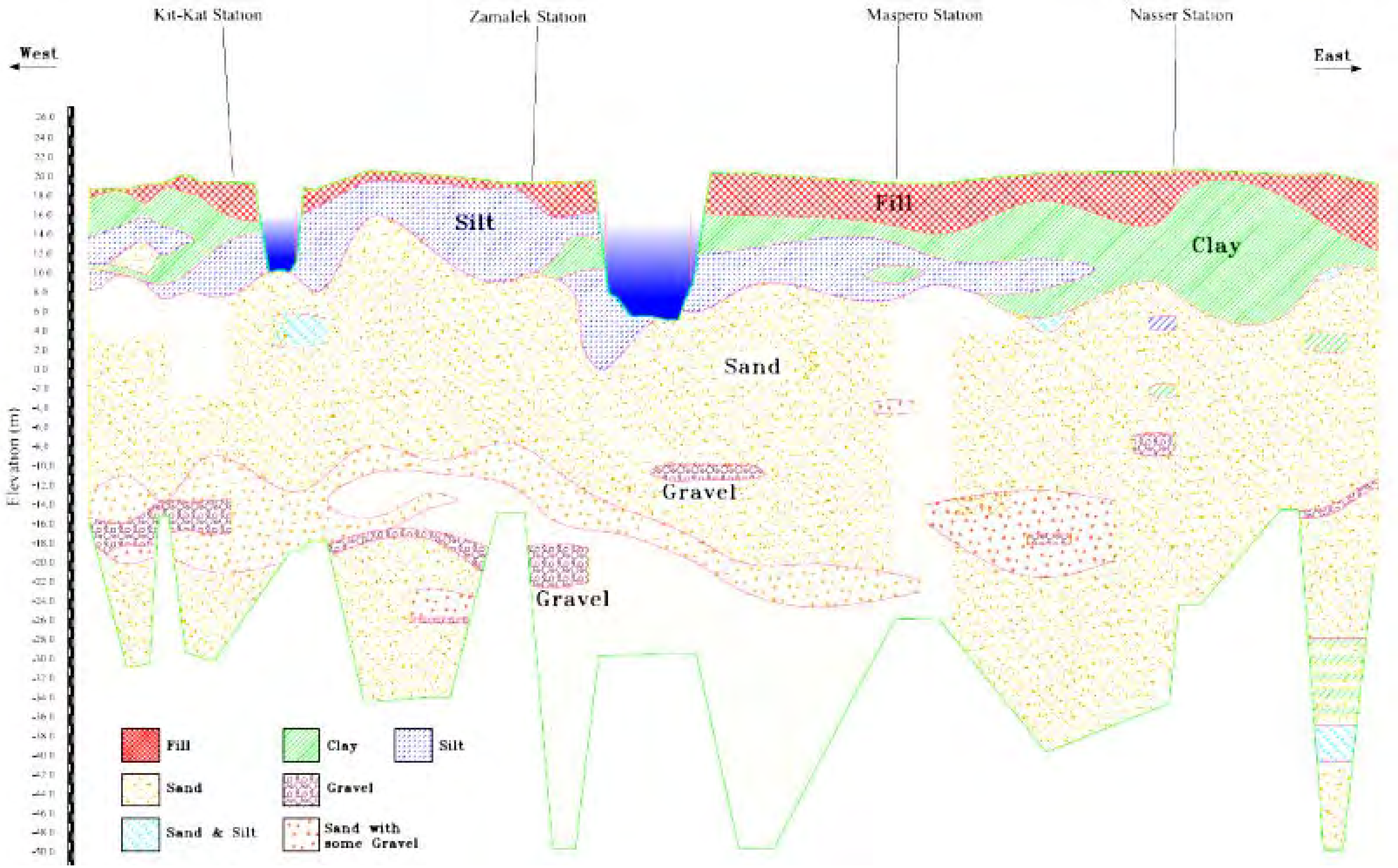

Figure 7-2: Soil Profile Along Cross Section of sub Phase 3A
Source: SYSTRA Geotechnical investigation report for Cairo Metro Line 3 Phase 3, 2010 (EQI 2012: 54)

Geologic hazards

Three types of geologic hazards can affect the GCR: earthquakes, expansive or collapsible soils, and floods.

Earthquakes

Over the past century, a large number of moderate earthquakes have been felt in Egypt. Their magnitudes have ranged from 3.5 to 6.6, meaning light to strong on the Richter scale, and they were reported to having been felt at distances varying from 10 to 700 km from their epicentres. Some earthquakes have been located outside the Egyptian territory but strongly felt in Egypt.

Most of the earthquakes that take place in Egypt occur in the northern part of the country. They are attributed to the Bahariya-Fayum-Abu Rawash-Cairo dislocation zone, which has a strong local tectonic activity. The dislocation zone is composed mainly of depressed areas, consisting of faulted zones with many minor faults. However, some earthquakes can also occur southward, in densely populated urban areas like Cairo.

Earthquakes have long been felt in the GCR. Most of these had epicentres located in the Hellenic Arc, Red Sea and Dead Sea. Since 1992 the three most notable earthquakes where those of the 12th of October, 1992 Cairo (magnitude of 5.8 – moderate earthquake), 22nd of November, 1995 Aqaba (magnitude of 7.1 – major earthquake) and 9th of October , 1996 Cyprus (magnitude of 6.4 – strong earthquake) (USGS and, Ibrahem, 1995, and Osman & Ghobarah, 1996). Susceptibility of the project area to earthquakes

The magnitude of earthquakes and the intensity with which they are felt depend on local site conditions, surface/subsurface structures, lateral attenuation, rupture directivity and focal depth. In the case of the Metro Line 3 – Phase 3 project, which is planned to run through Nile deposits in the Nile Valley, the estimated thickness of the soil is about several hundred meters in the middle of the valley (where the project is located) and becomes shallower further east and west (PARP and Moqqatam Plateau).

The Nile soil layers are underlined by thousands of meters of sedimentary rocks similar to the rocks exposed now at the Pyramids-Abu Rawash and Mokattam plateaus; these sedimentary rocks cover a basement composed of igneous and metamorphic rocks similar to the rocks exposed in the Eastern desert. The sedimentary and basement rocks beneath the soil are fractured and faulted. The major faults have an influence on the intensity of earthquakes.

The nature of the Nile soil itself also has a great effect in the amplification of the seismic wave field, which may explain the severity of the October 1992 earthquake. It destroyed several hundred buildings and claimed thousands of lives in Cairo (Fergany 1997). The areas most severely affected by that earthquake were Greater Cairo and the northern part of Fayoum, which was closest to the epicentre. In Central Cairo, buildings were damaged on both banks of the Nile, in areas adjacent to the project area, including Boulaq Abou Ela/Maspero, Mohandiseen, Imbaba, Boulaq El Dakrour, and Zamalek. Although most of the damage caused by the 1992 earthquake afflicted poorly built, relatively old constructions, a late 70s high-rise building in Ismail Mohammed St., i.e.: directly along the planned Metro tunnel in Zamalek, shows a major crack down the entire length of one of its columns.

Egypt enforces specific design norms respective to seismic risk (the Ministry of Housing, Utilities & Urban Development Code 201) - used for calculating loads and forces, including earth quakes for reinforced concrete constructions, since earthquakes are relatively frequent occurrences in the GCR. To mitigate the effects of similar future disastrous earthquakes, seismic risk factors must be considered in the construction of the Metro Line 3 (EQI 2012: 55)

Expansive and Collapsible Soils
Expansive and collapsible soils are one of the more common geologic hazards all over the world. They could represent local problems along the at-grade or elevated parts of the Metro line.

Expansive soils
Expansive soils contain clay is such proportions that they have the ability to swell and shrink when moisturised or subjected to desiccation. Some clays, mainly montmorillonites (or bentonite), are particularly prone to shrinking and swelling. Soils that expand and change volume as a result of moisturisation or desiccation can cause severe damage to build structures. Geology and climate play significant roles in the distribution of these problematic soils. Some of the rocks from the surrounding plateaus in the GCR contain primary bands and layers of clay and shale, which have accumulate in the floodplain through the action of wide and water. These primary and secondary shale and clay encountered along the route at this area could result in expansive soils.

Collapsible soils
Collapsible soils occur naturally in arid and semi-arid climates, where wind and intermittent streams deposit loose sediment or due to human activities. Thus collapsible soils consist of loose, dry, low-density materials that collapse and compact under a combination of water saturation and excessive loading. The collapse occurs when the land surface is saturated at depths greater than those reached by rain events. This saturation eliminates the clay bonds holding the soil grains together. Collapsible soils result in localised structural damage, such as cracking of building foundation, floors, roads, power lines, railways, bridges and walls in response to settlement.
Human activities can increase the risk of soil collapse. Such activities include the dumping of construction rubble and subsequent landfilling in the lowlands, alteration of natural drainage patterns, disposal of wastewater directly into the soil in urbanized areas, or watering of gardens around buildings.
Collapsible and expansive soils will not affect underground structures of the Metro Line 3 – Phase 3 tunnels, due to the homogeneity of the hosting soil and/or rocks and their saturation with water (constructions should be located under the level of the water table). However, they can cause localised structural damage, particularly along the sections at-grade or elevated on a viaduct.

Floods
Flooding may occasionally occur in areas adjacent to the plateaus, or immediately beneath the sloping plains, but the project area is unlikely to be affected by flash floods, as it is too far from such region. There is therefore little risk to the project related to flooding (EQI 2012: 56)

7.1.3 Hydrology

The River Nile and its alluvial aquifer meet all of Cairo's freshwater demand; human daily use (consumption and domestic uses), agriculture, and industry.

Surface Hydrology

The GCR covers an area of about 300 km², with an average length along the Nile river of about 50 km. The Nile cuts through the city from south to north, its flow depending on the discharge delivered through the Aswan High Dam, and the water withdrawals occurring along its path to the Delta Barrage. Just as the Nile is the primary source of fresh water, it is also the primary receptor of wastewater and drainage generated by different activities.

The Metro Line 3 Phase 3 alignment shall cross two branches of the Nile, from the downtown area (eastern bank of the Nile) to Zamalek (240 m wide, 5 - 7 m deep); and from Zamalek to the Giza area on the western banks (100 m wide, 5 - 6 m deep). Both these crossings shall be for phase 3A, and beneath the riverbed.

In addition, the alignments for sub-phases 3B and 3C will come into very close proximity with the Zomor Canal, west of the Nile, which generally runs parallel to the ENR Upper Egypt and El Manashi lines. Its main water supply source is the Nile River. The Zomor canal feeds the Oussim, Kanass, and Kom El Ahmar secondary irrigation canals in the vicinity of the Rod El Farag Station (EQI 2012: 56).

Zomor Canal

Zomor canal is one of the irrigation canals in Giza which passes through Bolak El Dakrour, its length is 27 km and width ranges between 10 and 25m. The depth of the canal at Cairo University and Bashtil is 2.0 and 1.6m respectively. Besides its original purpose, the Canal has been used as a waste dump as shown in Figure 7-3 and 7-4. The effect of waste leaching into the water is reflected in the chemical analysis of the collected samples as will be discussed later.

Figure 7-3: Zomor Canal besides Sudan St

Source: (EQI 2012:137)

Figure 7-4: Zomor Canal besides Cairo University
Source: EQI 2012: 137

The Metro tracks in the vicinity of Boulaq El Dakrour, and Imbaba/Bashteel's agricultural land will be either at-grade or elevated, therefore influence of the project on surface water bodies such as these canals seems possible. The 3C alignment, in particular, will follow the same course as the Zomor Canal, between the end of Gamaet El Dowal Street and Cairo University. In fact the alignment may be built directly above the canal. For sub-phase 3B, the Rod El Farag Terminal Station will be located in proximity of the canal, in agricultural land that depends on its waters. Flood irrigation is used in the cultivated areas located northwest of Imbaba, therefore agriculture drains are established to wash the mineral salts from the soil and maintain the water table below the root zone. There is only one main drain in the area which is Al Sawahel Drain, which runs parallel to the east of Zomor Canal. The drain does not run all the way south to Boulaq, however, but it will be in close proximity to the Rod El Farag station.

Neither the water levels nor the flow rates are monitored in the Zomor canal or Sawahel drain, however they fluctuate according to crop water requirements and the irrigation schedule. Accordingly, the canal might dry out during the winter closure period in February, or at other times when water requirements are minimal.
The water quality in these water courses is largely dependent on human activities, i.e.: agricultural, industrial, and domestic practises. The water quality in the Nile River is affected by the carried out activities upstream the point of concern. The water quality in the irrigation canal reflects the quality of the Nile water. However, due to the illegal dumping of wastes, the water quality is deteriorated. Finally, the water quality in the drains reflects the pollution load from agricultural activities in addition to the illegal effluent from the industrial and domestic activities. As such, the Zomor canal, which is located practically at the doorstep of some of the residents of Boulaq El Dakrour contains vast quantities of illegally-dumped waste.

Appendix 4 contains the results of the water quality analysis of two samples from the Zomor canal and two samples from the Nile branches surrounding Zamalek. A summary of the results is presented below in Table 7-2. *Although pH, EC and heavy metals' concentrations were within acceptable limits at all sampling points, the results of the analysis indicate significant anthropogenic pollution. The results show very low DO concentrations in the Zomor canal, which are lower than the limit imposed by law 48/1982 for freshwater bodies (minimum of 5 mg/l). COD was excessive at all locations, but especially so in the Zomor Canal, indicating the presence of large amounts of organic materials. On the other hand, BOD values were low, in conformity with the law. Oil and grease concentrations are excessive at all sampling locations, apart from Zomor Canal (northern location). Nitrates and*

Nitrites were within acceptable limits. Microbial tests also indicated significant counts of pathogenic fecal coliforms (E.Coli) in the Zomor Canal, probably from contamination from sewages in the area of Boulaq El Dakrou, and Proteus in the Nile branches (EQI 2012: 57).

Table 7-2: Analysis Results for the Surface Water Collected Samples

	Water quality standards for freshwater bodies (Egyptian Law 48/1982)	Zomor 1	Zomor 2	Nile East	Nile West
Parameter		Results			
pH	7-8.5	7.7	7.5	8.2	8.4
Electrical conductivity (EC), µS/cm	-	693	743	355	358
TSS, mg/l		12	7	6	11
DO, mg/l	>5	3.3	1.7	7.0	7.1
BOD mg/l	6	3.6	1.8	1.2	2.4
COD, mg/l	10	141.4	121.2	20.2	40.2
Oil & grease, mg/l	0.1	82	Nil	54	15
NO_3, mg/l	-	5.516	7.075	7.792	3.503
NO_2, mg/l	-	0.042	0.099	0.069	0.062
Aluminum, mg/l	-	0.2027	0.0915	0.1424	0.0736
Boron, mg/l	-	0.0401	0.0264	<0.01	<0.01
Cadmium, mg/l	0.01	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt, mg/l		<0.0009	<0.0009	<0.0009	<0.0009
Chromium, mg/l	0.05	<0.01	<0.01	<0.01	<0.01
Copper, mg/l	1	<0.008	<0.008	<0.008	<0.008
Iron, mg/l	1	0.2235	0.1983	<0.04	<0.04
Manganese, mg/l	0.5	0.0782	0.0902	0.0254	0.0236
Molybdenum, mg/l	-	0.0087	0.0069	0.006	0.0071
Nickel, mg/l	-	<0.002	<0.002	<0.002	<0.002
Lead, mg/l	0.05	<0.006	<0.006	<0.006	<0.006
Strontium, mg/l	-	0.6750	0.6396	0.3178	0.3131
Vanadium, mg/l	-	<0.01	<0.01	<0.01	<0.01
Zinc, mg/l	1	0.0220	0.0207	0.0103	<0.0007
As, µg/l	0.05	Nil	Nil	Nil	Nil
Hg , µg/l	-	Nil	Nil	Nil	Nil
Coli from Counts	-	170 CFU/ml	900 CFU/ml	80 CFU/ml	20 CFU/ml

Source : (EQI 2012: Annex 1)

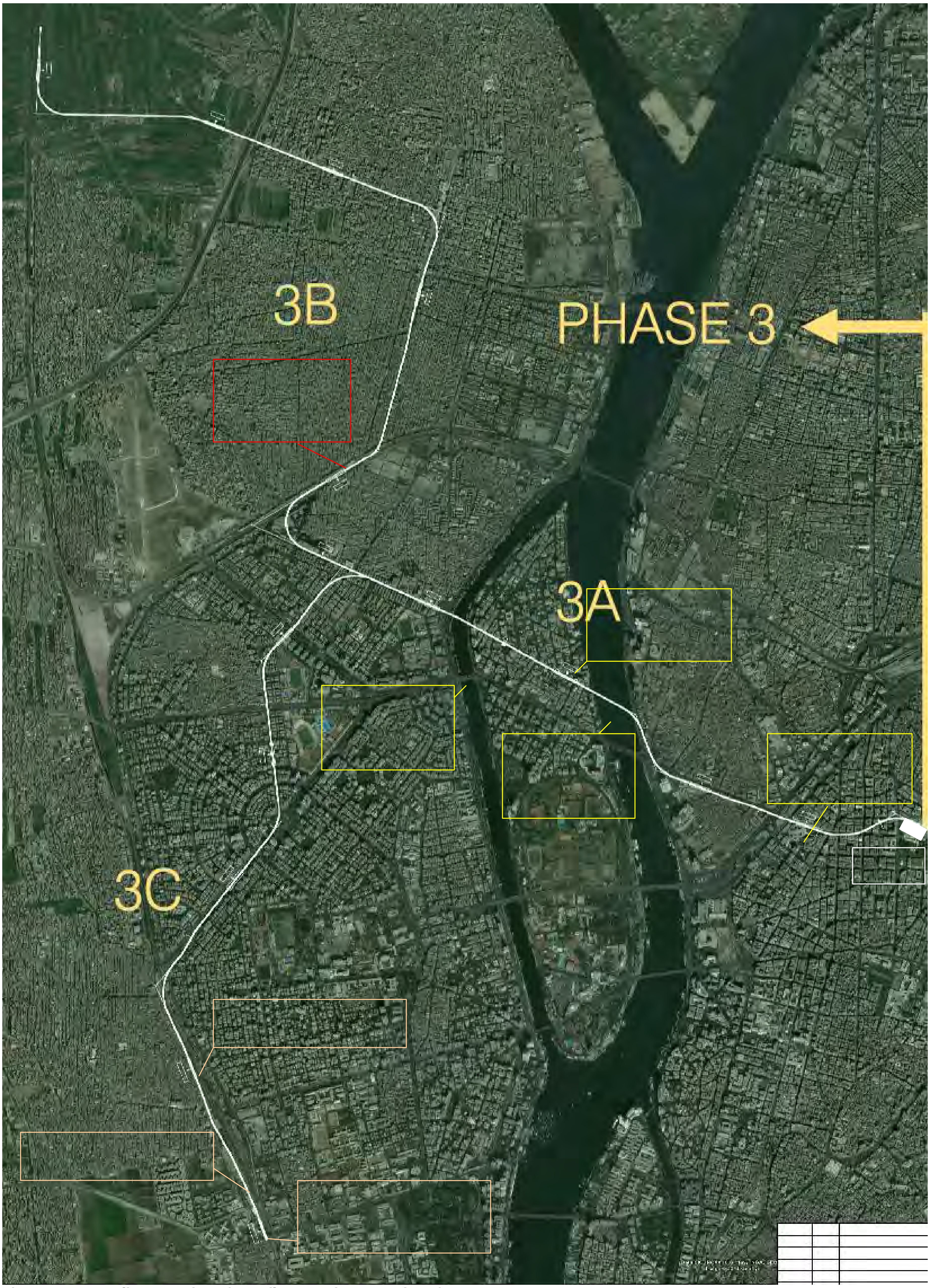

Figure 7-5: Sampling Locations for Soil, Groundwater and Surface Water

Hydrogeology

The main aquifers of concern beneath Cairo are the Nile Alluvium and the Nile Delta aquifers, which are closely connected as they part of the same Quaternary/Tertiary complex; sometimes no distinction is made between them in literature. They are recharged through seepage from the Nile River, canals, and excess irrigation water percolating downwards. The water in the top layers of the aquifers tends to flow horizontally and vertically from and to the canals, drains and the main body of the underlying aquifers themselves.

The Nile Alluvium aquifer lies in the Quaternary and Tertiary deposits of the Nile Valley floodplain. It extends beneath the delta and its desert fringe areas, and while it is only 5 to 70 m deep in the Cairo area, it becomes considerably deeper in the southern parts of the Nile valley (300 m at Sohag). It consists of a thick layer of graded sand and gravel with clay to silty clay aquitards (semipervious layers) at various depths in its major part, and an impermeable clay aquiclude at the bottom. In the western parts of Cairo City, near the PARP, there are no aquitards, so the aquifer essentially consists of a single alluvium layer (Said, 1962).

The Nile Delta aquifer is more prevalent in the central part of the Nile valley and northern section of Cairo. Much like the Alluvium aquifer, its bulk consists of Quaternary and Tertiary deposits (clay, siltcoarse sand and gravel) 200- 500 m thick, but it is confined between an impermeable Pliocene clay aquiclude at the bottom, and a semipervious Holocene aquitard (clay/silt cap) lying at the surface. The thickness of the aquitard increases uniformly from about 5 m in northern Cairo and reaches 60 to 70 m at the Mediterranean coast. The aquifer's overall thickness follows a similar pattern: it is very deep near the Mediterranean coast (1,000 m), but actually almost vanishes near Cairo, which is why it is considered to be distinct from the Alluvium aquifer (NWRC, undated; Said, 1962).

The depth to groundwater surface depends mainly on the ground surface elevation at a particular point. In the vicinity of the Metro Line 3 – Phase 3 project, the groundwater suface depth ranges from 3 to 7 m below the surface. Away from the Nile River and close to the sloping plains, the depth to groundwater increases to more than 40 meters due to the high topography of these areas. Groundwater levels in the Quaternary aquifer is in dynamic equilibrium with a constant average value over time (RIGW, 1989). While there are some pumping wells that serve the scattered rural communities in the vicinity of Rod El Farag Station (3B), the average daily pumping rate of these wells varies between less than 5,000 and up to 20,000 m3, with no major effect to the piezometric head

Groundwater salinity close to the Nile River is low (less than 1,000 ppm) but increases gradually in the fringes of the floodplain, where it may reach up to 5,000 ppm. The high salinity attributed to the reduction in the direct recharge rate from the Nile, but through salt leaching from the top layer, which occurs during irrigation. As The main prevailing types of groundwater in the Quaternary Alluvium are Ca (HCO3)2 and Mg (HCO3)2 aquifer. This indicates that groundwater replenishment is taking place as a result of the continuous recharge of the aquifer through excess irrigation water. The relative shallow depth to groundwater surface and the semi-impervious nature of the soil in some locations indicate that the Alluvium aquifer is particularly sensitive to surface pollutants. , including:
(1) Scattered point and line pollution sources from domestic activities.
(2) Diffuse pollution sources from agricultural activities.
(3) Scattered point and line pollution sources from industrial activities.

Groundwater quality in the project area

Four locations were selected to establish an environmental baseline of the groundwater quality along the Metro 3 – Phase 3 alignment. More specifically groundwater samples were collected at the planned locations of the Cairo University, Zamalek, Nasser, and Imbaba stations. These stations were selected to cover the main geographical areas encompassed by the project. The complete results of the analysis are available in Appendix 3 of this report. The results show that the groundwater pH at all locations conforms with the standards set by Law 48/1982 (pH 7 – 9) of freshwater bodies, but tends towards alkalinity, the majority of samples testing above the pH 8 mark. Oil and grease content is above the legal limit of 5 mg/l in all samples, and excessively so at the Cairo University (about 25 mg/l), possibly due to the proximity of the Metro 2 terminal station, multiple roads, and large ENR workshop/depot. Dissolve Oxygen levels are all above or equal to the minimal requirement of 5 mg/l.
Available metals are for the most part within legal limits, with the exception of Fe, Mg. Cairo University, in particular, has very high Fe concentrations. Nitrates are within acceptable limits at all locations, but nevertheless indicate contamination in some areas, such as in Cairo University, which has considerably higher concentrations than the other stations. Nitrite is slightly above the acceptable 1 mg/l limit at Nasser, but otherwise concentrations are within acceptable limits. BOD and COD and salinity (EC) were largely in excess of national standards at all locations. Predictably, microbial analysis revealed high counts of coliforms (E.Coli, Proteus, Salmonella, Enterobacter), indicating heavy contamination from the sewage network.

Generally, even where some elements were found to be within acceptable limits for freshwater bodies, their concentrations indicate major contamination from anthropogenic (i.e. municipal, industrial and agricultural) sources. The groundwater in the vicinity of the Cairo Metro 3 – Phase 3. The groundwater samples from Cairo University seemed to be of lowest quality, which can be attributed to infiltration from the Zomor Canal, the ENR workshop activity, and the proximity of Boulaq El Dakrour, where the wastewater networks are either lacking, or poorly maintained (EQI 2012: 58).

Table 7-3: Groundwater pollution sources and pollutants

Pollution Sources		Potential Pollutants
Domestic Activities	Leakage from sewage systems, septic tanks, sewage water drains	Basteria Nitrate and ammonium Phosphate Heavy metals Organic micro compounds
Agricultural activities	Excessive use of fertilizers Excessive use of pesticides Irrigation with waste water	Nitrate Phosphate Pesticides Bacteria (from wastewater irrigation)
Industrial activities	Main type of industry	Main type of pollutants
	Food production	Non chemical hydrocarbons AS PROTEINS Ammonia Vegetable oil products
	Textile industry	Aromatic hydrocarbons Heavy metals (Cd, Zn, Cu, etc.)
	Wool, paper and graphical industry	Aromatic hydrocarbons Mineral oil Heavy metals (Cd, Zn, Cu, etc.) Phenols
	Chemical industry	Aromatic hydrocarbons Chlorinated hydrocarbons Heavy metals (Cd, Zn, Cu, etc.) Phenols Cyanide, etc.
	Oil and soap industry	Mineral oils Aromatic hydrocarbons Heavy metals (Cd, Zn, Cu, etc.)
	Metal and machine industry	Heavy metals (Cd, Zn, Cu, etc.) Acids Aromatic hydrocarbons Mineral oils
	Construction (supporting)industry	Mineral oils
	Small scale service (gas stations and garage)	Mineral oils Aromatic hydrocarbons

Source: RIGW, Guidelines with respect to groundwater quality, 1992 **(EQI 2012: 60).**

7.1.4 Climate

Climate of Egypt is mostly hyper-arid, with the exception of coastal areas, which enjoy a slightly milder, arid climate due to the maritime effect of the Mediterranean Sea. Precipitation rate is generally low throughout the country and is mostly in the form of winter rain. Average rainfall is highest in the Mediterranean coastal belt, ranging from a maximum of 304 mm/year in Rafah, to a minimum of 73 mm in Port Said. South of the narrow coastal belt, rainfall drops to less than 10 mm annually throughout most of the country. One of the major features of rainfall of these regions is its great temporal and spatial variability. Percentage variability is greatest in the hyper-arid provinces.
The climatic profile of the Greater Cairo area is constructed using data obtained from four meteorological stations near the new Cairo area and Downtown. These are the Cairo Airport, Abbasiya, Qatamiya and Almaza stations. Climate of the area is a typical Mediterranean climate with hot and a dry summer and worm rainy winter. Rainfall is very scanty and highly sporadic in time and place. Temperature is high and undergoes wide daily and seasonal fluctuations. Potential evapo-transpiration is extremely high, and coupled with the low rainfall, results in extremely arid conditions which characterize eastern Sahara.

Temperature
Temperature is generally hot to warm throughout the year. July is the hottest month of the year with a mean ambient temperature of 27.7°C and a mean maximum of 34.8°C. January is the coldest month with a mean temperature of 13.7o C and a mean minimum of 8.8°C. Considerable daily fluctuations in ambient temperature occur in the project area, ranging from 11.2°C in winter to 14.5°C in summer. Data from the Qattamiya station shows absolute maximum and minimum temperatures of 46.1 and 1.0°C. Soil surface temperature in the study area is generally high. ***Error! Reference source not found.*** *shows the temperature profile of the Greater Cairo area.*

Precipitation
Precipitation is generally low and mostly consists of winter rain. Annual rainfall varies between 20.3 and 24.8 mm. The bulk of the rain (88%) falls during the five months from November to March. The period from July to September is practically rainless. Heavy downpours, where the equivalent rainfall of several years can occur within a few days or even hours, often resulting in violent flash floods. On the 5th of December, 1965, the Cairo Airport meteorological station recorded 50.0 mm rain within only a few hours. On the 6th of December, 1951 a rainfall of 40 mm was recorded in one day at the Almaza station. Storms resulting in rainfalls of 20 to 40 mm have been recorded in the greater Cairo area in the past with higher frequency. Fig. 4.4 shows mean monthly precipitation rates at four Greater Cairo stations.

Relative Humidity
Relative humidity is generally low in the project area, averaging 53.7% annually. Recoded RH values range between 40% in April and May to 62% in December. The highest relative humidity occurs in November, December and January and the lowest in the April to June period. Relative humidity fluctuates during the day showing high values at night and early morning and low values at noon. Table 7-7shows mean monthly relative humidity at four Greater Cairo stations.

Evaporation Rate
The project area is characterized by a very high evaporation rate, which exceeds the precipitation rate. Daily evaporation rate ranges between a minimum of 4.7 mm in January and a maximum of 18.1 mm in June, with an annual average of 10.2 mm. The highest evaporation occurs during the three months April, May and June (the time of low relative humidity), and the lowest evaporation rate occurs from November to January, the months of high relative humidity. Fig. 4.4 shows mean monthly evaporation rates at four Greater Cairo stations.

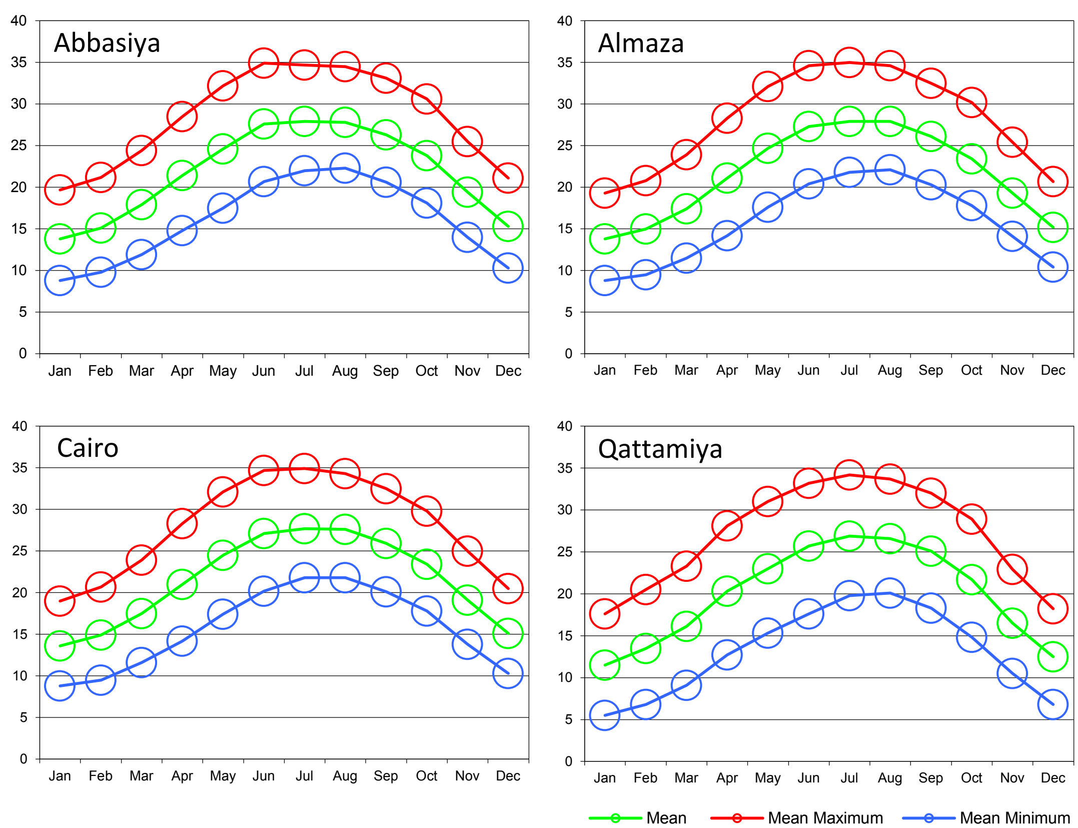

Figure 7-6: Mean Monthly Temperatures at Four Meteorological Stations in the Greater Cairo area

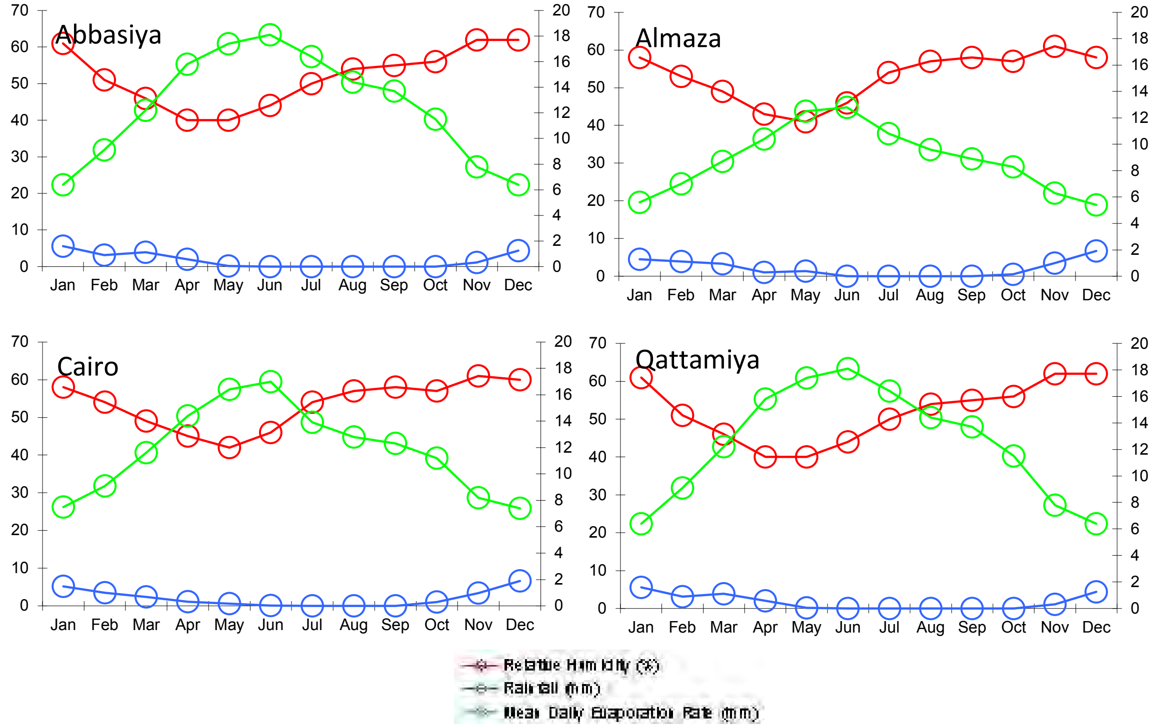

Figure 7-7: Mean Monthly Relative Humidity, Precipitation Rate and Evaporation Rate at Four Greater Cairo Stations

Cloud Cover

The sky is usually cloudless during most of the year. June is the month with the lowest cloud cover (0.9/8.0) and December is the month of highest cloud cover (2.7/8.0). There are variations in the occurrence of cloud throughout the daytime. Early morning (0300 - 0600) is the time of high cloud intensity throughout the year. Midnight and 2100 hour are the times of lowest cloud intensity.

Wind speed and direction

During most of the year, the prevailing wind blows from northeast, north or northwest with a moderate speed. During April and May, the prevailing wind blows from the southeast, shifts to northeast in June, to both northeast and northwest in July, August and September, before resuming its north-easterly direction during the rest of the year.

Fog, Mist, Haze and Sandstorms

Fog occurrence is infrequent in the GCR. The mean number of foggy days per year ranges from 8.1 in Abbasiya to 20.9 in Cairo Airport, occurring most often in July, August and September.

Mist and haze commonly occur in the GCR and appear to be associated with the air pollution levels. Frequencies of occurrence of mist ranges from 49.2 days per year in Abbasiya to 95.7 days per year in Almaza. Occurrence of haze in the area ranges from an average of 23.0 days per year in Qattamiya, to 202.8 days per year in Almaza. Both mist and haze occur most frequently summer months.

Wind-driven dust and sand rising is somewhat frequent in the Greater GCR, particularly during the winter months. Occurrence frequency of dust and sand rising ranges from an average of 13 days per year in Abbasiya to 27.2 days per year in Cairo Airport. Sand storms are less frequent, occurring at an average rate ranging from 0.5 days per year in Abbasiya to 4.4 days per year in Cairo Airport. Dust and sand storms occur most frequently during spring months.

Gales with surface wind speed of 34 knots or more occur at a frequency of 0.8 to 1.5 day per year in Qattamiya and Cairo Airport respectively, mostly during spring months.

Thunderstorms are rare in the Greater Cairo area, averaging only 0.9 days per year in Qattamiya to 1.8 days per year in Almaza. Late winter and spring is the time of maximum occurrence of thunderstorms (EQI 2012: 61).

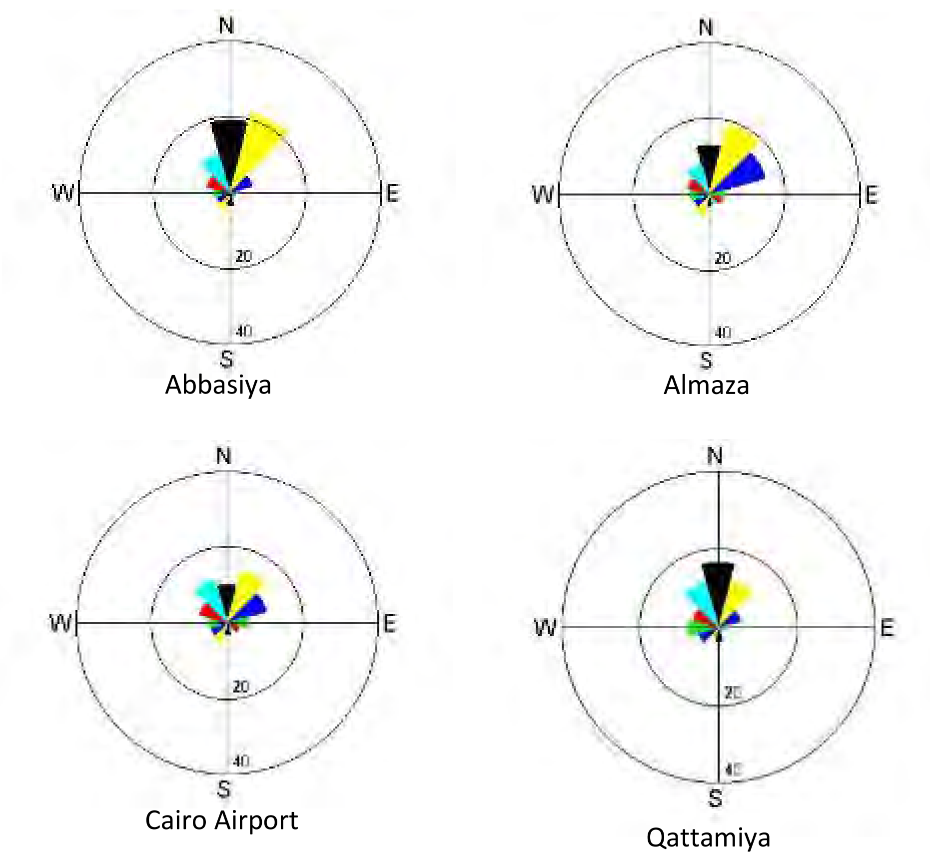

Figure 7-8: Wind Roses for Four Greater Cairo Stations

7.1.5 Air Quality

This section will describe the ambient air quality in the project area. Data and information have been derived from two overall sources: 1. The data available through the National Network Stations for Monitoring Air Pollutants of the EEAA and 2. The ambient air quality monitoring measurements as carried out by the EQI Study Team between the 16th November 2011 and the 2nd of December 2011 at four locations specific to the Metro Line 3 Phase 3.

Existing ambient air quality data

The Ministry of State for Environmental Affairs (MSEA) and its Executive Agency (EEAA) have established an integrated National Network for monitoring air pollutants composed of 87 stations for monitoring of main air pollutants periodically and continuously since 1998. Through the Egyptian information and monitoring program (EIMP) ambient particulate matter (PM10 and PM2.5) and lead as well as SO2, NO2, CO, and O3 have been monitored, while the Cairo air improvement project (CAIP) have monitored ambient particulate matter (PM10 and PM2.5) and lead. The monitoring network of the EEAA has also monitored other pollutants such as volatile organic compounds (VOC) and non-methane hydrocarbons compounds (NMHC). Furthermore, the MSEA compiles data from metrological stations, such as wind speed, direction, temperature, and relative humidity. The most important air quality indicators that are monitored through the network of monitoring stations include:

- Sulphur Dioxide (SO_2)
- Nitrogen dioxide (NO_2)
- Particulate Matters (PM_{10})
- Lead
- Carbon Monoxide (CO)
- Ozone (O_3)

In addition the following air quality indicators related to pollutants that affect citizen's health negatively are included in the monitoring programme: $PM_{2.5}$ and NH_3.

As part of the monitoring network there were 48 monitoring stations in Greater Cairo in 2009 distributed over different types of sites as presented in **Error! Reference source not found.**.

Table 7-4: Distribution of Air Quality Monitoring Stations According to Types of Sites in the GCR (2009)

Site Type	No. of monitoring stations in GCR - 2009
Industrial area	8
Urban area	9
Residential area	5

Traffic dense area	10
Remote area	4
Mixed area	12
Total	48

Source: EEAA State of the Environment Report 2009: 26

Under the EIMP monitoring *of* SO_2, NO_2, CO, and O_3 as well as ambient particulate matter (PM_{10} and $PM_{2.5}$) and lead *have been carried out at the sites presented in* Table 7-4. *The CAIP monitoring stations included 37 sites in total, but are limited to monitoring of* ambient particulate matter (PM_{10} and $PM_{2.5}$) and lead.

Table 7-5: EIMP Monitoring Sites in the GCR

No	ID	Area type	Starting date
1	Quallaly	Urban Centre	24-May-98
2	Gomhoryia	Street Canyon	25-December-97
3	Abbassyia	Urban/Residential	22-May-99
4	Nasr City	Residential	08-October-98
5	El-Maad	Residential	10-December-98
6	Tabbin	Industrial	27-October-97
7	Tabbin South	Industrial	19-October-98
8	Fum El-Khalig	Road side/Urban	07-November-98
9	Abu Zabel	Industrial/Residential	16-November-98
10	Shoubra El Kheima	Industrial	01-May-98
11	Cairo University	Residential	18-July-98
12	Kaha	Background site	1-July-2001
13	6 October	Residential/Industrial	12-January-99
14	10 Ramadan	Residential	15-December-98

Source: Safara and Labibb, 2010

The location of air quality monitoring stations in Delta and Greater Cairo are presented in Figure 7-9 overleaf.

Safara and Labibb (2010) have described the results of the air quality monitoring of ambient particulate matter and lead levels carried out by the EEAA in Greater Cairo for the period 1997-2007. Figure 7-9 shows the fluctuations in annual average PM_{10} concentrations in the period 1998-2007 in GC for selected monitoring sites representing different types of area: Abbasya (mixed site), Fum Al-Kalig and Quallaly (traffic sites), Maadi, Helwan and Heliopolis (residential sites), Shoubra Khema andTebbin (industrial sites), Massara (mixed site) and Kaha (background site).

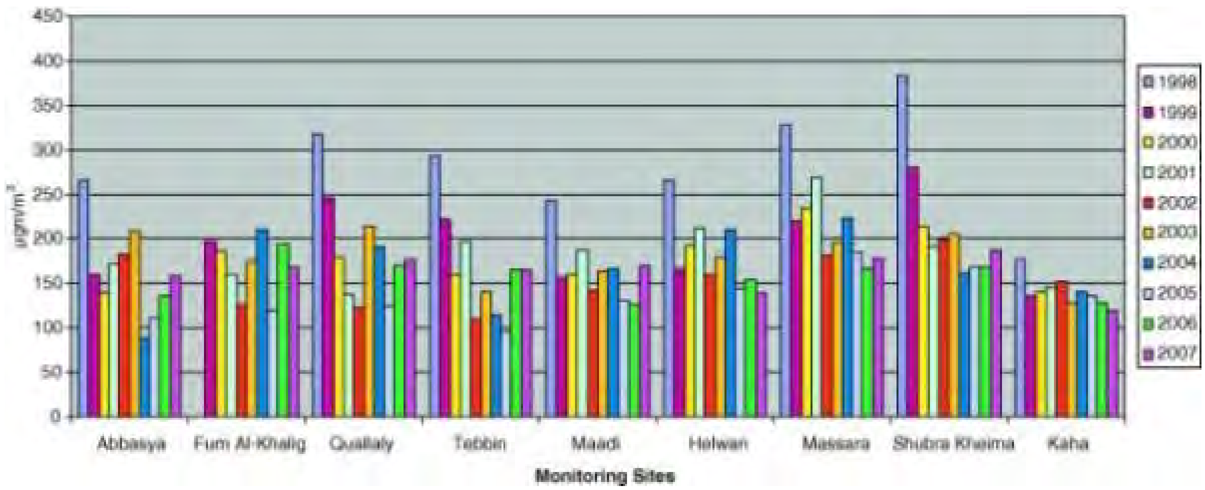

Figure 7-9: Fluctuations in Annual Average PM10 Concentrations in GC, 1998-2007

Source: Safara and Labibb, 2010

The PM_{10} concentrations are high and above the annual averages stated in the environmental law of Egypt (no. 4/1994) and the executive regulations. However, the results show fluctuations over the years, but a clear downwards trend can be discerned from the results.

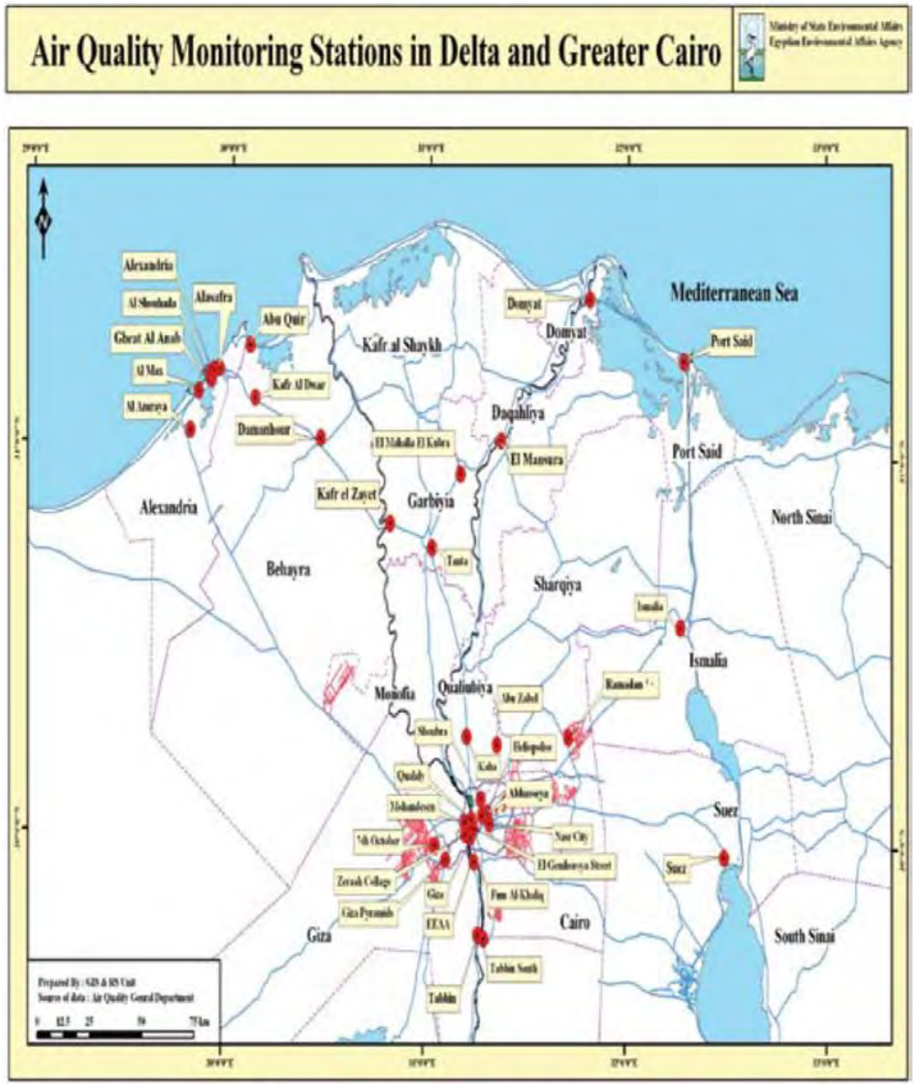

Figure 7-10: Location of air quality monitoring stations in Delta and Greater Cairo
Source: EEAA State of the Environment Report 2009: 27

Figure 7-11 shows the average source contributions of PM_{10} emitted from different source categories in the GC area during winter, fall, and summer.

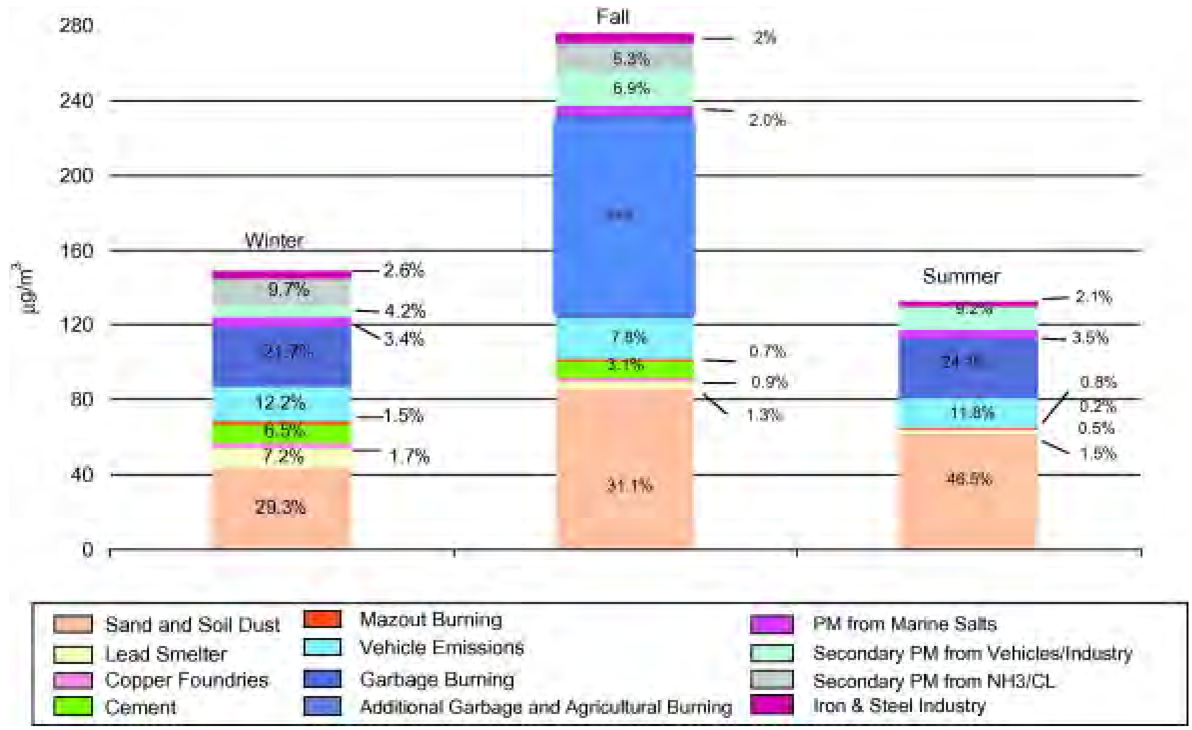

Figure 7-11: Average Source Contributions of PM10 Emitted from Different Source Categories

Source: Safara and Labibb, 2010

The analysis of the average source contribution shows that sand and soil dust is one of the main reasons for high PM_{10} concentrations in ambient air, which is associated with the arid climate with little rainfall and the constant northern wind carrying dust and sand particles from the deserts. However, the analysis also shows that burning of waste is a major cause of higher values of concentrations of particulate matter in the ambient air (Safara and Labibb 2010).

The annual average of all monitoring sites for Pb_{10} and $Pb_{2.5}$ concentration recorded during the period of 1998 through 2007 for the GC area are shown in Figure 7-12 below.

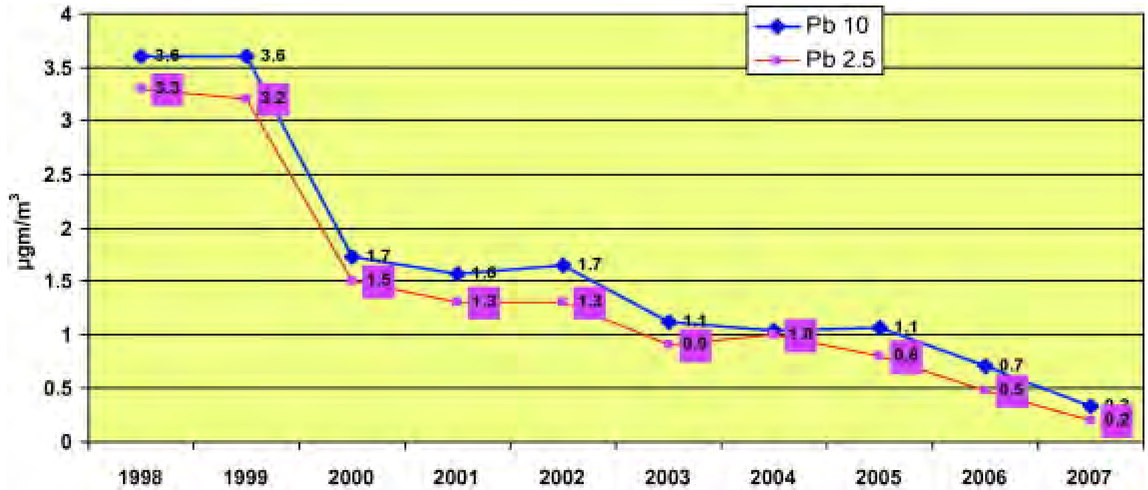

Figure 7-12: Annual average concentrations of Pb10 and Pb2.5 from 1998 to 2007 for the GC area (annual averages of all monitoring sites in the area)

Source: Safara and Labibb, 2010

It is evident that the annual average concentrations have fallen rapidly in the monitoring period, which is attributed mainly to the closing down and moving of lead smelters ((Safara and Labibb 2010).

The EQI study team presented the following information related to existing data on ambient air quality for the pollutants monitored by the EEAA, i.e. the major air pollutants particulate matters ($PM_{2.5}$, PM_{10}), Carbon Monoxide(CO), and Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), Lead (Pb) and Ozone(O_3).

Particulate matter (PM2.5, PM10)

Particulate matters are common pollutants in dry, semi-arid zones, industrial and heavy traffic areas. These airborne, suspended, particles consist of a mixture of primary particles resulting from incomplete combustion of fuels and secondary particles resulting from chemicals reactions between various atmospheric pollutants. Other types of dust particles are directly emitted from industrial facilities, such as cement plants and electrical power stations, solid waste incinerators…etc. Moreover, wind-borne dust particles from desert areas significantly affect air quality in the GCR. They are responsible for 30-50% of PM10.

[Inhalable] particles are one of the main causes of increased pollution levels in Egypt, and especially in the GCR. They have negative impacts on human health, causing dangerous respiratory system-related problems. Particles less than 10 µm (PM10) are harmful because they can be inhaled easily; and those less than (PM2.5) are even more dangerous, because they can penetrate deep into the lungs, interacting with the blood stream and reaching different organs of the body.

The Environment law 4/1994 has stipulated that annual average permissible limit of inhalable particles less than 10 µm in diameter (PM10) is 70 µg/m3. Average concentration of PM10 in the GCR in 2009, however, was 149 µg/m3.

Gaseous Pollutants

Combustion of fossil fuel is the main source of gaseous pollutants, such as nitrogen oxides (NOX), sulphur oxides (SO2) and carbon monoxide (CO). These gases have an important role in deteriorating air quality and smog formation. Furthermore, when these gases interact with oxygen, in the presence of hydrocarbons and under the effect of ultraviolet rays, they form very dangerous secondary pollutants such as Ozone (O3), which causes inflammation mucous membranes of respiratory system (leading to coughing, lung inflammation, asthma and bronchitis), as well as eye irritation.

Sulphur Dioxide (SO2)

SO2 is primarily generated through the oxidation of sulphur residues in liquid oil fuel during the combustion process from fixed sources, such as energy generation or industrial different plants, or mobile sources, such as vehicles (particularly those equipped with diesel-fired engines). The permitted annual limit in Law 4/1994, amended by Law 9 of 2009 is 60µg/m3. SO2 [concentration] measured during 2009 by the EEAA, shows that annual average concentrations did not exceed the permissible limits in the GCR (28 µg/m3 in 2009) [..]

Nitrogen dioxide (NO2)

NO2 is emitted as a result of fuel combustion processes at high temperatures, and Executive Regulations of Environmental Law 4/1994 did not define annual average limit for its concentration. However, the World Health Organization (WHO) specified 40µg/m3 as the annual average for NO2 concentrations, and the modified Executive Regulations for Environment Law No. 9/2009 suggest the application of WHO standards for nitrogen dioxide in ambient air. Annual average level of 2009 in Greater Cairo was 36 µg/m3 compared to 64 µg/m3 in 2008. This is due to increased control over factories' emissions, and the implementation of regulations requesting factories running on natural gas to use low-NOx burners to reduce NOX emissions. High concentrations are expected in areas of dense traffic, however, where poorly maintained cars are still in use [..]

Lead (Pb)

Pb affects human health through inhalation and the ingestion of food contaminated with Pb or its derivatives. Pb is present on dust particles, which when inhaled accumulate in human blood. It has negative impact on human embryos, and causes mental disabilities, especially among children, and anaemia.

Executive Regulation of Environment Law 4/1994 set permissible limits of Pb concentrations at 0.5 µg/m3 in residential areas and 1.5 µg/m3 in industrial areas. Pb concentrations have fallen significantly in the GCR over the past decade, from 1.67 µg/m3 in 2000 to reach 0.73 µg/m3 in 2009. This reduction represents about 60.3% decrease. This is due to efforts from the MSEA to reduce Pb pollution loads by relocating industrial sites (notably foundries) away from Cairo, the increased production of lead-free gasoline, and the use of compressed natural gas as a fuel for vehicles. Despite these efforts and their success, average concentrations for 2009 were slightly higher than the permissible annual average limit stipulated in Law 4/1994. This may be traced to the significant increase in the consumption of gasoline 80, following the recent price rise witnessed for other kinds of gasoline.

Carbon Monoxide (CO)

CO is emitted from vehicles' exhausts and the combustion of coal and wood. It is one of the most toxic pollutant to humans and animals, because it combines with haemoglobin into carboxyl haemoglobin, thereby preventing oxygen fixation in the blood and leading to asphyxiation. The Executive Regulation of Environment Law 4/1994 sets maximum allowable exposure to carbon monoxide for one hour to 30 mg/m3 and 10 mg/m3 for 8 hours. Despite the steady increase in human and industrial activities and consumption rates of energy, CO concentrations of 2008-2009 are relatively stable and within permissible limits: 99% of 2009 of the EEAA's recorded measurements were acceptable. This is due to improved fuel combustion efficiency in the industrial sector, electricity generating plants, and increased use of natural gas instead of diesel.

Ozone (O3)

O3 is a secondary pollutant that can be found in the lower layers of the atmosphere as a result of the interaction between volatile organic pollutants emitted from vehicles with nitrogen oxides in the presence of sunlight. Therefore, ground O3 concentrations are higher during the summer months as a result of the increase in sunshine hours. O3 constitutes a serious threat to human health and leads to the formation of smog. Executive Regulation of Law No. 4/1994 specifies that the highest ambient concentration of O3 must not exceed 200 µg/m3 in one hour, or 120 µg/m3 over a period of 8 hours.

In the GCR, average O3 concentration has dropped from 79 µg/m3 in 2007, to about 68 µg/m3 in 2009 (EQI 2012: 64ff).

<u>Ambient air quality monitoring by EQI Study Team</u>
The EQI study team conducted 24 hour air monitoring measurements at four locations specific to the Metro Line 3 Phase 3. These were carried out in the period between the 16th of November 2011 and the 2nd of December 2011. The parameters that were monitored included:

- NO_x; SO_2; CO; and O_3
- PM_{10}

- Wind Speed and wind direction
- Atmospheric Temperature
- Barometric Pressure (EQI 2012: 66)

For each of the measured parameters 1-hour averages were obtained for the four monitoring locations. The monitoring locations and dates of monitoring along with project changes since the EQI study are presented in **Error! Reference source not found.**.

Table 7-6: Air Quality Monitoring Locations, Dates, Description, and Project Changes

No.	Location	Dates	Description of project component	Description of location	Project changes
1.	Cairo University (Gamaat El Kahera)	16-17 Nov 2012	Elevated station, interconnection with Line 2	Intense traffic	-
2.	El Qawmeyya	17-18 Nov 2012	Elevated station	Very intense traffic, trucks	-
3.	Zamalek	30 Nov – 1 Dec 2012	Underground station	Residential area with less traffic	Location of station has changed
4.	Maspero	1-2 Dec 2012	Underground station	Intense traffic	-

Source: Based on EQI 2012: 66

In relation to the parameters monitored EQI states that atmospheric temperatures and other meteorological parameters were within the normal range for the period of the year where the study was carried out (EQI 2012: 65). The full results of the air quality monitoring are presented in Appendix 4. EQI provide the following conclusion on their ambient air quality monitoring:

The air emissions data shows that NO_x and PM_{10} exceeded the limits in all of the locations, apart from PM-10 in El Qawmeyya. Otherwise, PM_{10} measurements are up to twice as high as the Egyptian limit set by Law 4/1994; and NO_x, in particular has been measured in concentrations equivalent to the triple of the national limit. This is attributed to vehicular traffic. The highest concentrations of NO_x were in the vicinity of Maspero. Zamalek, which is more residential compared to the other 3 locations, and which does experience less traffic (in Ismail Mohammed St.), does experience lower levels of atmospheric pollution, with the exception of O_3. Predictably, the highest concentrations of ambient atmospheric pollution occurred around the morning and evening rush hours [..].El Qawmeya does experience intense traffic later into the evening than the other three locations, and is close to the Ring Road; it also is used by many trucks, which contribute greatly to NOx emissions (EQI 2012: 65).

It should be noted that the EQI study team have compared the obtained measurements for NOx have been compared with the limits for NO_2. This provides a skewed result. Therefore, the conclusion on the study should be modified to PM_{10} exceeded the limits in all of the locations, apart from PM_{10} in El Qawmeyya and that high levels of NOx concentrations where identified.

In Table 7-7 below the results of the air quality monitoring are presented with respect to the maximum 1-hour mean concentrations and their time of occurrence for the four locations.

Table 7-7: Air Quality Monitoring – Maximum 1-hour Mean Concentrations and their Time of Occurrence for the Four Locations

Para-meter	Zamalek		El Qawmeya El-Arabeya		Cairo University (Gamaat El Kahera)		Maspero	
	Max. conc.	Hour of occ.	Max. conc.	Hour of occ.	Max. conc.	Hour of occ.	Max. conc.	Hour of occ.
SO_2 (ppb)	6.30	8:00 & 17:00	21.50	16:00	22.40	16:00	20.80	14:00
NOx (ppb)	117.70	18:00	287.30	0:00	207.00	7:00	489.10	8:00 & 9:00
CO (ppm)	1.50	19:00	5.20	0:00	2.70	21:00	17.30	9:00
O_3 (ppb)	31.30	12:00	14.20	15:00	25.30	11:00	7.20	14:00
PM_{10} (µg/m3)	337.30	8:00	393.10	19:00	672.20	9:00	413.90	17:00

Source: EQI 2012: 65

Table 7-8 presents the monitoring results for 1-hour and 24-hour averages and compares them with the Egyptian standards, the EU standards, and the WHO guidelines for air quality.

Table 7-8: Air Quality Monitoring Results and Comparison with Air Quality Guidelines and Standards

Parameter and averaging	**Guideline/standard**			**Data point**			
	EU (2005 /2010)	**WHO**	**EGY (urban /industrial)**	Zamalek	El Qawmeya El-Arabeya	Cairo University (Gamaat El Kahera)	Maspero
SO_2 (µg/m3)							
1-hour	350		300/350	12.10	41.30	43.03	39.95
24-hour	125	125	125/150	5.73	29.05	29.62	29.05
Annual	20	50	50/60				
NO_2 (µg/m3)				**NOx (µg/m3)**			
1-hour	200	200	300	313.16	764.42	550.76	1301.35
24-hour			150	173.37	388.23	228.42	893.72
Annual	40	40	60/80				
PM_{10}							

(µg/m3)							
1-hour							
24-hour	50	50	150	219.50	89.20	319.90	315.50
Annual	40/20		100				
CO (µg/m3)							
1-hour		30000	30000	2570	8910	4630	29650
8-hour	10000	10000	10000				
24-hour							
O_3 (µg/m3)							
1-hour[1]	180/240[2]		180	62.6	28.4	50.6	14.4
8-hour	120	120	120				
24-hour							

Source: Based on EQI 2012: Appendix 4 with reference to EU air quality standards, WHO air quality guidelines, Egypt air quality standards. Note that the table reproduces the EQI study team's comparison of NO2 limits with NOx measurements.

7.1.6 Waste

In Egypt there is a tendency to dispose of municipal solid waste under bridges, along ramps, railways, and other such infrastructure. Large quantities of refuse can accumulate in such places, and will contribute to the degradation of the surrounding environment. An effective waste management system is not in place, even if authorities are created to cope with this situation. This weak institutional set up could impact the handling of waste, emerging from the construction of the Metro line. In the following therefore an overview is provided on the responsible waste management authorities, the legal framework for waste, the type of waste generated during the construction phase of the Metro line, the amount and type of waste generated in the project area, the waste management practice and the declared waste management objectives, based on interviews with relevant institutions.

Responsible Waste Management Authorities in Giza and Cairo Governorate

Even if the waste handling inside of the construction area of the stations and from the alignments are under the responsibility of the contractor, the transport and the dumping of the construction and other wastes in assigned landfill sites are to be controlled by the respective waste authorities.

1 Data point concentrations have been calculated based on EQI study team results using the conversion factor for O_3 of 1 ppb = 2.00 ug/m^3 assuming an ambient pressure of 1 atmosphere and a temperature of 25 degrees. The general equation is: ug/m3 = (ppb)*(12.187)*(M) / (273.15 + °C), where M is the molecular weight of the gaseous pollutant (Conversion between ug/m^3 and ppb, National Environmental Research Institute of Denmark, http://www2.dmu.dk/AtmosphericEnvironment/Expost/database/docs/PPM_conversion.pdf, accessed 8 July 2012.

2 There is an information threshold of 180 µg/m^3, and a warning threshold of 240 µg/m^3. For a warning to be issued, the value must be exceeded during three consecutive hours.

The Ministry of State for Environmental Affairs (MSEA) and its technical arm the Egyptian Environmental Affairs Agency (EEAA) host a General Directorate for solid waste management. The mandate of this directorate is the formulation of policy directives and the provision of guidelines for proper management of municipal waste. The responsible agencies for waste management in Giza and Cairo Governorate are the Cleansing and Beautification Authority (CBA). The scheme below shows the Giza Cleansing and Beautification Authority (GCBA).

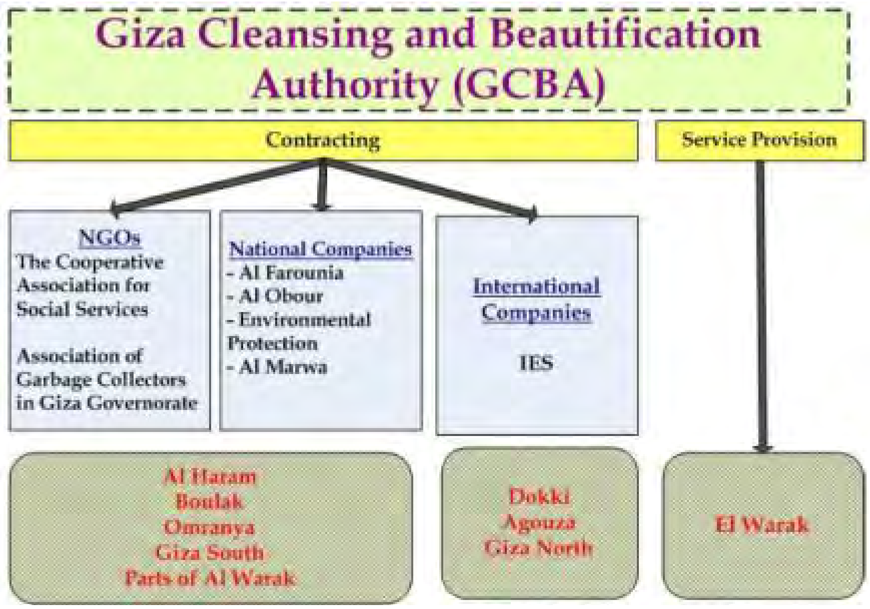

Figure 7-13: GCBA Service Structure

Source: Ecoconserv, Up Stream Poverty and Social Impact Analysis (PSIA) for Egypt's Solid Waste Management Reform, Final Report, December 2010

Cairo and Giza Governorates have special cleansing and beautification authorities which were established in 1983 and 1984 respectively in accordance with two presidential decrees. The logic behind establishing the two authorities was to pave the way towards a more efficient waste management system in the capital. The two authorities play the same role as the local government in all other governorates, but enjoy specialization, separate budgets and financed administrative structure, which allow them to employ a greater number of employees and workers on a governmental cadre basis.

Apart from undertaking waste management by itself, the CBA´s are the official governmental agency in charge of representing the governorate in contractual agreements with various local and international companies. The CBA is responsible for inviting bidders to provide the SWM services within Giza's and Cairo´s jurisdiction and according to Egyptian legislation, namely, Law 89 of 1998 for organizing the tenders and bids.

It is also the main competent authority for monitoring the performance of the international and local companies contracted for the various SWM activities, monitoring their adherence to the various contractual conditions and enforcing fines in cases of violating the contractual agreement. In case of any deficiencies in the performance of the other actors, namely the international and national companies and NGOs who are involved in waste producing and transporting, the CBA is also responsible for ensuring that the provided service meets reasonable waste handling and health and security standards that satisfy the served communities.

The responsibility of CBA regarding the project of the Metro line lies in issuing a license for transfer and disposal of the solid non-hazardous wastes as well as hazardous wastes to the designated places. CBA or a sub-contractor licensed by CBA provides the transport and/or disposal service.

Cleansing for the solid waste management (SWM) sector includes various activities related to SWM (waste collection from streets, waste transfer, final disposal and managing the controlled dumpsite). In addition to this the CBA is responsible for street cleansing and regular maintenance. In practice and like all local governments, the pressure on the SWM in house has given way to the introduction of roles for other actors in SWM systems. This mainly includes international and national private sector companies.

Over the last ten years and with the introduction of the international private sector companies in Egypt, new actors have been introduced to the SWM field in Giza and Cairo, with the main objective being to improve the waste management system in order to cope with the increasing demands and requirements associated with the increased population. The main national entities that cooperate with GCBA can be divided into two main groups, namely national private sector companies and NGOs or local associations.

Public waste collection, whenever it is carried out on its own, is usually not efficient; it operates at a loss and equipment is heavily subsidized. In addition, there are legal problems in terms of raising additional income from user fees. Because of this there is now a trend towards subcontracting a substantial part of waste collection and street sweeping services to new private companies, which have a higher efficiency. Subcontracting to private companies has mainly occurred with services in commercial areas, airports, hotels and in tourist towns. For these kind of services, as well as for the Zaballin (organized private groups of people living from waste recycling), fees are billed directly to the clients. In Cairo, traditionally the Zaballin collect waste from households in middle to high-income areas as in Zamalek, Dokki and Mohandesin and municipalities are in charge of street sweeping.

<u>Solid waste Management Regulations</u>

The contactor of the Metro line 3 Phase 3 has to respect the laws, which are related to an environmentally friendly waste management. The main legislation relating to solid waste management in Egypt is the Law 38 for 1967 as amended by the Law 31 for 1976. The law regulates the collection and disposal of solid waste from residential areas, commercial and industrial establishments, and public places. It prohibits the placement of wastes or wastewaters in areas other than those specified by the local council. It is important to note that the law only applies to cities and villages that have designated by a Governor's decree. A summary of the most significant articles of the relevant solid waste management laws is provided in the following Table.

Table 7-9: Description of Waste Relevant Laws in Egypt

Law and Article	**Description**
Executive Regulations Law 4/1994 on Environmental Protection Act, amended by Law 9/Year 2009 concerning Environmental Protection	According to the Executive Regulations an Environmental Register shall be prepared at the onset of construction of the Metro line and maintained for inspecting of relevant agencies.
Articles 37, 38, and 39 of the Executive Regulation of Law 4/1994 and Law 38/1967, as amended by Law number 31 of 1976,	The respective articles deal with the collection and transportation of solid wastes and prohibits disposal of solid waste except at designated sites. Solid waste generated during implementation of the Metro project should be disposed of in designated dump sites controlled by the responsible Governorate.
Article 33 of the Executive Regulation of Law 4/1994	The article requires that for activities resulting in the production of hazardous waste – which might occur from the soil excavation during the Metro construction - a register for hazardous waste shall be kept containing the method of disposal, as well as of the names of the parties contracted with to receive this waste.
Laws 38/1967, 31/1967 and 4/1994 Article 39 of Law 4/1994 and Article 41 of its Executive Regulations Articles 29 to 32 of Law 4/1994	These laws are dealing with the handling of solid waste management which might emerge from the construction site of the Metro. These articles require precautions to be taken during any digging, construction, demolition activities, or transport of resulting waste, in order to avoid air pollution. These articles provide regulations for the handling and storage of hazardous materials, including hazardous waste.
Ministry of Housing Degree # 134/1968	Implements Law 38/67 and declares specifications and locations of dumping sites and methods of treatment.
Ministry of Justice Degree (MoJ 3137/1976)	Identifies local Government employees as having authority to enforce Law 38/1967.
Prime Minister´s Decree No.	Promulgates the Executive Regulations of the Law 4/1994. Prohibits the burning, disposal or treatment of solid waste

338/1995, Article 38	except in designated areas as well as from waterways. Permits the incineration of infectious waste generated by medical care in hospitals and health centres, with certain provisions.

Waste generated by the Construction of the Metro Line

The quantity and the type of waste which will be generated during the construction phase and which could have negative impact on the environment and the community, depends on the activities for the construction of the Metro line, shown in the table below. It is obvious that all these listed activities have a direct waste production output and therefore could have a negative impact, if not treated adequately.

Table 7-10: Activities Implemented During the Construction Phase

Construction Activity
Levelling and land clearing
Metro railway construction (underground, at-grade, or elevated)
Tunnel boring work
Cut & cover (stations, transitional sections, annex structure)
Excavation work
Mud treatment (bentonite separation)
Foundation work (stations at-grade or underground)
Concrete mixing, casting and curing (all stations, columns, viaducts)
Transport of construction material
Storage of construction material
Operation of heavy/large equipment
Storage and disposal of construction solid/hazardous waste
Disposal of construction liquid waste
Disposal of excavated material
Construction of facilities (stations)
Stations' finishing work (painting, tiling, plumbing, and electrical, etc.)
Construction/installation of signalling & communication equipment
Construction/installation of transformers
Work base establishment and operation
Workers' activities and construction site management

Type of waste produced by the construction of the Metro line

The ESIA have to distinguish between the different types of wastes, which occur during the construction of the Metro line. For environmental sound storage, transport, recycling and disposal, all wastes produced have to be treated different according to their origin and kind, such as:

- Construction wastes, which are origin for the material, used for construction. These wastes should be considered separately according to the type of the construction activity and the type of the waste
- Excavation soil wastes origination from the tunnel earthwork have to be temporarily stored, checked according to their toxicity, transported and disposed on designated landfill sites.

- Tunnel / Engineering works and waste water drainage, which might originate from contaminated underground waters coming out during activities of tunnel boring and other large/small engineering works, which will be subject to sedimentation processes in the sedimentation pools.
- Equipment wastes originating from waste like e.g. oils, greases, chemicals etc. produced by the tunnel machines and other construction machinery, which need special storage and disposal.
- Solid waste originating from construction buildings on site, packing material, food wastes of the labours and other administrative works.

Amount and type of waste generated in the Governorates

To cope with the type of waste generated by the construction of the Metro line, the kind of waste management practiced in the areas, where the Metro line is passing through has to be considered for the impact.

Figure 7-14: Total Generated Waste in Greater Cairo (GC)
Source: Internet, Development Objectives Cairo 2012, UNDP

From the overall generated waste in Greater Cairo with about 12200 tons/day, the generation rate of waste in Giza is estimated at 4000 tons/day and the collection efficiency does not exceed 60% of the generation rate (EEAA, State of the Environment, 2009). For Cairo Governorate the figures are a daily waste generation figure of 11000 with about 68% efficiency of collection[3].
The amount and types of waste generated vary greatly between different districts of the governorates and are strongly reliant on the socioeconomic conditions and consumption patterns of the districts residents. Generally speaking, relatively high income areas have higher generation rates and are higher in the value of the waste composition. The following table provides an overview on the type of waste generated in the Giza Governorate.

[3] State of Environment Report EEAA, 2009

Table 7-11: Waste Composition in Giza Governorate (2009)[4]

Waste Component	Percentage of Total Waste Generated
Organic waste	47
Cardboard	26
Plastics	6
Textiles	3
Bones	0.5
Metals	2
Glass	2.5
Others	13.5

Source: GCBA 2009

In Egypt, the classification system of hazardous wastes, which is described below, follows the classification of the Basel Convention.

Table 7-12: Classification of Hazardous Waste

Egyptian Ministry of Industry Draft Hazardous Waste List (1997) and List of Hazardous Materials	1) Listed Wastes • General hazardous waste generated from non point emission sources • Hazardous Wasted generated from point emission sources (20 industries) 2) Hazardous Wastes which contain noxious matter 12 character include explosively Following two lists are added: Hazardous wastes which do not need permission from the Ministry of Industry and a list of hazardous wastes which required permission

Source: EEAA, own information 2012

By law (Law No. 4/1994), incineration has become the mandatory treatment for hospital and certain other hazardous wastes but exact figures are not available due to lack of control of quantities, produced by the generators.

[4] As might be observed from the Table above, the organic component constitutes the largest portion of the generated waste. Due to the urban nature of the governorate, the organic waste is mostly food waste. The category "Others" include mainly construction waste.

<u>Waste Management Practices</u>

Waste collection systems have left large areas of towns and cities (in some cases more than 50%) without service or under-serviced, and the majority of collected waste is dumped in facilities that lack any effective management. Composting, although widespread, has generally not been effectively implemented. Recycling activities have only been undertaken in some cities under unsafe and unhygienic conditions subjecting workers who participate in these processes to many risks. The majority of dumping sites are unsafe, and there are no preventive measures at these sites to prevent the self-ignition of waste. 50 - 60% of the waste composition is organic matter.

In the two Governorates, there seems to be a number of positive aspects related to the waste management situation, which is mainly valid for the less poor areas. This, in particular, includes the high level of attention from the government and strong political will for a better situation and constructive reforms for the sector. Moreover, in Giza Governorate, SWM sector involves a range of actors with good experience in SWM. The International Environmental Services (IES) is an Italian company, one of the subsidiaries of Ama Arab and is currently holding the concession for various cleansing and beatification activities in Al Dokki, Al Agouza and Giza North (Imbaba) Districts (30% of the total population of Giza). The signed contract between GCBA and IES started in 2002 and will end in 2017. The informal sector group, particularly the Zaballin and wahys, enjoy the know-how of the sector and have very rich experience in door to door collection service, which have proven, for long years, to be the most efficient and culturally appropriate SWM system mainly in Cairo Governorate but also to a smaller extend in Giza Governorate.

<u>Declared Waste Management Objectives</u>

According to EEAA and other contacted official agencies, there are plans to improve the waste management system. The future system could be demonstrated as shown in the following scheme:

Figure 7-15: Planned Solid Waste Management System in Greater Cairo
Source: Internet, Development Objectives Cairo 2012, UNDP

Main objectives for future handling of Solid Waste Management – as declared by the respective waste management authorities - by the respective authorities can be summarized as follows:

- Reuse and recycle sorted solid waste items in order to minimize depletion of natural resources, save energy, and protect the environment
- Reduce the quantity of wastes buried in Giza Governorate at Shubrament dumpsite (5,095 tons/day) by recycling solid wastes (estimated daily at about 1324 tons of paper and cardboard, 305.7 tons of plastic wastes, and 127.4 tons of glass) and by recycling organic wastes (estimated at about 2394.7 tons/day and constituting about 51%) which consequently would increase the lifespan of controlled Shubrament dumpsite.
- Implement planned engineered landfill sites for Greater Cairo Region (see map “Future Landfill Sites in Grater Cairo Region”)
- Increase the investment value of wastes through recycling
- Reduce usage of chemical fertilizers
- Minimize reusing hazardous wastes thus enhancing the health care for citizens
- Raise environmental awareness for citizens
- Reduce environmental pollution resulting from unsafe disposal of hazardous medical and /or industrial wastes

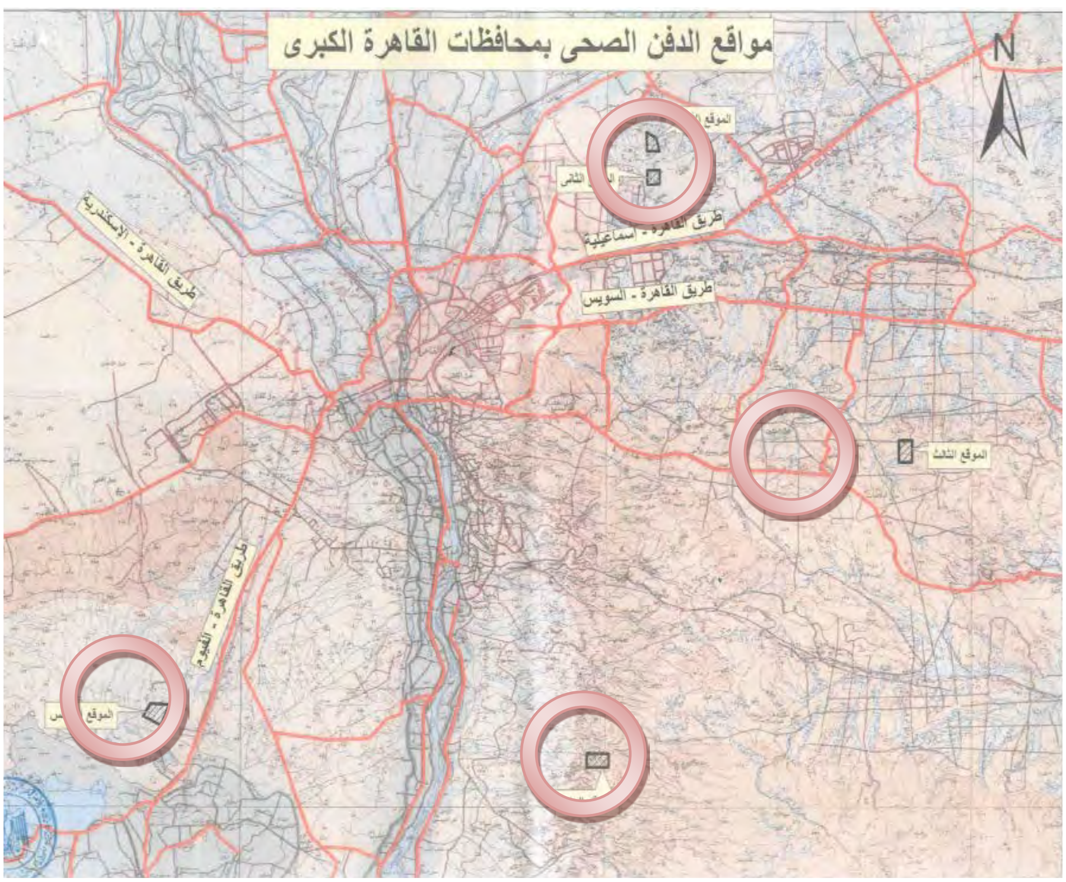

Figure 7-16: Future Landfill Sites in Greater Cairo Region

Source: Ecoconserv , Waste Study 20010

7.1.7 Noise and Vibration

This section will describe the ambient noise and vibration conditions in the project area. Data and information have been derived from two overall sources: 1. The data available on the ambient noise conditions through the National Plan for Noise Control as developed by the MSEA and the National Noise Monitoring Network as implemented by the EEAA and 2. The ambient noise and vibration monitoring measurements as carried out by MB Consultant on behalf of the EQI Study Team between the 14th and 26th of September, 2011.

Existing ambient noise data

Noise is an enduring problem in Cairo [and] has harmful implications on public health, affecting both the physical and psychological well-being of all members of society (EQI 2012: 68).

[M]ost of the noise generated in the GCR is related to transport. First, the number of vehicles on the roads increases by 15% annually, and second, the limited capacity of road infrastructure leads to traffic congestion, and increased use of horns (EQI 2012: 68).

The EEAA has developed a National Noise Reduction Plan and established a National Noise Monitoring Network (NNMN). Through the NNMN environmental noise is mapped in order to develop plans for noise control, urban planning of new infrastructure, and to establish a basis for reduction of existing noise emission levels in Cairo over the period 2007-2012. In the first stage of the NNMN 30 monitoring stations have been established in Greater Cairo, with monitoring commencing in March 2007. Locations of noise monitoring stations were selected to represent a range of activities (industrial, commercial, and tourist activities, roads, railways, residential areas) and noise monitoring was carried out using mobile monitoring units as well as permanently installed monitoring stations (EEAA 2007: 53). The data obtained include A-weighted average equivalent noise levels (L_{Aeq}) for the locations over a time interval specified in accordance with ISO 1996-2:2007 (EEAA 2007: 55).

Figure 7-17 below shows the installation of noise monitoring stations in southern Cairo in 2007.

On the basis of the noise monitoring carried out in the Cairo Governorate in the first stage of the National Noise Reduction Plan the following main sources of noise emissions were identified:

1. Transportation and road noise: Considered the main cause of environmental noise in Egypt. Areas lying on main roads are affected by traffic noise due to the annual increase of vehicles, neglect of regular car maintenance, and poor road pavement. Furthermore, noise emissions from trains were found to affect those residing beside railways up till 150 meters away,

2. Commercial and human activity noise: Noise produced by shops and all types of commercial facilities and activities, as well as citizens', including peddlers', daily activities,
3. Loud speaker noise: Noise results from use of loud speakers in open area celebrations, weddings, funeral ceremonies, outside mosques, and for commercial propaganda (EEAA 2007: 52).

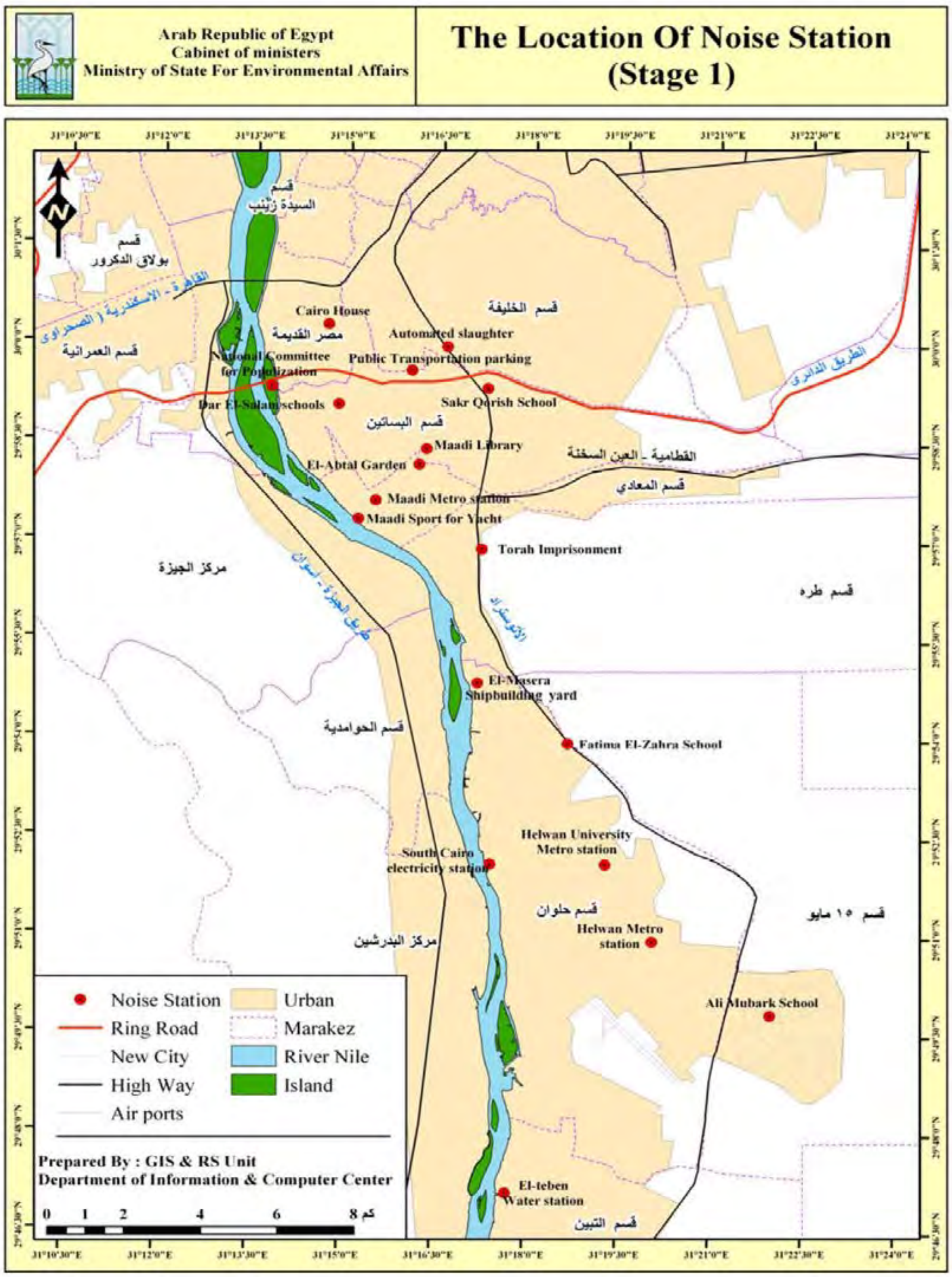

Figure 7-17: Location of noise monitoring stations in southern Cairo

Source: EEAA 2007: 63

*Noise monitoring measurements carried out by the MSEA throughout the 2008 and 2009 show little variation [..]. The following data [presented in **Error! Reference source not found.**5] summarises average LAeq range measurements taken over three day (24-hour) periods during 2009, in the central northern, eastern and western regions of GCR. The main urban land-use types are covered (EQI 2012: 68).*

Table 7-13: : Average noise levels for different types of land-areas in the GCR (2009)

Type of Area	Noise levels, dB (A)		
	Day, 7 am to 6 pm	Evening, 6 pm to 10 pm	Night, 10 pm to 7 am
Industrial areas	78	78	76
Commercial areas	78	77	83
Main roads	75	75	72
Residential areas	75	74	70

Source: EQI 2012: 68

It is noteworthy that the noise levels show almost no variation between day, evening, and night time. In the below Table 7-14 the average noise levels obtained from the noise monitoring are compared with the maximum permissible noise limits as per the Executive Regulations of the Environment Law promulgated by Law No. 4 of 1994 (February 1995)[5].

Table 7-14: Average noise levels for different types of land-areas in the GCR (2009)

Type of Area	Noise levels, dB (A)					
	Day, 7 am to 6 pm		Evening, 6 pm to 10 pm		Night, 10 pm to 7 am	
	Result	Permissible level	Result	Permissible level	Result	Permissible level
Industrial areas	78	60-70	78	55-65	76	50-60
Commercial areas	78	55-65	77	50-60	83	45-55
Main roads	75	-	75	-	72	-
Residential areas	75	45-55; 50-60	74	40-50; 45-55	70	35-45; 40-50

Source: Modified from EQI 2012: 68 and the Executive Regulations of the Environment Law promulgated by Law No. 4 of 1994, 1995: 59

It is evident for the comparison in Table 7-14 that "despite the MSEA's adoption of a noise reduction plan, noise levels in residential, commercial and industrial areas are in excess of legal limits, at all times" (EQI 2012: 68).

[5] The noise monitoring was carried out for the day, evening, and night categories and are therefore not compared with the permissible limits as per Annex 7 to the updated decree 1095 for the year 2011, which only stipulates permissible limits for day (7 am to 10 pm) and night (10 pm to 7 am).

Further initiatives and studies under the National Noise Reduction Plan of specific relevance to the Cairo Metro, Line 3, Phase 3 include:

- Study Noise Level at 26th of July Corridor: Noise levels were measured at the 26th of July corridor and based on the results noise barriers were installed along the 26th of July corridor to shield residential areas.
- Study on Noise Monitoring in Underground Metro (First and Second Lines): Noise measurements were carried out in underground sections of the Line 1 and 2 during morning and evening and results were forwarded to the Ministry of Transport (MoT) to help reduce noise levels in Metro lines, and include studying the expected noise levels within the EIA study on the construction of the third and fourth lines (EEAA 2008: 44).

<u>Existing vibration data</u>
The Egyptian Law No. 4 of 1994 does not set limits for vibration levels and a systematic compilation of vibration data has not been identified.

<u>Ambient noise and vibration monitoring by EQI Study Team</u>
The MB Consultant was contracted by the EQI to conduct a series of 24 hour ambient noise and vibration measurements and manual traffic counts in the project area. These were carried out on working days between the 14^{th} and 26^{th} of September, 2011 at eight locations specific to the Metro Line 3, Phase 3 as envisaged at the time. Since then the location of the Zamalek station has changed and the name and location of the Monera station has changed to El-Bohy Station.

No criteria has been identified behind choosing this specific time period, but the chosen period does not include national holidays or special events which could affect the measurements or render them not representative of actual conditions.

The noise and vibration measurements were conducted using a B&K Sound Analyzer type 2260.

The microphones were mounted on a tripod at 1.2 m height above ground level. The instruments were calibrated using B&K Sound Level Calibrator Type 4231. The calibration was performed for the microphones and the instruments before and after each group of readings.

The noise measurements were obtained for one 10 minute interval per hour over 24 hours at some locations and for six 10 minute interval per hour over 24 hours for some locations. The equivalent continuous A-weighted noise level, L_{Aeq} in dB were obtained and the data presents:

- L_{Amax} – the A-weighted instantaneous maximum levels, recording during the measured period,
- L_{Amin} – the A-weighted instantaneous minimum levels, recording during the measured period
- LA10, LA50, and LA90 – the A-weighted sound levels, which are exceeded for respectively 10%, 50%, and 90% of the measuring period.

The vibration measurements were carried out in the same locations and on the same dates over 24 hours with one measurement per hour. The vibration measurements only measured displacement and did not include frequency measurements or dB measurements.

Monitoring was done at eight different locations on the planned route of the new metro line. The monitoring locations and dates of monitoring are presented in the table below.

Table 7-15: Monitoring locations, date, description, and project changes

No.	Location	Date	Description	Project changes
1.	Naser	14/9/2011	Underground station	-
2.	Maspero	18/9/2011	Underground station	-
3.	Zamalik	19/9/2011	Underground station	Location of station has changed
4.	Kitkat	20/9/2011	Underground station	-
5.	Monera in El-Bohy Street	21/9/2011	Elevated section	Name and location of station has changed to El-Bohy Station
6.	Ring Road	22/9/2011	Elevated station	-
7.	Gamat El-Dewal El-Arabia	25/9/2011	Underground station	-
8.	Cairo University	26/9/2011	Elevated station	-

Source: Based on MB Consultant, 2011

The results show that at any time of the day, evening, or night, noise intensities at all of the 8 monitored locations are in excess of allowable limits set by Law 4/1994 [..]. Residential or mixed residential/commercial areas such as Zamalek (Ismail Mohamed St.) or El Bohy St. and away from main roads are predictably quieter an night; although generally, measurements are quietest at night in all locations. The results are also somewhat in line with the measurements carried out by the MSEA in 2009 [presented in..] (EQI 2012: 69).

Table 7-16 below shows the variation in equivalent continuous A-weighted noise levels as recorded at monitoring locations.

Table 7-16: Variations in Equivalent Continuous Noise Levels as Recorded at Monitoring Locations

No.	Location	Variation / dB, LAeq
1.	Naser	73.5 – 95
2.	Maspero	70.1 – 83.4
3.	Zamalik	59.7 – 73
4.	Kitkat	71.7 – 78.4
5.	Monera	62.9 – 87.5
6.	Ring Road	64.7 – 81.3
7.	Gamat El-Dewal El-Arabia	70.3 – 80.8
8.	Cairo University	74.1 – 83.1

Source: Based on MB Consultant, 2011

Gaps in data

The vibration measurements only measured displacement and did not include frequency measurements or dB measurements.

7.2 The Natural Environment

Information and data on the project study area were gathered from published material and studies performed by EQI. Analysis of recent satellite images and topographic maps of the area was carried out to obtain a broader view of the main components of its natural make-up. Field surveys refined and supplemented those of published information.

Pristine natural habitats do not exist in the area covered in the Metro Line 3 – Phase 3 project, although cultivated land within its area of influence or desert areas at the fringes of the city can support a diversity of fauna and flora. Even the densely populated urban areas in the urban mass can support considerable wildlife.

According to the different ecosystems and the habitats crossed by the route, 3 main types of habitats can be identified:

- *Urban and suburban habitats (Nasser – Ring Road – Cairo University)*
- *Agricultural Lands (Ring Road – Rod El Farag)*
- *Water courses (Nile River, Zomor Canal & Sawahel Drain)*

While the aquatic habitats in the project area are the most sensitive to environmental change, it has to be stressed that the literature review and field survey did not identify any protected biodiversity elements or protected areas, as per Law 102/1983. There are, however, centenary Banyan trees (sp. Ficus microcarpa, F. retusa and F. nitidia), that are considered valuable [..], but these trees are no longer threatened by the project. The agricultural zones are legally protected inasmuch as it is forbidden by Law 53/1966, amended by Law 116/1983 to construct private buildings on such land (except housing for farmers, equivalent to 2% of the total area owned).

The project mostly cuts through densely populated urban and semi-urban environments in; only the northwestern stretch of sub-phase 3B cuts through agricultural land. In the urban environment, different micro-habitats can be discerned, including gardens, public parks, roadsides and railway corridors, and wastelands. The latter are more common in the informal urban sectors of Imbaba and Boulaq El Dakroor.

The northwestern stretch of sub-phase 3B cuts through agricultural land where crops are grown for sale in nearby local markets. Crops include animal foods such as clover, as well as all sorts of vegetables for human consumptions, including cabbage, tomatoes, cucumber, among others (see section 4.3.1)

Water courses occur in the vicinity of all 3 sub-phases: the two branches of the Nile around Zamalek in 3A, El Zomor canal and Sawahel drain in 3B, and El Zomor canal near Boulaq El Dakroor in 3C. The Nile River and the irrigation or drainage canals have similar fauna and flora, although the latter two support a much lower biodiversity. The wetlands surrounding watercourses provide vital habitats for amphibians and other micro-fauna. Banks of the irrigation canals and drains support a biodiversity different than that of the true aquatic environment. However, irrigation canals and have heavy loads of pesticides, fertilizers and other organic pollutants, and sometimes host molluscs which transmit schistosomiasis (i.e.: Bulinus spp. and Biompholaria spp.), or fascioliasis (i.e.: Lymnaea spp) to people and animals.

Despite the probable reduction in habitat diversity in irrigation canals, they are able to support various levels of fish production. Fish undoubtedly enter the irrigation system from the source waters and it is probable that some species form breeding colonies in the canals, although there is little data to support this. In Egypt, it is estimated that almost 16% of the freshwater fishery production comes from the Nile and its irrigation canals (Sadek, 1988). As such, the Nile and irrigation canals represent the most sensitive habitats along the project alignment; the terrestrial habitats have lost their natural features and are of low ecological value (EQI 2012: 72).

7.2.1 Flora and Fauna

Nationwide jurisdictions for the management of natural flora and fauna are mainly shared between the Ministry of Agriculture and the EEAA. The EEAA is in charge of management of the nature protectorates, and of institutional coordination for implementing the main conventions on nature conservation (Convention on Biological Diversity, RAMSAR Convention, Bonn Convention, CITES Convention). The National Strategy and Action Plan for Biodiversity Conservation is the main framework of actions undertaken for the preservation of natural habitats and wildlife, until 2017 (EQI 2012: 73).

<u>Terrestrial flora</u>

Most of the flora along the path is composed of introduced species of trees and plants. However, some of these trees, particularly in Ismail Mohammed St., Zamalek, are over 100 years old and should be preserved. The vegetation, including some of the introduced species, also has important ecological functions that benefit man. For example plants serve as natural water purifyiers, soil stabilizers, nitrogen fixators (e.g. Casuarina sp.) and as food and shelter for wildlife.

The common trees of the Nile Valley within proximity the GCR include palms, sycamores, Christ's thorns, willows, Aleppo pine, cypress, and acacias, among others. Some of these were introduce by the ancient Egyptians from the Middle East and East Africa. Other trees were introduced more recently, and include various species of gum (Eucalyptus) and pine (Casuarina) from Australia. These trees can now be seen along the banks of the Nile. Decorative trees from almost every continent can now be found in the gardens and hotel parks in the area. Most of the trees now growing in the Greater Cairo Region are in fact introduced ornamentals, such as the pink-flowered Cassia nodosa, the Flame Tree, Delonix regia, and Bauhinia variegata.

Along the proposed Metro Line 3 Phase 3 alignments several such species of trees and other ornamental plants are found. Some of these trees are very old, possibly dating back to the 19th centuray when modern Cairo was built. Trees are among the most noticeable features of certain areas, such as in Zamalek. Several species of mostly foreign ornamental trees line along the sidewalks and in yards belonging to most of the old houses of this upper class neighbourhood.

The list of trees observed along the Metro Line 3 – Phase 3 alignment is presented in the Appendix 3. Several Ficus species (Malay Banyan, Spotted Ficus, Rubber Tree) are found in all 3 sub-phases, as well as Bombax ceiba (Silk-cotton Tree). Palm trees are also very common in the urban areas. It is worth mentioning that uprooting some of these trees with the aim of replanting them either elsewhere, or upon the completion of the construction phase, is a very costly process. Moreover, only few of them would be successfully regrown since the majority of these trees have already produced deep root systems and attained huge sizes (EQI 2012: 73)

At the new site of the Zamalek Station, about 11 trees including flamboyants, Indian almond and rubber plant trees will have to be removed instead. These trees are in good condition but are still relatively young and of medium size. Ismail Mohammed St. generally has a fairly diverse collection of ornamental street trees planted on both of its pavements and along its entire length. Many of the buildings on this streets also have trees within their gardens.

Table 7-17: Plant Species in the Study Area

Plant Species in the Study Area Classification Status According to http://www.iucnredlist.org in the categories of LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, CR: Critically Endangered, EW: Extinct in the Wild, EX: Extinct, and Not listed		
Latin name	*Common name*	*Classification Status*
Boulaq El-Dakrour Region		
Ficus microcarpa (Syn.: Ficus retusa, Ficusnitida)	Indian Laurel, Malay Banyan	Not listed
Ficus elastica	India Rubber Tree, Rubber Plant	Not listed
Salix subserrata(Syn.: Salix safsaf)	Palestine Willow	Not listed
Delonix regia (Syn.:	Royal Poinciana,	VU

Poinciana regia)	Flamboyant	
Peltophorum africanum		Not listed
Casuarina equisetifolia	Horsetail Tree, Southsea Ironwood	Not listed
Bombax ceiba (Syn.: Bombax malabaricum)	Silk-Cotton Tree	Not listed
Phoenix dactylifera	Date Palm	Not listed
Washingtonia robusta (Syn.: Washingtonia gracilis)	Washington Palm, Thread Palm	Not listed
Arecastrum romanzoffianum (Syn.: Cocos romanzoffiana)	Queen Palm	Not listed
Wadi Wl Nil Street		
Ficus microcarpa (Syn.: Ficus retusa, Ficus nitida)	Indian Laurel, Malay Banyan	Not listed
Ficus elastica	India Rubber Tree, Rubber Plant	Not listed
Bombax ceiba (Syn.: Bombax malabaricum)	Silk-Cotton Tree	Not listed
Phoenix dactylifera	Date Palm	Not listed
Washingtonia robusta (Syn: Washingtonia gracilis)	Washington Palm, Thread Palm	Not listed
Delonix regia (Syn.: Poinciana regia)	Royal Poinciana, Flamboyant	VU
Pongamia pinnata	Indian Beech, Karum Tree	Not listed
Brachychiton populneus (Syn: Sterculia) diversifolia, Brachychiton diversifolius)	Kurrajong	Not listed
Eucalyptus camaldulensis (Syn: Eucalyptus) rostrata, Eucalyptus longirostris)	Murray Red Gum	Not listed
Koelreuteria elegans	Flamegold, Chinese Rain Tree	Not listed
Ismail Mohamed Street, Zamalek		
Ficus microcarpa (Syn.: *Ficus retusa, Ficus nitida)*	Indian Laurel, Malay Banyan	Not listed
Ficus elastica	India Rubber Tree, Rubber Plant	Not listed
Ficus virens (Synonyms: Ficus lacor, Ficus infectoria)	Spotted Ficus, Lacor	Not listed
Pleiogynium timoriense	Queensland Hog Plum,	Not listed

(Syn: Pleiogynium cerasiferum, Pleiogynium solandri)	Burdekin Plum	
Terminalia arjuna	Indian Almond, Arjun	Not listed
Bombax ceiba (Syn.: Bombax malabaricum)	Silk-Cotton Tree	Not listed
Mangifera indica	Mango	Data Deficient
Delonix regia (Syn.: Poinciana regia)	Royal Poinciana, Flamboyant	VU
Brachychiton populneus (Syn.: Sterculia diversifolia, Brachychiton diversifolius)	Kurrajong	Not listed
Bauhinia variegate	Orchid Tree, Mountain Ebony	Not listed

Source: EQI Consultant (2012) and http://www.iucnredlist.org

The Delonix regia (Syn.: Poinciana regia) or Royal Poinciana, Flamboyant is listed as vulnerable (VU) on the IUCN Red List. The status as vulnerable, however, refers to its status in west and north Madagascar to which the tree is native. It is cultivated in and throughout many tropical countries.

The soil of the Nile Valley can nurture a wide variety of introduced fruits and vegetables as well. As can be seen in some of the gardens and cultivated plots in Cairo or Giza. In the further areas of Giza, such as in the Bashteel district near Rod el Farag Corrdiro, commonly cultivated crops include berseem (Egyptian clover) and wheat in winter, and maize in summer; but other vegetables are grown as well. These include tomatoes, potatoes, spinach, and molokhia, while fruits include citrus, (up 50 percent of total fruit production), bananas, grapes, and dates. Other significant crops include cotton, crop, sugar beet, and a number of bean crops for human consumption (EQI 2012: 74).

Freshwater flora

The vegetation of the Nile and irrigation canals plays an important role in providing food and shelter to many aquatic and semi-aquatic species. Vascular freshwater hydrophytes of the Nile and its irrigation network comprise 87 species of flowering plants, belonging to 45 genera and 25 families. These hydrophytes can be divided into 3 main groups: submerged, floating (free or fixed), and emergent. Vigorous growth of hydrophytes is observed in some parts of the Mansoureya Canal. This includes the floating Water Hyacinth Eichhornia crassipes which completely covers the water surface in some areas. Such vigorous growth is probably due to the fact that the canal waters have elevated concentrations of nutrients. Emergent species such as Phragmites australis, Typha domingensis, Juncus subulatus, which can be considered as weeds, and several species of Juncus grow in the shallow areas near the canal banks. E. crassipes and P. australes, two invasive species, will tend to dominate in such poor quality water. A list of hydrophytes of the Nile and its canal system in the Cairo region is shown in Appendix 3.

Table 7-18: Dominant Hydrophytes in the waterways in the Cairo Region

Dominant Hydrophytes in the waterways in the Cairo Region Classification Status According to http://www.iucnredlist.org in the categories of LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, CR: Critically Endangered, EW: Extinct in the Wild, EX: Extinct, and Not listed	
Latin name	*Classification Status*
Submergent Species	
Ceratophyllum demersum	LC
Elodea canadensis	Not listed
Myriophyllum specatum	Not listed
Potamogeton crispus	LC
P. pectinatus	Not listed
Ruppia Maritima	LC
Emergent Species	
Cyperus alopercuroides	Not listed
C. articulatus	Not listed
C. difformis	LC
C. papyrus	LC
C. schimperianus	Not listed
Echinochloa stagnina	Not listed
Juncus subulatus	Not listed
Leersia hexandra	Not listed
Leptochloa fusca	LC
Paspalum distichum	Not listed
Persicaria salicifolia	Not listed
P. senegalensis	Not listed
Phragmites australis	Not listed
Pycreus mundtii	Not listed
Saccharum spontaneum subsp. Aegypticatum	LC
Scirpus litoralis	Not listed
S. maritimus	Not listed
S. trigueter	Not listed
Typha domingensis	LC
Floating Species	
Azolla filiculoides	Not listed
Eichhornia crassipes	Not listed
Lemna gibba	LC
Ludwigia stolonifera	Not listed
Nymphaea caerulea	Not listed
N. lous	Not listed
Pistia stratiotes	LC
Potamogeton nodosus	LC
Vossia cuspidata	Not listed

Source: EQI Consultant (2012) and http://www.iucnredlist.org

Fauna

Below the fauna species found in the project area are described. The fauna of the project area is mainly composed of common and widespread species and none of the species of reptiles and amphibians, birds, mammals, invertebrates or freshwater fish found in the project area is, according to the EQI study team, on the Egyptian or international lists of threatened species (EQI 2012: 74ff).

Reptiles and amphibians

The cultivated lands, cities, and villages of the Nile Valley and Delta collectively support 39 species of reptiles and amphibians, although in the study area they are relatively few.

Amphibian species in the region are few (only 4 species). They include the Square-marked Toad, Bufo regularis, and Green Toad Bufo viridis. These are a typical freshwater species, but can withstand being outside of water for several days. The frogs belonging to the family Ranidae, which includes the Marsh Frog Rana ridibunda and Mascarene Frog Ptychadena mascareniensis are particularly well adapted to life in water bodies with dense waterside vegetation, and are found in the more rural parts of the study area.

The study area is inhabited by 5 families of lizards and 2 families of snakes. The latter include several poisonous species of viper, the Egyptian cobra Naja haje haje, the semi-poisonous African Beauty Snake, Psammophis sibilans, the Tessellated Water Snake, Natrix tessellata, which is common in streams and irrigation canals, the Ocellated Skink, Chalcides ocellatus, and the Bean Skink. The snakes do not venture much into the densely built-up, urbanised areas and are confined to the western part of the Metro alignment, in Bashteel. Lizard species such as Chalcides ocellatus and Mabuya quinquetaeniata are associated with mesic environments, and are found on the banks of canals. None of the species listed from the area is on the Egyptian or international lists of threatened species. Annex 4 of Appendix 4 *shows a list of amphibians and reptiles reported from the GCR (EQI 2012: 74f)*

Table 7-19: Reptiles and Amphibians recorded in the Study Area

Reptiles and Amphibians recorded in the Study Area Classification Status According to http://www.iucnredlist.org in the categories of LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, CR: Critically Endangered, EW: Extinct in the Wild, EX: Extinct, and Not listed		
Latin name	*Family*	*Classification Status*
Lizards		
Trapelus flavimaculatus	Agamidae	Not listed
Trapelus pallida		Not listed
Certopodion scaber	Gekkonidae	Not listed
Hemidactylus turcicus		LC
Ptyodactylus hasselquistii		Not listed
Stenodactylus sthenodactylus		Not listed
Tarentola annularis		Not listed

Tropiocolotes steudneri		Not listed
Acanthodactylus boskianus	Lacertidae	Not listed
Acanthodactylus scutellatus		Not listed
Mesalina guttulata		Not listed
Mesalina rubropunctata		Not listed
Chalcides ocellatus	Scincidae	Not listed
Sphenops sepsoides		Not listed
Mabuya quinquetaeniata		Not listed
Scincus scincus		Not listed
Chamaeleo chamaeleon	Chamaeleontidae	Not listed
Snakes		
Coluber rogersi	Colubridae	Not listed
Psammophis schokari	Psammophis schokari	Not listed
Malpolon moilensis	Malpolon moilensis	Not listed
Spalerosophis diadema	Spalerosophis diadema	Not listed
Telescopus dhara	Telescopus dhara	Not listed
Cerastes cerastes	Viperidae	Not listed
Cerastes vipera	Cerastes vipera	LC
Echis carinatus	Echis carinatus	Not listed
Echis coloratus	Echis coloratus	Not listed
Naja haje	Elapidae	Not listed

Source: EQI Consultant (2012) and http://www.iucnredlist.org

Birds

The birds of Egypt are the most diverse and prominent group of all of the country's non- aquatic vertebrates. Most of these birds are non-breeding winter visitors. Only about 150 species are resident breeding species. None of these species are endemic, although there are a few sub-species that are confined to the habitats of the Nile Delta and Valley. None of the bird species observed by the team or reported from the study area is listed as threatened or restricted in local Egyptian or international (IUCN) lists of threatened species. Annex 3 shows a list of species reported from the greater Cairo area and its immediate vicinity, and those that have been observed by the team during this study.

All Falconiformes (falcons) and Strigiformes (owls) are protected species included in CITES Appendices I or II. Besides, they have a high ecological importance in controlling the number of rodents. Many resident birds (such as Hoopoe, Cattle Egret, etc) although common and widespread, are locally protected as useful to agriculture according to the list attached to decree of the Minister of Agriculture No. 28 of 1967, issued in implementation of the provisions of article 117 of Law No. 53 of 1966 promulgating the Law on Agriculture.

Because of the prevalence of the urban built-up structures, and the high human population density in the general area of the Metro Line 3 Phase 3 (excluding the western extremity of Phase 3B), the resident avifauna is comprised of fewer species than the rural areas of the Nile Valley, where much of the Egyptian, non-migratory, bird population is confined. However, the abundance of available food in the cultivated areas, and water from the Zomor canal, actually attracts some migrating birds during the winter months, when the number of breeding birds can reach as many as 66 breeding species.

Among the more visible birds found in the area, especially in the rural part of sub-phase 3B, are the Black-shouldered Kite Elanus caeruleus; Kestrel Falco tinnunculus; Cattle Egret Bubulcus ibis; Spur-winged Plover Vanellus spinosus; Barn Owl Tyto albo; Graceful Warbler Prinia gracilis; Goldfinch Carduelis carduelis; and Hooded Crow Corvus corone; Garden Bulbul Pycnonotus barbatus; Olivaceous Warbler Hippolais pallida; Palm Dove Streptopelia senegalensis; and Pied Kingfisher Ceryle rudis. The bird populations in the purely urban areas are restricted to the House Sparrow Passer domesticus; Brown-necked Raven Corvus ruficollis,, Palm Dove Streptopelia senegalensis; Common Kestrel Falco tinnunculus; and the Senegal Thick Knee Burhinus senegalensis (EQI 2012: 75).

Table 7-20: Birds recorded in the Study Area

Birds recorded in the Study Area Classification Status According to http://www.iucnredlist.org in the categories of LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, CR: Critically Endangered, EW: Extinct in the Wild, EX: Extinct, and Not listed		
Latin name	*Family*	*Classification Status*
Falconiformes Order		
Falco concolor	Falconidae	NT
Falco tinnunculus		LC
Falco biarmicus		LC
Elanus caeruleus	Accipitridae	LC
Charadriiformes Order		
Vanellus spinosus	Charadriidae	LC
Burhinus oedicnemus	Burhinidae	LC
Burhinus senegalensis		LC
Ciconiiformes Order		
Bubulcus ibis	Ardeidae	LC
Pteroclidiformes Order		
Pterocles senegallus	Pteroclididae	LC
Pterocles coronatus		LC
Pterocles lichtensteinii		LC
Columbiformes Order		
Streptopelia senegalensis	Columbidae	LC
Columba livia		LC
Streptopelia turtur		LC
Strigiformes Order		
Bubo bubo	Strigidae	LC

Athene noctua		LC
Tyto alba	Tytonidae	LC
Coraciformes Order		
Merops apiaster	Meropidae	LC
Merops orientalis		LC
Merops superciliosus		LC
Ceryle rudis	Cerylidae	LC
Passeriformes Order		
Passer domesticus	Passeridae	LC
Ammomanes cinctura	Alaudidae	LC
Ammomanes deserti		LC
Galerida cristata		LC
Alaemon alaudipes		LC
Ptyonoprogne obsoleta	Hirundinidae	LC
Hippolais pallida	Acrocephalidae	LC
Pycnonotus barbatus	Pycnonotidae	LC
Carduelis carduelis	Fringillidae	LC
Oenanthe lugens	Turdidae	LC
Oenanthe monacha		LC
Oenanthe leucopyga		LC
Scotocerca inquieta	Sylviidae	LC
Passer domesticus		LC
Corvus ruficollis	Corvidae	LC
Corvus corone		LC
Prinia gracilis	Cisticolidae	LC

Mammals

The mammals in the study area are all terrestrial, and belong to 6 orders, further divided into 11 families and 24 species. Rodentia is the best-represented order, with 11 species inhabiting both urban and peri-urban environments. Orders Chiroptera and Carnivora are also well represented. None of the mammal species recorded from the area is listed on national or international lists of threatened species. Annex 3 shows a list of mammals of the Greater Cairo area and its immediate vicinity (EQI 2012: 75).

Table 7-21: List of the mammals recorded in the study area

List of the mammals recorded in the study area Classification Status According to http://www.iucnredlist.org in the categories of LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, CR: Critically Endangered, EW: Extinct in the Wild, EX: Extinct, and Not listed			
Order	*Family*	*Species*	*Classification Status*
Insectivora	Erinacidae	*Hemiechinus auritus*	LC
Chiroptera	Pteropodidae	*Rousettus aegyptiacus*	LC
	Rhinopomatidae	*Rhinopoma hardwickei*	LC

	Vespertiliontidae	*Pipistrellus kuhlii*	LC
Lagomorpha	Leporidae	*Lepus capensis*	LC
Rodentia	Cricetidae	*Gerbillus gerbillus*	LC
		Dipodillus dasyurus	LC
		Dipodillus henleyi	LC
		Meriones crassus	LC
		Psammomys obesus	LC
		Sekeetamys calurus	LC
	Muridae	*Rattus rattus*	LC
		Mus musculus	LC
		Arvicanthis niloticus	LC
		Acomys russatus	LC
		Acomys cahirinus	LC
	Dipodidae	*Jaculus jaculus*	LC
Carnivora	Canidae	*Vulpes vulpes*	LC
		V. rueppelli	LC
		Canis lupaster (subspecies of Canis aureus)	LC
	Felidae	*Felis sylvestris*	LC
		Felis chaus	LC

Terrestrial Invertebrates

Insect species belonging to the orders Thysanoptera, Hemiptera, Homoptera, Coleoptera, Neuroptera, Diptera, Siphonaptera, Lepidoptera, Neuroptera, and Hymenoptera (together more than 2500 species) are found in the area. Coleoptera, Lepidoptera, Thysanoptera, Hemiptera, Homoptera and Coleoptera are crop/vegetation pests that also serve as vectors of plant diseases and viruses. Hymenoptera are important pollinators, but some species feed on crops at the larval stage. Neuroptera include many predatory beneficial species which act as biological control agents. Diptera and Siphonaptera, including mosquitoes, disease transmitting flies, and fleas, are of great medical and veterinary importance.

Arachnids are represented by 6 orders in Egypt, but not all are present within the Study area (EQI 2012: 75f).

Freshwater Invertebrates

The invertebrates inhabiting the Nile and Zomor Canal in the study area include a variety of annelids, crustaceans, molluscs, and also microscopic or near-microscopic organisms, such as protozoa and rotifers, which play a very important role in the aquatic environment

Freshwater annelids include Oligochaeta and leeches (Hirudinae). The major crustacean groups in the Egyptian Nile system are Cladocera and Copepoda. They constitute a highly diversified group in terms of size, structure, and habits. They live mostly among the weeds, clinging to plants and higher algae. Several species are commonly found in or near the mud, although they are not specifically adapted to live in mud. These crustaceans are of great value, since they convert smaller algae into a form edible by carnivorous animals, and there is a period in the life of almost every fish when it feeds exclusively on them.

Freshwater molluscs (bivalves and snails) are well distributed along the Nile and its irrigation and drainage canals. They live among aquatic plants and in the mud. 16 species of gastropods and 8 bivalves are more common.

None of the invertebrate species of the area is listed on international or local lists of threatened species (EQI 2012: 76).

Freshwater fish

There are 70 recorded fish species inhabiting the Nile and its irrigation/drainage network in the Cairo area, 70% of which belong to the families Characinidae, Cyprinidae, and Siluridae. Cichlids contribute the highest percentage of commercial fish production in that area. Nine species have been introduced for aquaculture and aquatic weed control. Annex 3 of appendix 4 (and the table below) shows a list of common fish recorded from irrigation canals in Lower Egypt, including the Greater Cairo area. None of the fish species of the area is listed on international or local lists of threatened species (EQI 2012: 76).

Table 7-22: Freshwater fish in the Study Area

Freshwater fish in the Study Area Classification Status According to http://www.iucnredlist.org in the categories of LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, CR: Critically Endangered, EW: Extinct in the Wild, EX: Extinct, and Not listed		
Latin name	*Family*	*Classification Status*
Bagrus bajad	Bagridae	LC
Bagrus docmak		LC
Lates niloticus	Centropomidae	LC
Haplochromis loati	Cichlidae	Data Deficient
Haplochromis wingatii		Not listed
Hemichromis bimaculatus		LC
Oreochromis aureus		Not listed
Oreochromis niloticus Niloticus		Not listed
Tilapia zillii		Not listed
Clarias anguillaris	Clariidae	LC
Labeo niloticus	Cyprinidae	LC
Synodontis schall	Mochokidae	LC
Petrocephalus bane bane	Mormyridae	Not listed

Source: EQI Consultant (2012) and http://www.iucnredlist.org

7.3 The Socio-Economic Environment

The social baseline for Greater Cairo Metro Line three comes in the following sections:

- The first section discusses the methodology of the study applied in order to fulfill the requirement of the EIB and the AFD.
- The second section discusses detailed background information on the two governorates namely Giza and Cairo Governorates in terms of location and administrative jurisdiction; population; employment status; unemployment, education; health and medical services; infrastructure and facilities; and economic activities. The health conditions and information was presented in the same section about health status in Giza and Cairo. Some information is available on the Governorate and District level.
- The third section includes results of the survey that was applied among different areas. The data was disaggregated according to gender, affected groups, and age category within the two governorates.
- The fourth section outlines the transportation network in Egypt, especially Greater Cairo Region. It also addresses current situation of road accidents in Egypt and the vision of Ministry of transport in this regard. This section will help better understand potential positive impacts of introducing Greater Cairo

7.3.1 Methodology and Sampling

To prepare the ESIA and the SESIA, the Consultant has employed a participatory bottom up approach that depended on a diverse range of tools to serve the objectives of the various parts of the ESIA. The Consultant accessed large amounts of quantitative and qualitative information from various primary and secondary sources. Secondary data collection involved the review of information in previous reports and studies to obtain background data about environmental and socio-economic characteristics of project areas.
The ESIA survey implemented during October 2011 relied upon two sources of data, namely secondary and primary data. As well as, the supplementary study collected additional data from vendors, shopkeepers, students, workers which were not investigated during the ESIA study. Therefore, they were supplemented by the study applied during June and July 2012. The main sources of data were as follow:

<u>Secondary Data Collection</u>
Aims at analysing different reports about the project site. The secondary data analysis method was used to review some of the recent reliable documents published in Egypt. Moreover, provide a clear socioeconomic profile of the communities that will host the project. Thus, the following reports have been reviewed:

- Egyptian Human Development Report 2010
- Egyptian Census results 2006
- Egypt Description by Information, IDSC, 2007
- Egypt Description by Information, IDSC, 2010

- Egyptian Demographic and Health Survey 2009
- Egypt Description by Information, IDSC, 2009
- Resettlement Policy Framework, World Bank
- Different laws that govern the expropriation process
- WHO publications on the website
- IDSC website
- CAPMAS website

Primary Data collection
In addition to the literature review, structured site visits were undertaken to collect primary data directly from stakeholders in order to garner their perceptions about the project's predicted impacts. The main tasks and issues covered through the site visits and stakeholder consultations are:

- Environmental and social baseline and current situation.
- Stakeholders' perceptions of the project and the anticipated impacts.
- Stakeholders views and recommendations on the mitigation of predicted negative impacts.
- Roles and responsibilities associated with the Environmental and Social Mitigation Plan (ESMP).

The Consultant has identified and targeted key groups of stakeholders, these groups include:

- Local communities including services' beneficiaries.
- Local Communities near to the potential metro line.
- Institutions in charge of the provision of the services (including governmental, semi-governmental and non-governmental, National Authority for tunnels).
- Potential affected groups who will be expropriated

A structured questionnaire was designed, tested and applied in the field to collect quantitative data on the status of the current situation of communities views on the project areas.
The questionnaire also investigated community view on the suggested project identifying their perception and the willingness to have such developmental project.

- Basic information about the potential affected groups, beneficiaries and communities
- Perception towards the project
- The current type of transportation
- Relocation activities

Due to not having a list of households in the areas among which the sample might be selected randomly the study team had to select the sample in convenient with a range of 1/5. However, the sample was to some extent limited as it was 15 per each route 225 in total for the whole line. In addition, the sample selected was among the residents. Vendors, shopkeepers, students, etc. was not investigated. Therefore, the SESIA tried to cover such groups using a structured questionnaire that covered the same above mentioned issues.

In addition site visits, field observations, documentation through photographs were utilized in the different routes. The 15 project sites are divided in three sect ions 3A, 3B and 3C where stations are proposed. They are as follow:

- Section 3A is comprised of Nasser, Maspero, Zamalek and Kitkat stations with an approximate length of about 4 km.
- Section 3B is approximately 6.8 km and comprises Sudan, Imbaba, El Bouhy, El Wehda, Ring Road and Rod El Farag Corridor stations
- Section 3C comprising Tawfiqiya, Wadi El Nil, Gamet El Doula El Arabia, Boulak El Dakrour and Cairo University stations with an approximate length of 5.8 km.

The data collected during the ESIA will be presented as it was mentioned in the report indicating what has been reported during this phase, However, the supplementary data collected under the SESIA will be analysed using Statistical Package for Social Studies SPSS 18. Moreover, the qualitative data will be analysed and presented under different sections.

<u>The key field research questions guiding the survey are:</u>

- What are the policies and legislations that have influence on the project?
- What are the different socioeconomic criteria for the areas?
- What is the main perception towards the project?
- What are the potential impacts of such project?
- How can the project be implemented with limited disturbance for the community?
- What are the appropriate mechanisms needed to apply an appropriate stakeholder engagement plan?
- What is the capacity and organizational framework to apply during the implementation of the stakeholder engagement plan?

<u>Sampling</u>

The ESIA and the SESIA covered a wide range of sampling in order to cover all potential groups. The following are the description of the investigated people:

- Community people 225 residential during the ESIA and 135 vendors, shopkeeper, workers, students in the SESIA,
- Scoping sessions were implemented in different areas to identify the project affect people and the vulnerable groups,
- The National Authority for tunnels were interviewed and informed about the stakeholder engagement plan and the Gap Analysis report. Such meetings were informative and guiding to enhance the study,

- Compensation Committee under NAT was interviewed regarding expropriation activities[6] ,
- Different meetings were implemented with SYSTRA (the planning organization) in order to have clear information about the project routes.

SESIA Objectives

The overall objective of this study is to measure the social impact of the project. This necessitate to measure and highlight the following objectives:

- Highlight the legislations under which the project will be implemented, in case of expropriation of lands7
- Identify positive and negative impacts on the local market in change in demand for local services, as well as access to social infrastructure
- Impacts caused by inducting secondary development, such as squatters, within the project areas;
- Identify the impacts on employment, housing of workers, and general public safety issues,
- To address the land use in the areas and investigate the ability of expropriation,
- Identify potential obstacles that might face the project and how to overcome them,
- Outline the vulnerable groups that might be affected by the project and identify the appropriate mitigation measures,
- Investigate the possibility of having stakeholder engagement during the implementation phase of the project. The role of NGOs and different institutions was investigated to support the project and discern what types of assistance should be provided during each phase,
- Identify the methods of quality assurance and monitoring system needed during the construction and operation phases, Finally, try to propose a Social Management Plan that might be responsible for any potential social problems
- Try to investigate the different potential alternatives of the current project. Provide various option to minimize the need for involuntary resettlement

The findings will provide decision makers the AFD and the EIB with the needed information in order to minimize the unfavourable impacts and develop the best compensation strategy, if needed.

[6] Further meetings are needed to be implemented with the compensation committee and the counterparts in the governorates and any other entities affiliated to the compensation activities

[7] Regardless of having a decree to allocate lands by the governor in some cases the project might find illegitimate possession of land

7.3.2 Giza and Cairo Governorates' Socio-Economic Conditions

Egypt is administratively divided into 27 governorates. Each governorate is further divided into a number of Administrative districts, known as "Markaz". Egypt has a total of 180 of these Administrative districts, 213 Cities, and 4,632 Villages[1]. Governorates can be either fully urban or a mixture of urban and rural. Fully urban governorates have no Administrative districts and are administratively comprised of Cities only. Egypt has four urban governorates, which are Cairo, Alexandria, Port Said and Suez.

The Metro Line 3 Phase 3 alignment transects through the Cairo and Giza Governorates., Cairo, Giza and Qalioubeya are the three governorates comprising the GCR.

In the following section, socio-economic information is presented, starting with a broad background on the Cairo and Giza Governorates, which are transacted by the Phase 3 alignments, in terms of location and administrative jurisdiction; population; employment and unemployment; education; health and medical services; infrastructure and facilities; and economic activities(EQI 2012)

7.3.3 Location and Administrative Jurisdiction

As the project will pass through two governorates, namely Giza and Cairo, among which two main administrate districts will be covered in Cairo Governorate (Zamalek – Boulak Abu El Ela) and fife districts in Giza Governorate (Dokki- Boulak El Dakrour- Agouza- Imbaba- Giza Qism).

<u>Cairo Governorate</u>
Cairo Governorate is located on the east bank of the Nile. It borders the Qalioubeya and Sharqeya Governorates to the north, the Giza Governorate to the south and west, and Suez and Ismailia Governorates to the east. Cairo is privileged with a unique strategic location that qualified it to be the political capital of Egypt, besides its idiosyncrasy as a cultural, artistic, scientific, and historical capital of the Arab and the Islamic world. The governorate is one of Greater Cairo Region that includes Cairo, Giza, and Qalioubeya governorates.

Cairo's total area covers 3085,12 km2. It is considered one of the governorates which comprises a sole city, and by large the biggest Arab city and the most populated in Africa and the Middle East.[8]

According to the results of the 2006 census, Cairo is inhabited by 7.8 million people and visited by 2 million Arabs, Foreigners, and Egyptians daily either for health treatment, tourism, or for business. CAPMAS indicated that the estimations for Cairo Population is 8,052,228 million people in 2008.

[8] Source: Egypt Description by Information, IDSC, 2007

In dealing with the population growth problem in Cairo, the New Urban Communities Authority - an affiliate to the Ministry of Housing - embarked on extension in desert and built new cities as New Cairo City, the closest city to Cairo, and one of the third generation cities that was established by virtue of presidential decree No 1991/2000.

The governorate hosts several industrial zones that make it a haven attracting capital, which could be invested to develop the national industry and enhance its competitiveness on the local and international levels. Some of these industrial zones are located in El Basateen, El Waily, Heliopolis, Helwan, and the duty free zone in Naser City, as well as in the new industrial zones in the newly established cities namely; Obour, Qatameyah, Badr, and El Amal. The governorate has a solid base of strategic and consumer industries such as iron and steel, cement, military equipment, electric appliances and cars, as well as textiles and ready-made clothes.[9]

Giza Governorate

Giza governorate is one of the Greater Cairo Region that includes Cairo, Giza, and Qalioubeya governorates. Giza Governorate lies mostly on the western side of the River Nile, just south of Nile Delta. It is bordered on the west and northwest by El Beheira and Matruh governorates, on the south by the New Valley Governorate. On the southeast, it is bordered by Fayoum, Beni Suef and Minya Governorates. The eastern part of the Giza Governorate (El Saff & Atfeeh Marakez) extends to Suez and is bordered in the northeast by Cairo. The total area of the governorate covers 13184 km^2, representing 1.3% of the Republic's area. The governorate encompasses 10 Marakz, 12 cities, 7 districts, 51 rural local units annexed by 171 villages, and 636 hamlets.

According to the results of the 2006 census, Giza population is 6490.8 million people; 58.6% of them live in urban areas, and 41.4% in rural areas and population natural growth rate has reached 19.3 per thousand.
Besides being an agricultural governorate, Giza is also considered an industrial one as it hosts many industries such as: food, spinning and weaving, basic metals, engineering and electronics, as well as mining. Moreover, the governorate hosts two industrial zones; one of them is located along Cairo-Alexandria Desert Road and has big industrial companies. In addition to that, the governorate hosts many new projects such as the under construction new Egyptian Museum, the Smart Village, and the third underground line.

7.3.4 Local distribution and land use

Based on the information provided in Egypt Description by Information 2007, Cairo Governorate compiles of 31 districts as it is categorized as fully urban governorate and Giza consists of 10 main Markaz, 12 cities and 7 districts. In addition to 51 rural local units, 171 affiliated villages and 636 Hamlets.

Table 7-23: Administrative Division for Cairo, Giza Governorates

Administrative Division	Cairo	Giza

[9] Source: Egypt Description by Information, IDSC, 2007

No. of Markaz	0	10
No. of cities	0	12
No. of districts	31	7
No. of rural local units	0	51
Affiliated villages	0	171
Villages outside local units	0	0
Hamlets	0	636

Source: Egypt Description by Information, IDSC, 2007

The total area of the Cairo Governorate is up to 3085.12 Km^{2}.. The total populated area represents about 5.2% of the total area. While housing and scattering areas represent 2.25%. The agriculture land is about 47.34 km^2.

Giza Governorate is one the biggest governorate in Egypt, the total are is estimated with 13184 km^2 among which 1191 km^2 are populated. It represents about 9.0% of the total.

Table 7-24: Distribution of area and land use in Cairo and Giza Governorates

Area	**Cairo**	**Giza**
Total area	3085.12 km^2	13184 km^2
Total populated area	190.42 km^2	1191 km^2
Housing and scattering areas	96.52 km^2	84 km^2
Facilities and cemeteries	17.66 km^2	120 km^2
Ponds and fallow	28.90 km^2	9 km^2
Agricultural land within agricultural borders	15.45 km^2	776 km^2
Agricultural land outside agricultural borders	31.89 km^2	202 km^2
Population density in the populated area	40.89 Thousand person/ km^2	5.27 Thousand person/ km^2
Population density in the total area	2.52Thousand person/ km^2	0.48Thousand person/ km^2
Total populated area (% to total area)	6.2%	9.0 %

Source: Egypt Description by Information, IDSC, 2007

7.3.5 Basic Demographic Characteristics

<u>Population and gender distribution</u>

The total population of Cairo was estimated at approximately 8.129 million in 2010 according to the Egyptian Human Development Report estimations, with an additional 2 million commuters coming in and out of the city every day. Cairo's population represents 10.8% of the country's total population. Annual population growth increased from 1.1 between 1986 and 1996 to 1.3 between 1996 and 2006. The estimations of the population in Giza is 6490.8 million in (EHDR 2010)

According to 2006 Census, The total population of Cairo Governorate is 7.786.6 million people among which 49.3% are females. The average of family members is 3.8 people. While Giza propulsion is 6.491 million. Females represent 48.5%. the average family size is 4 persons.

Table 7-25: Population of Cairo, Giza Governorates

Population	Unit	**Cairo**	**Giza**
Total population	*Thousand persons	7786.6	6490.8
Females (% of total population)	%	49.3	48.5
The average of family members	Person	3.8	4

Source: Egypt Description by Information, IDSC, 2007

The distribution population density in Boulaq Abou El Ela compared to Zamalek is high. The average number of family members is also higher in Boulaq Abou El Ela where there are slums. Average family size in Boulaq Abou El Ela is 3.3, compared to 2.3 in Zamalek. The population density ratio is 1.27 in Boulaq as opposed to 0.53 in Zamalek.
Imbaba is the most highly populated in Giza governorate, followed by Boulaq El Dakrour. According to the 2006 census, each division has a population of more than half a million. Average family size is larger in Giza Qism and Boulaq El Dakrour. According to the 2006 Census, the average family size is highest in Imbaba (4 individuals per family), followed by Boulaq El Dakrour and Giza (3.9 individuals). The population density ratio is highest in Imbaba (1.19%) followed by Boulaq El Dakrour (1.15%). The smallest population density is in Agouz (EQI 2012)

Due to the rapid urbanization in Imbaba and Boulaq El Dakrour, the population is increasing rapidly there. However, it is worth mentioning that the two areas are one of the biggest squatters in Giza which attracts more immigrants from upper Egypt.[10]

[10] "*Impact of the rural migration on the squatter areas in Greater Cairo*", M. Hassan, Ein Shams University, 2010

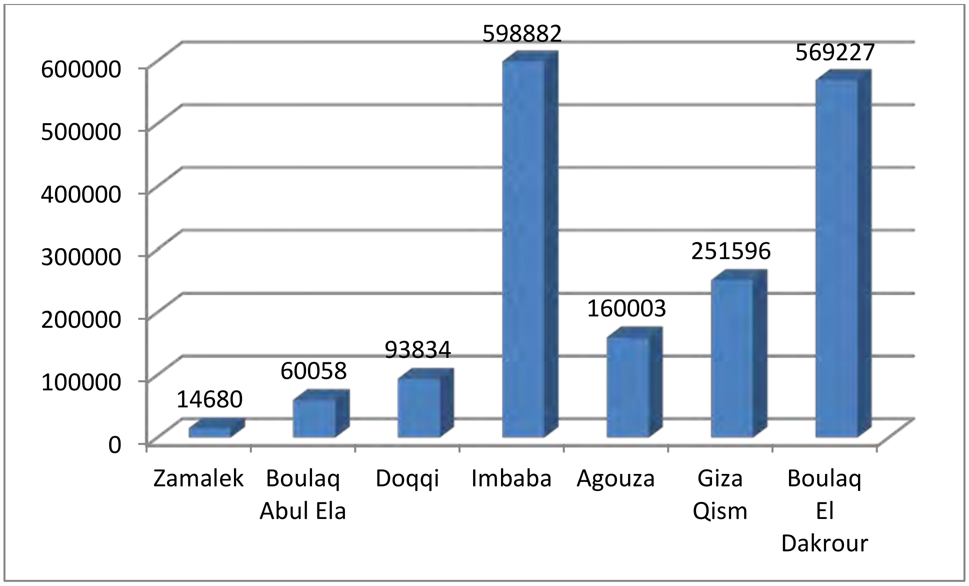

Figure 7-18: Distribution of Population among Project's Areas
Source: CAPMAS website, census 2006

<u>Age Structure</u>
The age-distribution of the population in the two governorate is slightly different as in Cairo and Giza 18.0 % of the total population are less between 5- <15 years old. While the same category represents about a quarter of the total population.

Regarding age distribution in the project areas, it was notable that around 50.0% of the total population in the whole seven areas lie in the category of 15-45 years old. Indicating that the communities are relatively young communities. However, in Dokki, Zamalek and Agouza the tendency to have over 45 is high as 50.0% of Dokki population are above 45 years, whereas Zamalek population above the same age category is 40.0% and 36.0% in Agouza.

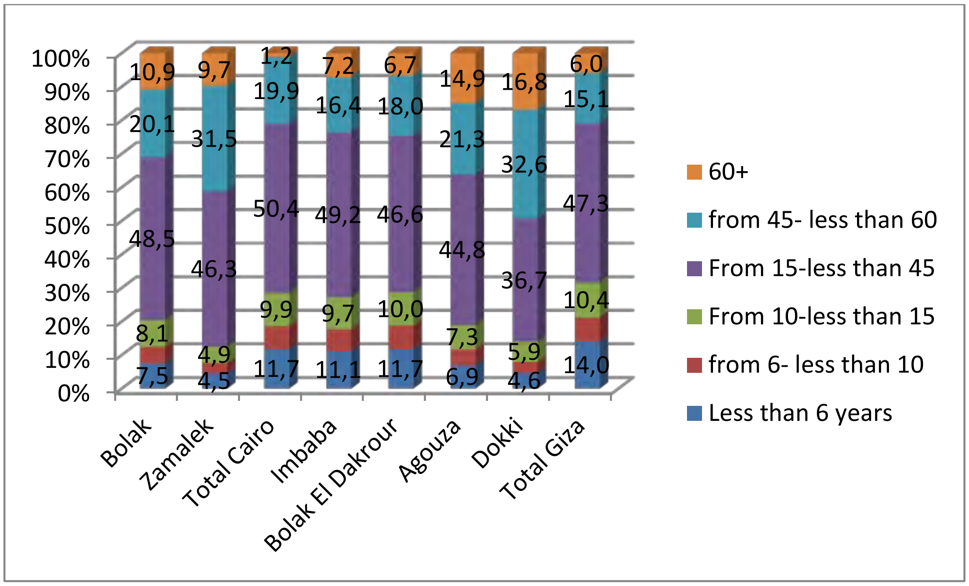

Figure 7-19: % Distribution of the age category of the population by project areas

Source: CAPMAS website, census 2006

<u>Crude Birth and Death Rate and Natural increase</u>

The crude birth rate in Cairo is (28.7 Live birth/ thousand persons) and 27.8 in Giza that is relatively higher than the rate reported for Egypt as a whole (27.8)

Death rate was higher in Cairo 9.1 and the lowest was in Giza 5.3. That is approximately the same as the total death rate of Egypt; since the national estimate is (6.1 deaths/1000 populations per year). Egypt Human Development Report 2010

The natural rate for increase represents the difference between the level of births and deaths in a population. It is important because it indicates how fast a population will grow (EDHS 2009).

The natural rate of increase varies from 1.5 in Cairo and 2.5 in Giza which is to some extent different from the one reported in Egypt 2.0. Egypt Human Development Report 2010. But for the life expectancy at birth, it is 71.3 in Cairo while it is 69.5 in Giza. This rate is approximately the same rate as it was reported in Egypt which is 71.7.

Table 7-26: Natural Growth of Cairo, Giza Governorates

Population	Unit	**Cairo**	**Giza**
Birth rate	Live birth/ Thousand	28.7	27.8
Mortality rate	Dead person/	9.1	5.3
Population natural growth rate	Per thousand persons	1.5	2.5

Source: Egypt Human Development Report 2010

The growth rate in the project areas vary completely as two areas decrease (Boulaq Abou El Ela -1.9% and Agouza -0.84%) while the data revealed that the growth rate in Boulaq El Dakrour is the highest 2.26%. Regarding the other three areas the growth rate was the least in Doqqi 0.11% followed by 1.25% in Zamalek and 1.36% in Imbaba.

CAPMAS population growth estimates until 2050 show that population growth is highest in Boulaq El Dakrour followed by Imbaba, Agouza and Doqqi. The 2050 forecasts show an overall trend of densification compared to 2006. A significant population growth can be noticed along the extensions of line 3 phase 3 corridor. The population in the areas toward the western end of line 3 notably rises, especially around the stations in Mohandeseen (Agouza district) and in the northern part of Imbaba. The informal settlements in Boulaq el Dakrour also face noticeable population growths, as well as the north-west bordering area of the city.

The growth rates in the areas falling under the course of sub-phase 3A almost stalled, as the region turned into a business and service hub with no possible horizontal expansion, especially in Boulaq Abou El Ela. Forecasts indicate a decrease in population in Boulaq Abou Ela from 62,000 in 2006 to 27000 expected in 2050, indicating a decrease of more than 50%. A slight increase in population growth is expected in Zamalek resulting from vertical extension there. The following table highlights growth rates in some areas that fall in the course of the Metro Line Phase 3 in Cairo governorate (EQI 2012)

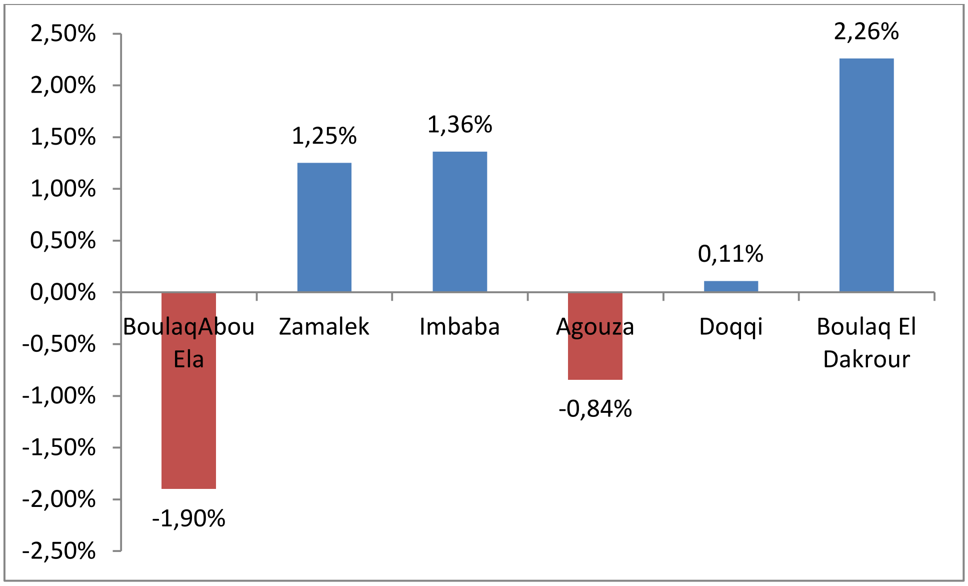

Figure 7-20: Natural Growth in the Project Areas
Source: CAPMAS website, census 2006

7.3.6 Living Conditions

Household Size and Density

Household is defined as "Family (and non-family) members who share residence and livelihood, and operates as one social and economic unit". The customary levels of demographic parameters and the norms governing living arrangement patterns, together determine the size and composition of households in any population

The 2006 census reported a national average household size of (4.18). While the density is not as high as may be anticipated, an average family size in Cairo 3.75 and Giza 3.88. that affected the density in house as Cairo and Giza were of the least density rate 1.13.

Table 7-27: Average family size and density rate of Cairo, Giza Governorates

Governorates	Total hourseholds	Average Family size	Density Rate
Cairo	89,186	3.75	1.13
Giza	15,219	3.88	1.13
Egypt	308,289	4.18	1.15

Source: Egypt Human Development Report 2010

The density ratio is the highest in Boulaq Abu El Ela while it is the least in Zamalek 0.53 followed by Dokki 0.8 and Agouza 0.91. The density reflects the socioeconomic characteristics of the household. Therefore, where the social status is high the density is low. That was reflected in the project areas as the highest social status areas were of low density.

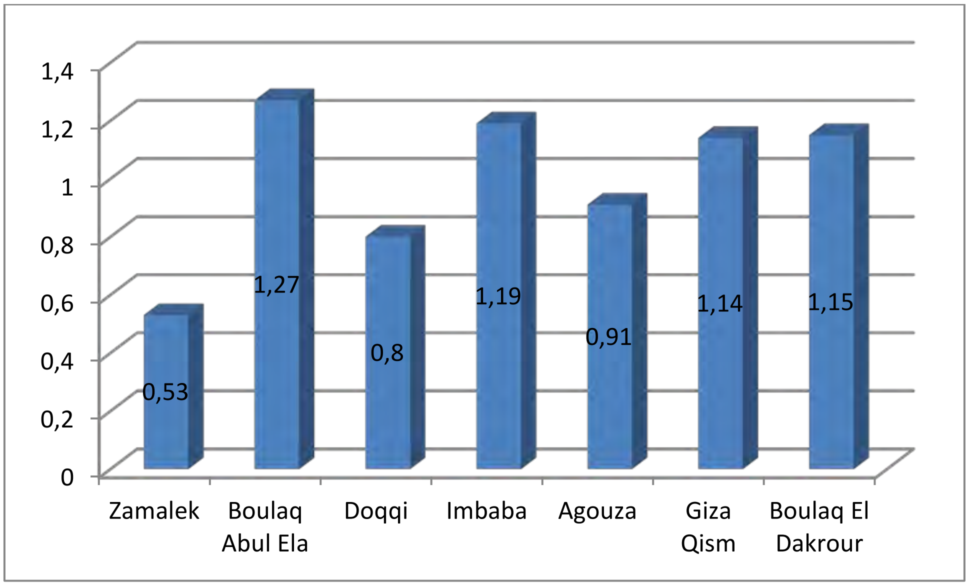

Figure 7-21: Natural growth in the project areas
Source: CAPMAS website, census 2006

Type of residence

In Zamalek, the percentage of families that live in separate residential units (apartments) reaches 92% as opposed to 62% in Boulaq. About 17% of families in Boulaq and Maspero area live in separate rooms (one or more rooms) followed by 4% in Zamalek. In addition, approximately 184 families, comprising nearly 427 individuals, live in shantytowns and slum areas in Boulaq Abou El Ela that is being planned to be developed in the urban planning master plan. The majority of the households in the other areas live in apartment. The type of house reflects the housing characteristics. However, the type of houses in Zamalek, Agouza and Doqqi is completely different than what is in Imbaba and Bolaq El Dakrour. The site visit showed that the houses in Zamalek are of a good conditioned, elite houses. However, in Imbaba and Bolaq the houses are made of red bricks unpainted or poor painted.

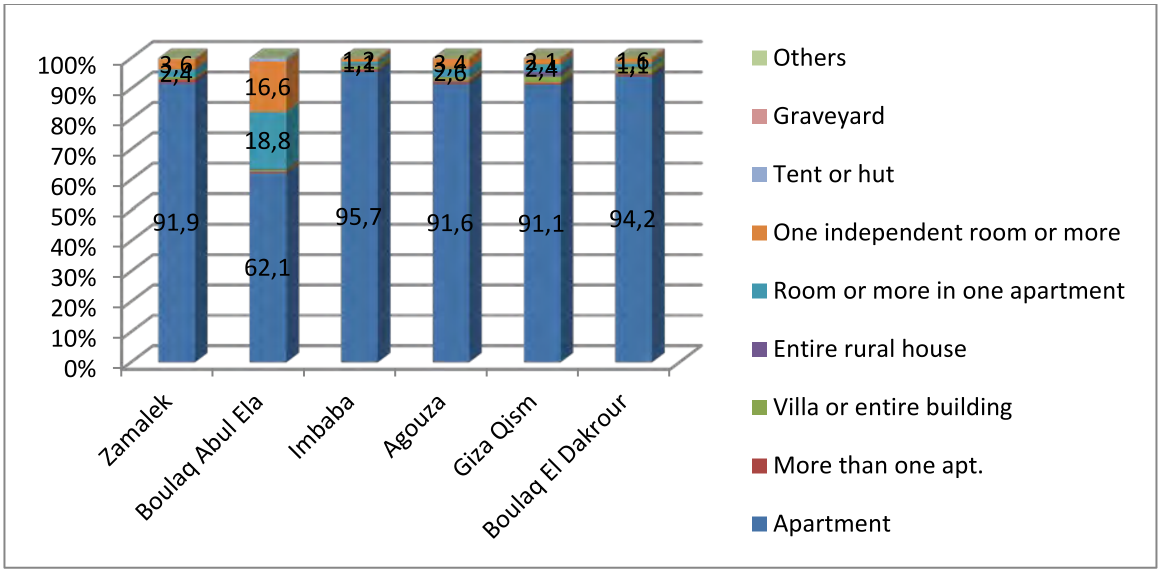

Figure 7-22: % Distribution of the project areas by type of residence
Source: CAPMAS website, census 2006

Figure 7-23: House type in Zamalek (left) and Bolaq El Dakrour (right)
Source: EQI Study and SESIA site visit, respectively

Ownership of residence

The type of ownership of residential areas along sub-phase 3A in the Cairo Governorate differs from district to district, and depends largely on the socio-economic conditions. Data reveals that the majority of residents in Boulaq Abou El Ela live in rented apartments (70%) as opposed to 51% in Zamalek. Owned houses on the other hand increases in Zamalek (42%) and decreases to 28% in Boulaq Abou El Ela.

On average in Giza Governorate, 55% of residents live in rented residential units. This rate is higher in Boulaq El Dakrour (60%) and in Imbaba up to 66%. For those who own their residential units, Agouza scores 25%, but this is considerably lower in Boulaq El Dakrour and Imbaba where only 2.5% of the populations own their homes.

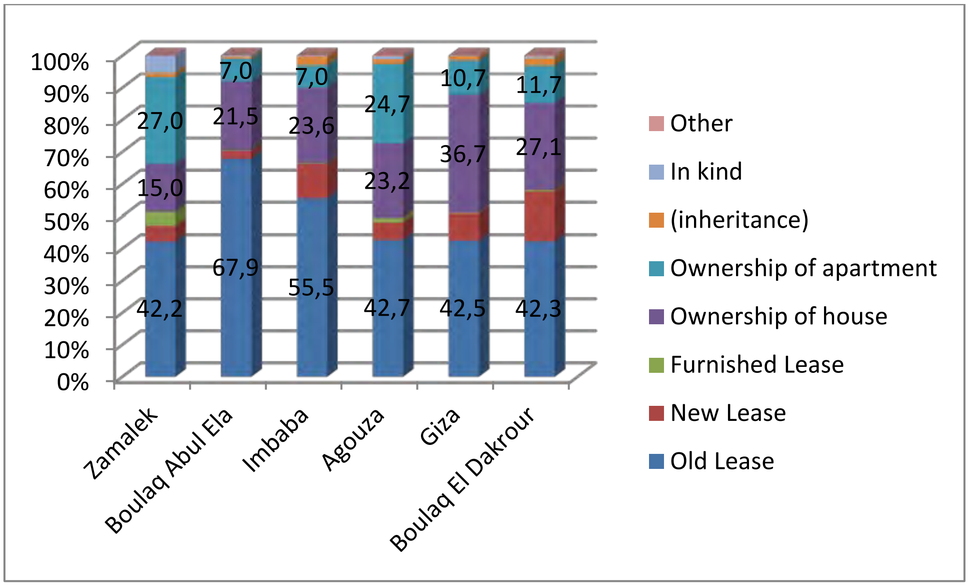

Figure 7-24: % Distribution of the project area by ownership of residence
Source: CAPMAS website, census 2006

<u>Access to Electricity</u>
Access to electricity in urban Egypt is high at(99.0%) (EHDR 2010). That is primarily due to the care given to improve living conditions for people in Egypt in particular access to electricity. Even squatter areas have access to electricity regardless of their formality and legality. That indicates to the stability of infrastructure in most of areas.
Regarding Cairo and Giza almost 99.0% of the population use electricity.

<u>Source of Potable Water</u>
The two governorates depend almost entirely on the Nile water for all its water needs whilst ground water, which is extremely saline and brackish in nature, is not used for drinking water purposes and is only partially used for irrigation in some areas.
Accessibility to potable water is high in Cairo and Giza indicating the wellbeing of community there. The high rate of access to potable water is mainly due to the Government's clear prioritization of water quantity and quality issues. Most households have easy access to water (tap water in dwellings). Not only that, the type of source of water available reflects the wellbeing of the house conditions as it is mainly tab water inside the unit. Few percentage reported using other types i.e. wells or pumps. However, it is worth mentioning that the quality of water supply is poor as water in some area has bad smelling and coloured.

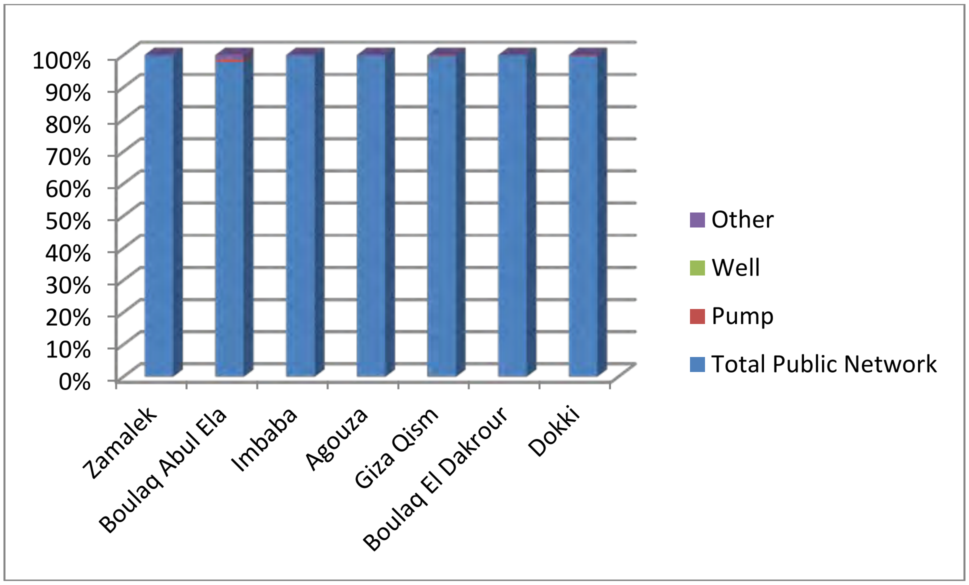

Figure 7-25: % distribution of the project area by source of potable water
Source: CAPMAS website, census 2006

<u>Access to sanitary system</u>
The project areas are privileged with a high connectivity rate to the sewage network. Few percentages of the households in Imbaba does not have access to proper sewage network. That is mainly due to having some squatters in Imbaba.

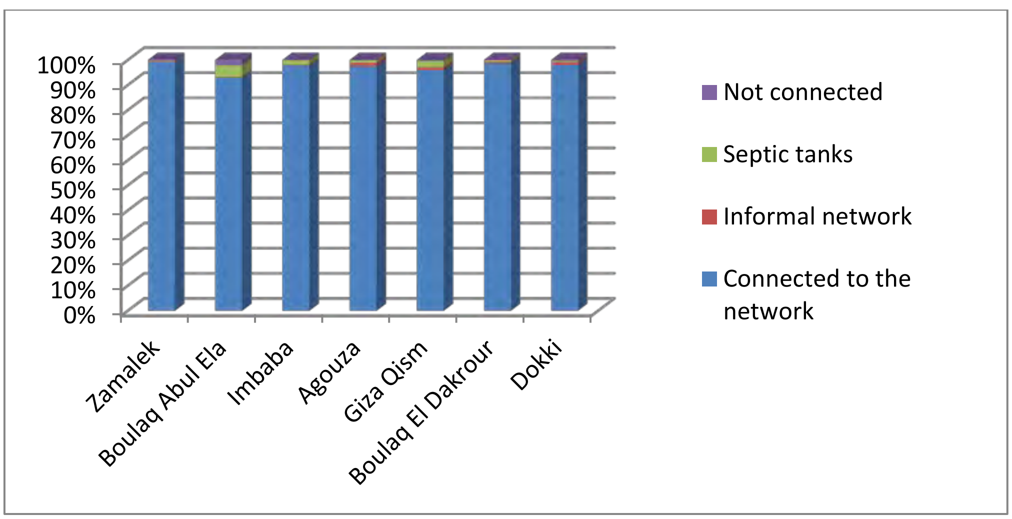

Figure 7-26: % distribution of the project area by access to sewage system
Source: CAPMAS website, census 2006

Health conditions and Handicapped We should use disabled/ people with special needs

There is no comprehensive medical records system in Egypt, and health statistics are generally only provided for the national as a whole. Health and medical statistics are sometimes drawn from limited studies, and it is not rare to find disagreement between studies on similar health subjects or diseases (EQI 2012)

However, the census provides some statistics about disability on the level of administrative divisions. The data revealed that the highest disability rate reported was in Boulak Abo El Ela 1.5%, while the least was in Zamalek 0.39%.

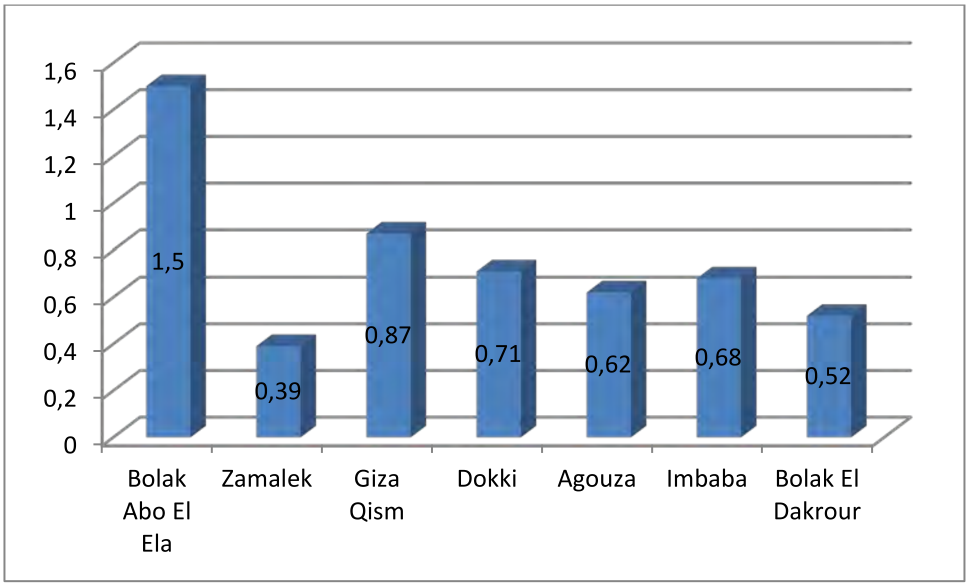

Figure 7-27: % distribution of the people with special needs
Source: CAPMAS website, census 2006

The total governmental expenditure on health in Cairo is considered to be of 7.52% of the total expenditure on health in Egypt23. Unexpectedly, crude deaths rates, infant mortality rates per 1000 live births and maternal mortality rate per 100000 live births in Cairo in 2005 (8.9 ‰, 31.1 and 61.7 respectively) show to be significantly highest in Cairo than averages in pertinent Governorates of Greater Cairo Region, as well as national average, while the number of private pharmacies in Cairo reaches 3.268 17 Center for Political and Strategic Studies, Egyptian Governorates' Series, Cairo Governorate, 2004.

The total governmental expenditure on health in Giza is considered to be of 4.88% of the total expenditure on health in Egypt7. Crude death rate in Giza in 2005 (5.5‰) is slightly lower than national average (6.4‰) and average in Cairo (8.9‰), but slightly higher than Qalioubeya (4.9‰). Infant mortality rate in 2005 (13.5 per 1000 live births) seems to be lowest in Giza and also lower than national average (20.5). Similarly is maternal mortality, which reached 43.8 per 100000 live births in 20058.

As for medical services, there is one Ministry of Health (MOH) general hospital, 7 specialized, 14 public and central and about 227 private hospitals in Giza Governorate in 2006, while the number of private pharmacies in Giza reaches 2.770. Health units are estimated to reach 5.1 per 100000 inhabitants in 2005, which is higher than national average (3.8).

<u>Communicable diseases</u>
High immunization rates have been achieved and sustained. Viral hepatitis (C and A) and tuberculosis are a significant public health problem. The prevalence of HIV/AIDS in 15-49 year-olds, on the other hand, is low (0.01%). Although Egypt is considered a low epidemic country for HIV/AIDS, a risk factor does exist.

<u>Vector borne diseases</u>
The prevalence of Schistosomiasis infections may have decreased in recent years, it is still pervasive. Malaria, on the other hand, is no longer a serious health concern, as the annual number of cases declared is very limited.

<u>Non-communicable diseases</u>
Neuro-psychiatric disorders and digestive system diseases are leading causes of morbidity, accounting for 19.8% and 11.5% of the non-fatal burden, respectively. Chronic respiratory diseases (6.9%), injuries (6.7%) and cardiovascular diseases (5.6%) are other significant causes of morbidity. Disabilities are mainly attributed to osteoarthritis, injuries, while cancer has most often been observed in breasts, liver, bladder and lymph nodes. Around 1.2% of the population is blind, mainly due to untreated cataract; trachoma is prevalent in some governorates. Other lifestyles habits, such as smoking, lack of exercise, poor dietary choices, and non-observance of traffic rules are becoming increasingly important in the overall morbidity and mortality of the Egyptian population.

<u>Other health problems of concern</u>
Maternal and child health are somewhat problematic, as maternal and infant mortality rates remain high. Iron deficiency anemia is prevalent; and malnutrition is commonly observed in children under five years old, particularly in rural Upper Egypt.

The generally degraded environmental conditions of urban Egypt affect the health of city- dwellers. Air pollution, in particular, has been of concern for some years. Particulate matter and lead alone are linked to serious respiratory pathologies. Lead was phased out of petrol in Cairo, Alexandria and most of Lower Egypt's cities in late 1997, leading to substantial improvements in ambient air quality.

Excessive noise also has a debilitating affect on the psyche; and unfortunately, it remains a pervasive problem in Egypt. It is mainly caused by traffic and the use of car horn (EQI 2012).

7.3.7 Human Development Profile

Egypt's Human Development Report (2010) ranked the governorates according to their human development index scores, Tracking the level of Human Development achieved in different governorates since 2005, five governorates occupied the first five rankings in Human Development level, namely Port Said, Suez, Cairo, Alexandria and Damietta. while the governorates that occupied the bottom five ranks are , Assuit, Menya, Beni Suef and Suhag.. This is relatively reflects the poor conditions of the governorates. Some determinants constitute such index including, education, work status …etc. This section will discuss in details such determinants

Education

The Egyptian Human Development Report (2010) stated that adult literacy rate (+15) is t was (80.7%) in Cairo and it was about (80.3%) in Giza whereas the overall rate is (70.4%) in Egypt.

The combined Primary, Preparatory and Secondary level gross enrolment ratio is up to (63.1%) in Cairo is and (77.5%) in Giza while it is only (66.0%) in Egypt[11]. That is mainly due to paying attention to education in the governorates. Education Index consequently 0.748 in Cairo and 0.794 in Giza versus 0.689 in Egypt.

For more information about the educational status of the Governorate population, CAPMAS information census 2006 was more informative as indicted in the table (Appendix 5).

he highest level of education was mainly in Cairo followed by Giza, While the illiteracy rate was relatively high in Giza (19.71%) and Cairo (19.31%). Total number of schools in the scholastic year 2006/07 reached 3798 schools in the Governorate. According to official data, total number of schools in Giza reached 2580 schools in the scholastic year 2006/076.

As it was anticipated, education is one of the indicators that reflects the welfare of the society. Zamalek was of the highest level of university education followed by Boulak Abo El Ela and Dokki, while Giza Qism was of the highest illiteracy rate followed by Imbaba and Boulak El Dakrour.

[11] Primary education in Egypt starts at age 6 and continue for a period of 6 years schooling. This is then followed by preparatory school for 3 years. The two stages represent basic compulsory education. Secondary education is for 3 years, which is finally followed by higher / university education.

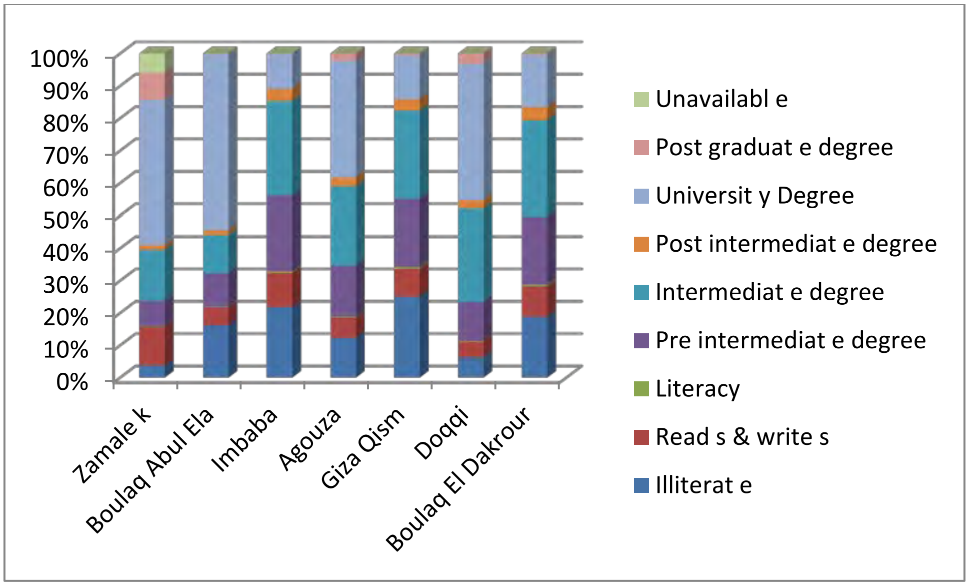

Figure 7-28: % distribution of the project areas by the educational level
Source: CAPMAS website, census 2006

7.3.8 International Labour Conventions and their implementation into Egyptian Legislation

Egypt has been a member of the ILO since 1936 and has ratified a number of ILO core conventions.

Table 7-28: Ratified ILO Conventions

ILO Convention	Ratified by Egypt
Minimum Age Convention, 1973 (No. 138) *Minimum Age specified: 15 years*	9 Jun 1999
Worst Forms of Child Labour Convention, 1999 (No. 182)	6 May 2002
Forced Labour Convention, 1930 (No. 29)	29 Nov 1955
Abolition of Forced Labour Convention, 1957 (No. 105)	23 Oct 1958
Equal Remuneration Convention, 1951 (No. 100)	26 Jul 1960
Discrimination (Employment and Occupation) Convention, 1958 (No. 111)	10 May 1960
Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87).	6 Nov 1957
The Right to Organise and Collective Bargaining Convention, 1949 (No. 98)	3 Jul 1954
Workers Representatives Convention, 1971 (No. 135)	25 Mar 1982

Source: International Labour Organization (ILO)

Despite the Egyptian State long membership of the ILO and the ratification of 63 of its conventions, it has not been able to implement the provisions of these conventions. Despite the fact that Egypt voluntarily ratified Convention No. 87 and 98 (Freedom of Association and Protection of the Rights to Organize and the Rights to Organize and Collective Bargaining, respectively) in the 1950s it has not enforced these conventions, nor brought its domestic legislation in line with the provision of these international conventions.

According to Egypt's extant legislation, Trade Union Law 35/1976, unions are legally confined to operate under a monopolistic, state-controlled union (Egypt Independent 26.06.2012).

Moreover, the recent dissolution of the 'Revolutionary Parliament' raises further questions regarding the future status of trade union legislation, along with other labour regulations. Beyond trade union liberties, the Egyptian state has been criticized for failing to establish a new national minimum wage, for criminalizing the right to strike and for failing to address the rampant problem of child labour, among other problems.

7.3.9 Freedom of Association and Protection of the Right to Organise, Convention No.87 and Right to Organise and Collective Bargaining, Convention No.98

C87 specifies that all workers, with no distinctions should have the right to establish and join organisations with no further authorisation. The organizations should be able to draw up their own programmes and administration and be able to elect their representatives in full freedom with no interference from public authorities. Furthermore, organizations should at all times be able to join federations and confederations with full freedom. The term *organization* means any organization of workers or of employers for furthering and defending the interests of workers or of employers. Each Member of the ILO, where this Convention is ratified, must undertake all necessary and appropriate measures to ensure that workers and employers may exercise freely the right to organize (ILO).

C98 promotes that all workers shall enjoy adequate protection against acts of anti-union discrimination in respect of their employment. Such protection shall apply respect of acts calculated to:

- Make the employment of a worker subject to the condition that he shall not join a union or shall relinquish trade union membership; and
- Cause the dismissal of or otherwise prejudice a worker by reason of union membership or because of participation in union activities outside working hours or, with the consent of the employer, within working hours (ILO).

National implementation

C87 and C98 were ratified in Egypt in 1957 and 1954, but there are still significant areas where the conventions are not implemented in practice. The right to form and join trade unions is heavily reduced in law as there was only one legally recognised national trade union centre, the Egyptian Trade Union Federation (ETUF).

ETUF was the only workers union during the former regime and had 2,980,000 members out of a work force of 25 million. ETUF had strong ties to the government and controlled the finance and management of all trade unions (ITUC Report). Workers who organising outside the ETUF could be fired, and the 2003 Labour Act made it legal for an employer to dismiss a worker without giving any reason (ITUC Annual Survey 2011).The first trade union broke a way in 2008 and later more followed. Post the revolution independent unions and committees along with workers independent groups in industries declared the creation of Egyptian Federation for Independent Trade Unions (EFITU) and its constitutional body in January 2011 (Unionbook, The Social Network for Trade Unionists). Moreover, Centre for Trade Unions and Workers Services (CTUWS) was founded by Kamal Abbas, who also took part in forming the EFITU. At this point the organisation is struggling be recognised legally as a NGO and has strong ties to the British workers movements.

The independent federation and the CTUWS calls for all workers to unite and protest for their rights and it envisions a future with independent trade unions, in which workers will not only be able to directly negotiate with employers, but also take stronger stands against political candidates and policies that hurt the prospects for workers. But so far they have had little actual impact and the only legally recognized union is still ETUF (ITUC annual Survey 2011). The absence of a bona fide national trade union centre makes it very difficult for workers to settle disputes through bargaining; hence, there is a tendency for them to resort to protests and strikes (ITUC Annual Survey 2011). In the private sector, where the Egyptian ETUF representation is very weak, employers avoid collective bargaining, and fail to respect government decisions on the minimum wage, social security and other issues (ITUC Annual Survey 2011).

7.3.10 Workers Representatives, Convention No.135

C135 defines that Workers' representatives must have effective protection against any act prejudicial to them, including dismissal, based on their status or activities as a workers' representative or on union membership or participation in union activities, in so far as they act in conformity with existing laws or collective agreements or other jointly agreed arrangements (ILO).The Convention defines *workers' representatives* as persons who are recognised as such under national law or practice, whether they are trade union representatives, namely, representatives designated or elected by trade unions or by members of such unions; or elected representatives, namely, representatives who are freely elected by the workers in accordance with provisions of national laws or regulations or of collective agreements and whose functions do not include activities which are recognised as the exclusive prerogative of trade unions in the country concerned.

Furthermore, the convention states that where there exist both trade union representatives and elected representatives, appropriate measures shall be taken, wherever necessary, to ensure that the existence of elected representatives is not used to undermine the position of the trade unions concerned or their representatives and to encourage co-operation on all relevant matters between the elected representatives and the trade unions concerned and their representatives.

National implementation
National laws or regulations, collective agreements, arbitration awards or court decisions may determine the type or types of workers' representatives which shall be entitled to the protection and facilities provided for in this Convention. This applies for Egypt, where the Egyptian Law does not protect all workers' representatives for dismissal.
The Trade Unions Act No. 35/1976 (as amended) only protects members of the trade union boards from suspension or dismissal, except pursuant to a court decision (Art. 46) (ILO website)

7.3.11 Equal Remuneration, Convention No.100 and Discrimination, Convention No.111

Both conventions were ratified in 1960. C100 determents that *remuneration* includes the ordinary, basic or minimum wage or salary and any additional emoluments whatsoever payable directly or indirectly, whether in cash or in kind, by the employer to the worker and arising out of the worker's employment; Furthermore, the term *equal remuneration for men and women workers for work of equal value* refers to rates of remuneration established without discrimination based on sex (ILO).

The Member Country shall promote and ensure the application to all workers of the principle of equal remuneration for men and women workers for work of equal value.

This should be applied by national laws or regulations, legally established or recognised machinery for wage determination, collective agreements between employers and workers or a combination of these various means (ILO).

C111 states that *discrimination* includes any distinction, exclusion or preference made on the basis of race, colour, sex, religion, political opinion, national extraction or social origin in opportunity or treatment in employment or occupation.

Furthermore, the terms *employment* and *occupation* is clarified to include access to vocational training, access to employment and to particular occupations, and terms and conditions of employment. But excludes: those made in respect of a particular job based on the inherent requirements thereof.

National implementation

Discrimination in salaries for employment is prohibited by Egyptian law. But equal wages for equal work in not respected in practice. Women's participation in the labour market is low and women face a considerable pay gap. Disabled persons, homosexuals and people living with HIV/AIDS also face discrimination in various aspects of employment, including hiring. Furthermore, there is no law prohibiting sexual harassments. Consequently, the law does not adequately protect women from discrimination and does not explicitly include a requirement for equal remuneration (ITUC).

7.3.12 Forced Labour, Convention No.29 and Abolition of Forced Labour, Convention No.105

C29 defines forced or compulsory labour as work or service exacted under the menace of penalty or involuntarily. Exceptions can be military service, conviction (no rent out to private), emergencies and community service. Furthermore, C105 emphasizes the member country shall not make use of any forms of forced or compulsory labour as a means of:

- Political coercion, education or punishment for political views;
- Mobilising labour for economic development;
- Labour discipline;
- Punishment for strikes; and
- Discrimination.

National implementation

The Egyptian law prohibits forced labour and trafficking but in practice this is, according to ITUC, still considerate an issue. The government has been slow in reacting to cases of forced labour and trafficking. Trafficking of children for marriage and sexual exploration and forced begging is the most common forms of forced labour in Egypt, but also women in domestic work posts a risk of forced labour (ITUC Annual Survey 2011). With regard to this the use of forced labour is unlikely to be an issue in this specific project.

7.3.13 Worst Forms of Child Labour, Convention No.182 and Minimum Age, Convention No.138

C138 emphasises that member countries that has ratified this convention shall pursue a national policy to abolish child labour and raise progressively the min. age for employment to a level consistent with the fullest physical and mental development of young persons. The minimum age is specified as, never less than the age of completion of compulsory schooling and never less than 15 (14 in dev countries) and, furthermore, 18 as minimum age for work likely to jeopardise the health, safety or morals of young people. Exceptions from this are work done in schools for general, vocational or technical education or in other training institutions. With regard to Worst Form of Child Labour, Convention No. 182, ratified in 1999, clarifies a child as a person under the age of 18. Worst form of Child labour is defined as slavery or likely, including trafficking, prostitution and forced recruitment of children in armed conflicts. Furthermore, work that per definition is harmful to health, safety or morals of children (ILO).

National implementation

The Egyptian Child Protection Law of 2008 sets the minimum age for regular work at 15 years of age and for seasonal work at 13 years of age (ITUC). Children must not work more than six hours a day, with an hour's break, and no overtime, night, or on holidays. The Labour Code of 2003 permits the employment of children as young as 12 years old. However domestic work and family enterprises are not included in the Labour Code and the Code explicitly excludes children working in agriculture. Children are not allowed to perform hazardous work and a list of such occupations has been enacted by a Decree of the Ministry of Manpower and Migration (ITUC).

Rural children and children from poor or female-headed households in Egypt account for the overwhelming majority of working children. A large proportion of working children are found in family businesses and in the agricultural sector. Furthermore, children are found working in a number of hazardous sectors, including leather tanneries, glassworks, blacksmith, metal and copper workshops, battery and carpentry shops, mining and quarrying, carpet weaving, auto repair workshops, and textile and plastics factories (The UN Refugee Agency). Child labour is not necessarily a direct risk to this project. The issues can occur in regard to supplier chains and other sectors in direct relation to the project. This should especially be taking into account as a risk during the construction phase with regard to how and where the materials used are produced.

7.3.14 Labour and Employment Status in Cairo and Giza, Governorates

Labour force is an important indicator for any socio-economic study. In Cairo (29.9%) of the population were in the labour force and (29.3%) in Giza. Female in the labour force was only 11.9% in Cairo, while they were up to 14.4% in Giza.
Industrial labourer in Cairo represented (41.7%) while they represented (32.6%) in Giza. Due to the nature of the governorate Cairo almost has no agricultural labourers. The most dominant human activity is service as 57.9% of the labour force in Cairo work in this field

Table 7-29: Employment status in Cairo, Governorates

Information about employment	Cairo	Giza	Egypt
% of labour force 15+ of total population	29.9	29.3	32.4
% of female labour force 15+ of total population	11.9	14.4	23.9
Distribution of labour force by sector			
% of agricultural labourer 15+2007	0.4	11.1	31.7
% of Industrial labourer 15+2007	41.7	32.6	22.1

% of services labourer 15+2007	57.9	56.3	46.2
Professional& Technical staff (% of labour force15+) 2007	27.8	15.6	18.7
Wage earners (% of labour force 15+Total 2008)	77.4	67.3	56.6
Wage earners (% of labour force 15+Female 2008	89.2	65.9	39.8
Employees in Gov public sector & public enterprise sector (% of labour force 15+)Total 2008	31.2	23.4	25.6
Employees in Gov public sector & public enterprise sector (% of labour force 15+)Female 2008	58.9	40.0	30.5

Source: Egyptian Human Development Report 2010

The high unemployment rate reported was in Cairo 11.9% versus only 6.7% in Giza. However, the definition of work for majority of people is "the job that produces money". Due to that definition, some of unpaid workers i.e. with family in workshops do not consider themselves as employed. The same concept might be applied on the housewives who raise poultry at home and sell them. They also perceive themselves as unemployed. Thus the results of employment quantitative surveys might be misleading. However, the data available is as follow: 22.6% of the female in the labour force are unemployed in Cairo while they represent only 13.9% in Giza.

Urban areas suffer from the unemployment more than rural areas as it is 8.3% in Giza in urban areas versus 4.1% in rural areas. The highest unemployment rate reported was among secondary graduate 55.9% in Giza and 44.2% in Cairo. Followed by 46.1 among university graduates in Cairo and 34.5% in Giza.

Table 7-30: Unemployment status in Cairo, Giza Governorates

Information about employment	Cairo	Giza	Egypt
Unemployment rate (%) according to gender			
Total 2007	11.9	6.7	8.9
Female 2007	22.6	13.9	18.6
Unemployment rate (%) according to type of area			
Urban 2007	11.8	8.3	11.7
Rural 2007	0.0	4.1	7.0
Unemployment rate (%) according to education			

Below secondary 2007	9.7	9.7	4.8
Secondary 2007	44.2	55.9	62.4
University 2007	46.1	34.5	32.8
Future labour force replacement ratio	200.2	139.5	289.0

Source Egypt Human Development Report 2010

Economic Wellbeing

In 2010, EHDR reported that the real gross domestic product (GDP) per capita is7726.4 in Cairo, 8242.8 in Giza, 8857.4[12]. This means that gap between the two governorates and Egypt is relatively high.

Economic Activities

Industry is considered an important economic activity for the Governorate's economy. In 2007, Egypt Description by Information reported that the total number of industrial zones in Cairo is 10 zones versus 2 in Giza. However, the total factories in Cairo was 1971 and in Giza was 830. 26 associations serve the industrial sector in Cairo versus 35 associations in Giza.

Table 7-31: Industrial Zones - Productive Cooperation Associations 2006/2007

		Cairo	**Giza**
	Unit	N	N
No. of industrial zones	Zone	10	2
No. of productive factories in industrial zones	Factory	1971	830
Area allocated for industrial activity :	Feddan	9730.7	6745
Area allocated for factories	Feddan	7501.7	6290
Area available for allocation	Feddan	2229.0	455
No. of productive cooperation association	Association	26	35
Members in association	Members	2411	1423

[12] GDP per capita for Egypt is estimated from the National Income Accounts of 2006/2007. The estimated GDP per

capita in local currency (LE) is transformed to its value in US$ using an appropriate exchange rate (taking into consideration the estimations of the Ministry of State for Economic Development .Then the real GDP per capita (ppp US$) is calculated by applying a suitable factor to the estimated GDP per capita in US$ (the factor used in the International Human Development Report for 2008). This resulted in a national GDP per capita index for Egypt of 0.727 in 2008.

Source: Egypt Description by Information, IDSC, 2007

Cairo governorate hosts several industrial zones that make it a haven attracting capital, which could be invested to develop the national industry and enhance its competitiveness on the local and international levels. Some of these industrial zones are located in El Basateen, El Waily, Heliopolis, Helwan, and the duty free zone in Naser City, as well as in the new industrial zones in the newly established cities namely; Obour, Qatameyah, Badr, and El Amal. The governorate has a solid base of strategic and consumer industries such as iron and steel, cement, military equipment, electric appliances and cars, as well as textiles and ready-made clothes.

To enhance the management mechanisms and maximize the benefit of IT utilization in an effort to overcome problems of local development administration at all the governorate's bureaucracy, the Administration Modernization Program was launched adopting electronic applications in developing business and administrative activities to provide a high quality service for citizens. This program includes five projects, which are intended to: develop the work system in the governorate's Main Department (Diwan Aam), and in regions and districts, establish an electronic portal for Cairo governorate,

Giza is an industrial city as it hosts many industries such as: food, spinning and weaving, basic metals, engineering and electronics, as well as mining. Moreover, the governorate hosts two industrial zones; one of them is located along Cairo-Alexandria Desert Road and has big industrial companies. In addition to that, the governorate hosts many new projects such as the under construction new Egyptian Museum, the Smart Village, and the third underground line. In addition, the governorate has the sound and light project and several museums and gardens that attract internal and bound tourism such as: Naggy Museum, the Zoo, the Agricultural Museum, and the Modern Arts Museum, in addition to entertainment places in El Haram Street, besides the Media Production City in 6th of October City.

7.3.15 Urbanization

Cairo is an urban governorate which suffers severely due to the squatter areas which are 75 areas surrounding all Cairo among which 5 slum areas are under removal and 2 areas will be removed. 68 of the squatters are under development. The severity of problem in Giza is less than it is in Cairo as only 36 areas are categorized as squatters among which 22 are under development and 14 have been developed[13]. Due to the Egyptian society conditions urbanization is not a systematic organized process but sometimes it happens haphazardly. Due to that the problem of squatters and slums come to the scene.

[13] Egypt description by Information, IDSC, 2007

7.3.16 Vulnerable Groups

Methodology of vulnerability identification

The identification of the vulnerable groups, considering their interest and setting plans to mitigate for any negative impacts on them, lies within the core of social impact assessment. This mainly returns to the fact that vulnerable groups are more exposed to the implications of various impacts and are more likely threatened to get in more impoverishment. Identifying vulnerable groups and assessing the Metro Line 3 project impact on them was one of the key gaps identified by the Gap Analysis Report.

By conventional definition, the vulnerable population are defined as those groups of people who are typically excluded, disadvantaged or marginalized based on their economic, environmental, social, or cultural characteristics. While various groups could fit within this description (e.g., women, youth, people with disabilities, refugees), a need for having a more specific and focused definition to identify the vulnerable groups relevant to the project raised as a necessity to the team. The SESIA analysis methodology for identifying the vulnerable groups and assessing project's impacts on them has been influenced by the Sustainable Livelihood Approach (SLA) which helped in setting the scene for describing the context, motivations and resources of the affected vulnerable households.

The SLA analysis to identify the vulnerable groups relied upon focusing on collecting information about the potential affected people, ranking them according to the severity of impact using different elements of the SLA which are:

1. Assets (social, physical, economical, human and natural assets)
2. Risks and vulnerability surrounding the targeted individuals
3. Polices and organizations that govern the implementation of mitigation measures

The level of vulnerability of certain group and the severity of the impact on these groups has been assessed by reviewing the individual's assets base using the sustainable livelihoods analysis (SLA) approach. The less assets base the affected groups have, the less alternatives and the less coping abilities they have and the more attention should be given in designing their compensation schemes and/or mitigation measures. The dimension of the asset base that affected population possesses has been considered and integrated in the various qualitative and quantitative tools designed by the Consultant.

The analysis of the vulnerability issues has been considered as a crosscutting issue in each of the mentioned impacts, including also the pure environmental impacts. It is believed that certain groups are more vulnerable to the environmental impacts than others due to higher level of exposure to these impacts or lack of alternatives or survival methods that allow for coping with these impacts. The presentation of the vulnerable groups, in that sense, has been integrated in each of the impacts (where applicable) and was addressed in deeper approach under the social impacts assessment.

Vulnerable groups related to impacts on livelihoods
As the project might result some unfavourable economic impacts during the construction and operational phase. The potential loss of income might result due to the construction as many areas will be closed either temporarily during construction or permanently due to resettling some business within commercial areas. The vulnerable groups related to the economic impacts might be summarized as follow:

- Workers who work in shops with no insurance coverage and no health care. Those groups might be discharged during the construction in case of any effect to the shops. They will not be entitled for compensation as well as they are not covered by any legal right for health care or insurance. This particularly applies to the workers who are the main bread-winners within their families, more specifically on elderly workers who might not be acceptable in other jobs.
- Vendors who work in the project areas who can't work in other areas due to the distance or not having another area to sell their goods in i.e. the vendors in 26th of July street,
- The widowed who raise their children with no other source of income than selling goods in the street which is blocked due to the construction. Their vulnerability will be relatively high in case of not being covered by any social insurance,
- Female headed families in El Bohy market that will be demolished, in case of not having alternative place to work in their families will be in terribly vulnerable situation,
- During the construction the green areas in Gameat el Dewal El Arabia Street will be removed. This garden became the place for vendors (tea-snacks …etc.) to work in. They are mainly among poor people who rely upon daily wage, the effect on their source of income will not be compensated for.

Vulnerable groups resulted due to the land acquisition activities
- Affected people who rent apartments or shops who are not eligible for appropriate compensation under the Egyptian legislations might find difficulty to get alternative house or shop. This applies in particular to certain sub-groups within the renters (tenants) like pensioner with limited source of income who are not expected to be able to recover from the project impacts unless if tailored compensation schemes are considered.
- Affected people due to the expropriation of their shops in Boulak Abo El Ela commercial areas might find it difficult to have another source of income, particularly, if the compensation is too limited to purchase another unit in a similar commercial area.
- People live in the Ring Road, particularly who have no legal right for compensation for their lands. The vulnerability might be high in case of they can't prove that they are entitled for compensation who are defined by NAT as " *Those who have the right for compensation*"

- Students who enrolled schools close to their house in Imbaba. They will be relocated in different areas. Their vulnerability might be high if they have no mean of transportation or if they are handicapped. This applies also to their families and their primary care –takers who have to pay for any additional cost associating with schools relocation.

Vulnerable groups resulted due to accumulation of wastes

- Accumulation of construction wastes in the sites might result many hazards on the surrounding communities. The hazardous effect will be high among those who have a fragile health condition, particularly, if they are of poor living conditions and uncovered with medical insurance umbrella ,
- Accumulated wastes might result disturbance to communities in case of preventing people from accessing different services. In case of having a critical service i.e. pharmacy, medical service, bakery…. etc. that might be a big burden to different communities, particularly, old people, handicapped and children,
- Accumulating wastes around restaurants might make people unwilling to go inside the restaurants, especially in case of having flies and bad smelling that will affect the owners of restaurants.

Vulnerable groups resulted due to the air quality and dust

- Allergic people who live in a poor conditioned will be the most potentially affected groups due to the implementation of the project. Especially, if they are not covered by medical insurance,
- Young children who are allergic to dust might suffer due to the implementation of the project, especially, if they are of poor families who can't afford paying for their medical treatment

Vulnerable groups resulted due to noise and vibration

- Despite the fact that, with the exception of Zamalek, the nature of activities and social set-up of the other areas where the line will cross involves high level of noise, it is expected that certain groups might be more vulnerable to the impacts of noise like elderly and sick people. This might have negative implications on these groups.

Vulnerable groups resulted due to the effect on the utilities

- Affecting some critical activities like clinics and medical centers might affect the level of service provided by these centers and accordingly the lives of patients due to serious dependency on the utilities services like water supply and electricity)

Vulnerable groups resulted due to the effect on the traffic flow

- Groups with limited level of mobility are more exposed to this impact
- The most affected people due to the traffic disturbance are taxi, Tuk Tuk and microbus drivers who rely upon their daily income. Some of the cases might not have alternative source of income.
- Traffic impacts might also be more serious in cases of emergencies (fires, transferring patients …etc.).

<u>Vulnerable groups resulted due to the effect health and safety</u>

- Children, elder people and those who suffer due to any accidents or health problems resulted from the project, including labourers. These groups will be considered as vulnerable in case if they belong to poor families and if they are not covered with health care insurance.

<u>Conclusion</u>

Vulnerable people will be identified in the RAP and RPF study. The RAP that will be developed under the project will make precise provisions with respect to identifying and assisting vulnerable groups which include:

- Identification of vulnerable people and identification of the cause and impacts of their vulnerability, either through direct interviews by the Project social worker or through the community; this step is critical because vulnerable people often do not participate in community meetings, and their disability/vulnerability may remain unknown,
- Identification of required assistance at the various stages of the process: negotiation, compensation, moving,
- Implementation of the measures necessary to assist the vulnerable person,
- Monitoring and evaluating continuation of assistance after resettlement and/or compensation took place.

7.3.17 Results of Social Survey

<u>Sample description for residents</u>

An analysis of the findings reveals that about 40% of the selected sample in each phase is female reaching 49% in phase 3C. In addition, about one third of the sample (30%) are 30 to 49 years of age while 23% are 50 to 59 years of age and 32% are over 60 years of age. Only 7% of the sample is younger than 30 years of age.

A further breakdown of the findings reveals that about 34% of the sample has between 2 to 3 members in their families, 38% have between 4 to 5 members, while 8% have only 1-2 members. Moreover, 17 % have more than 5 family members and this was found to be in Imbaba and Boulak El Dakrour areas.

On the other hand, about one third of the sample (35%) has been living in their neighbourhoods for periods ranging from 20-39 years while those living in their neighbourhoods for 40 to 50 years represent 25% and 36% in Zamalek, Nasser and Maspero. Furthermore, about 16% has been living in their neighbourhoods for up to 10 years. This is higher (28%) for areas like Imbaba extending to the Ring Road and Rod El Farag Corridor as these areas were previously agricultural land and urban expansion has only recently extended there. Only 14% however, have lived in their neighbourhoods for more than 50 years increasing to 20% in areas like Nasser, Zamalek and Maspero.

Concerning educational attainment, data findings reveals about 28% of the total sample who have never received any formal education (i.e. they are either illiterate, or they barely read and write). This percentage for the same category increases to 39% in Imbaba and the Ring Road area. About 8% of the sample has received basic education (primary and preparatory). In addition about 14% who have received secondary education. Almost a half (50%) of respondents have university degrees or higher and this percentage increases to 63% for the same category in areas like Zamalek and Maspero.

Findings for occupation reveal that almost half of the total sample (44%) is outside the labour force, namely either retired or housewives. More than a quarter of the total sample (29%) are engaged in top managerial and technical positions, 14% in technical assistance and administrative work, and about 9% in services, retail and trade. Only 4% work in agricultural, handicrafts and manufacturing related businesses.

Less than half of the total sample (43%) earns EGP 1000 per month. This category reaches 60% in Imbaba and Rod El Farag Corridor. Another 21% of the total sample earns a monthly income ranging between EGP 1000 to EGP 2000. Moreover, 15% and 21% earns a monthly

income ranging between EGP 2000-3000 and more than LE 3000 respectively. In phase 3A those who earn more than EGP 3000 are 35%. Out of the entire sample 97% were found not to receive any financial support. A total of 97% of the total sample said they do not receive any financial support.

<u>Housing Conditions</u>

Analysis of the findings revealed data on housing conditions, access to infrastructure and public facilities. These include age of buildings, appearance, construction material, and type of residence. For apartments in buildings, data collected include average number of apartments in buildings, average size of apartments, number of rooms, as well as size of gardens/green spaces if any. For all interviewed households, data include access to infrastructure (sanitation, piped water and electricity), household utilities and appliances including TV, radio, fridge, washing machine, electric fans, air conditioners, microwaves, as well as vehicles).

About 15% of all interviewed households live in buildings that have been constructed for 20 years most of which lie in areas that exit on phase 3B (Sudan, Imbaba, Rod El Farag Corridor). For the latter, 32% of buildings have been built for 20 years. Furthermore, 47% of interviewed households live in buildings that have been built between 21 and 50 years, and 33% from 51 to 80 years. In Zamalek, Kitkat and Maspero i.e. phase 3A, the percentage for the same category reaches 56%. As for those buildings that have been built for more than 80 years, about 33% can be found along line 3A.

About half of the sample (51%) believes their buildings to be in good condition. Another 36% see they live in buildings of moderate condition and only 13% of the sample think the buildings they live in are in poor condition. This is true for areas which lie on line 3C such as Boulak El Dakrour, and Bein El Sarayat near Cairo University where 22% of the sample there believe their buildings to be in poor condition. The can be explained by the fact that 87% of total buildings in the sample are constructed of cement, while only 13% are made of mud brick or other building materials like wood. Moreover, 91% of the total sample lives in apartments in a building as opposed to only 7% who live in separate houses, and about 2% live in one room only.

A further breakdown of the findings reveals that about 58% of the buildings whose households were represented in the sample are comprised of two to five floors. This reached 69% for Imbaba area. In addition, 37% of the sampled households live in buildings with six to eleven floors. This reached 62% in areas like Zamalek and Nasser. This can be verified by the prevalence of larger buildings there as well as in areas like Wadi El Nil and Gamet El Doual El Arabia. On the other hand, the average number of apartments/residential units per building is closely related to the area under study. For example about 26% of buildings in Imbaba, Boulak El Dakrour and Rod El Farag Corridor comprise 5 residential units on average. Another 33% of the sample have 6 to 11 residential units/apartments and about 26% of buildings have more apartments than mentioned and these are found in Nasser, Zamalek and Gamet El Doual El Arabia.

About 50% of total sample live in middle sized apartments (up to 100 m²) and another 30% live in apartments ranging in size from 100 m²-150 m². Only 20% live in apartments larger than 150 m². Furthermore, 43% of apartments comprise one to two rooms. Another 37% have 3 rooms and only 19% have three or more rooms. This percentage rises in line 3A to 34% where older and vintage like buildings exist and usually these comprise more than three rooms. It is noteworthy to mention that only three households out of the entire sample (225 households) have a garden. Two of the three gardens are of a size that ranges between 50 m² to 100 m² and one garden is 100 m² or more.

As for access to infrastructure and public utilities, about 94% of households are connected to public sewage network, 97% have access to piped water and %100 have access to electricity. Common facilities owned by the majority of households include TV, radio, refrigerators, washing machine and electric fans. About 42% of households have air conditioners and only 21% have a microwave. In addition, 41% of families posses cars and 9% posses bicycles or motorcycles.

<u>Property ownership</u>

Findings from this section reflect data on kinds of property, legal status of property, ownership types and sources of ownership and legal status of land for proprietors and average rent for leased residential units or land. Nearly half of the entire sample (48%) lives in privately owned units. Another 48% live in apartments with contractual arrangements using the old rent system and 4% in the new rent system and only 2% illegally occupy their units. A total of 64% of the sample bought their units and 33% inherited it from parents.

As for types of land ownership, 73% of the sample privately own their land and 12% are state owned and another 13% belong to the Religious Endowment Authority and only 2% of the land in the sample belongs to insurance companies. As for the those that are tenants who make up 52% of the sample, findings reveal that 63% of them pay a monthly rent of EGP 30 or less and this is because the majority of project sites are in old areas where rent is considerably lower. Another 15% pay between EGP 31-50, 13% pay between EGP 51-100, and 6% pay between EGP 101-200. Moreover, 3% pay a monthly rent of more than EGP 200.

Transportation

The most frequently used method of transportation mentioned in the sample is the use of private cars (31%). Another 24% said they use public transportation especially the microbus and only 10% said they use taxis. As for the use of the metro only 8% of respondents said they use it on a daily basis, about 5% said they use the metro about 3 to 4 times a week. Another 9% said they use it 1 to 2 times per week and another 9% use the metro less than 5 times per month.

When asked about the information they know about the metro project for phase 3 line 3, 45% of respondents expressed that they had no idea about the project and were not aware of it which indicates a need for action to steer awareness campaigns to define project stages in these areas.

On the other hand, 47% of the sample said they worked in the same district there they live. An additional 31% work in the same Governorate and only 22% work outside their Governorate. In 64% of the cases, the length of time it takes respondents to get to work can reach 30 minutes daily, and 18% of respondents said it takes them between half an hour and an hour. As for the kinds of transportation used forgoing to work, 31% use their private cars to go to their workplaces and 34% use public transportation (EQI 2012).

Sample of commercials and non-residents

The additional data collected that covered the commercial activities and non-residents will be described as follow:

The data collected revealed that the majority of the non-residential are males, particularly, in Imbaba and Kit Kat as the majority of vendors and shopkeepers are mainly males. However, in Zamalek a third of the sample surveyed were among females who might work as cleaning staff in the shops or companies.

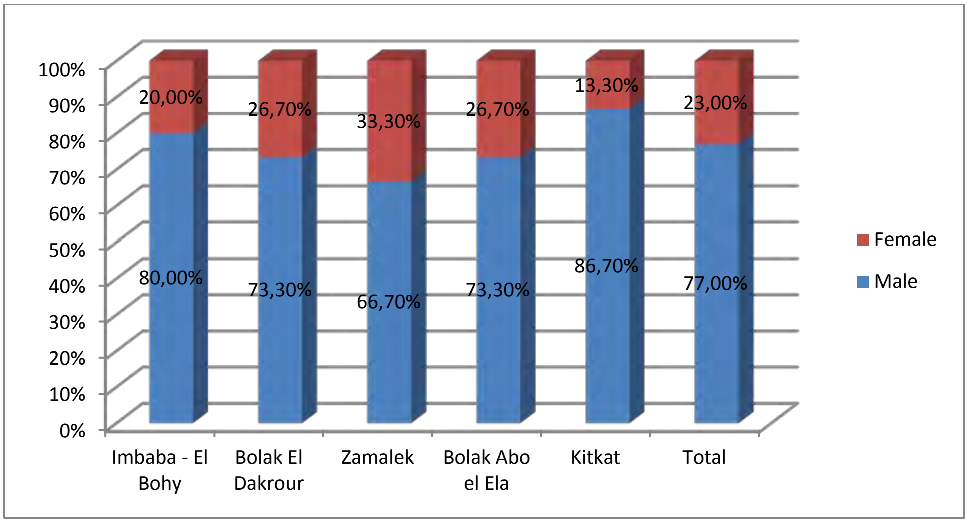

Figure 7-29: % distribution of the commercial and non-residential sample by gender and area

The study team tried to cover different age categories among young, middle age and old groups. The wide range of age categories affected the responses of each category. It was notable that the majority of workers in Boulak Abo El Ela were of a younger group as they were mainly vendors. However, Zamalek was represented by a higher age category who were mainly among shopkeepers and garage boys.

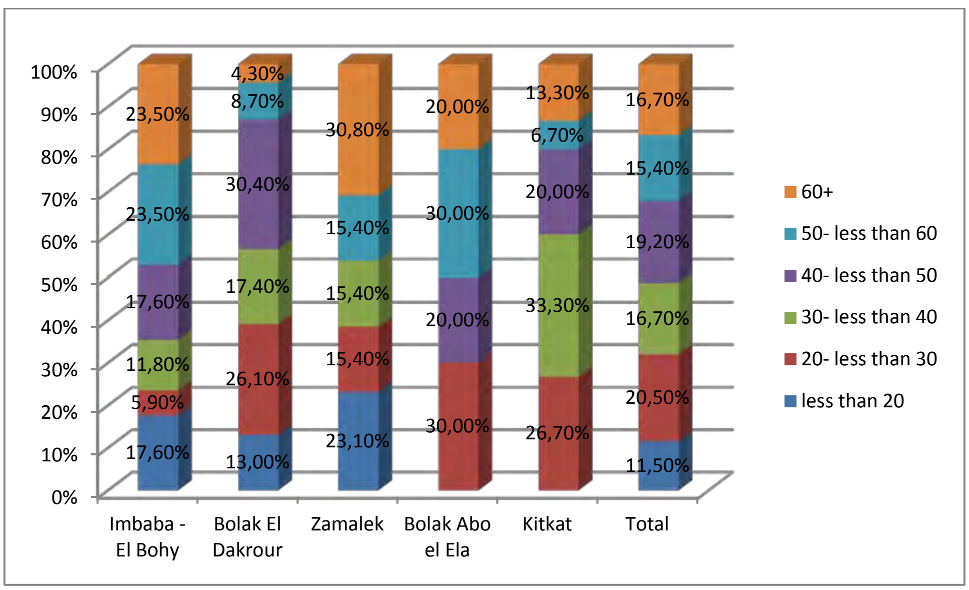

Figure 7-30: % distribution of the commercial and non-residential sample by age categories and area

Regarding the education of sample it was notified that the lowest education reported was in Boulak el Dakrour that has more vendors who are illiterate. However Boulak Abo El Ela was of the highest level of education due to the Shop owners. 25.9% of the sample was among vocational education graduates who are more accepting to working in sales. However, 35.3% of the sample were illiterate who are mainly among vendors and Tuk Tuk drivers.

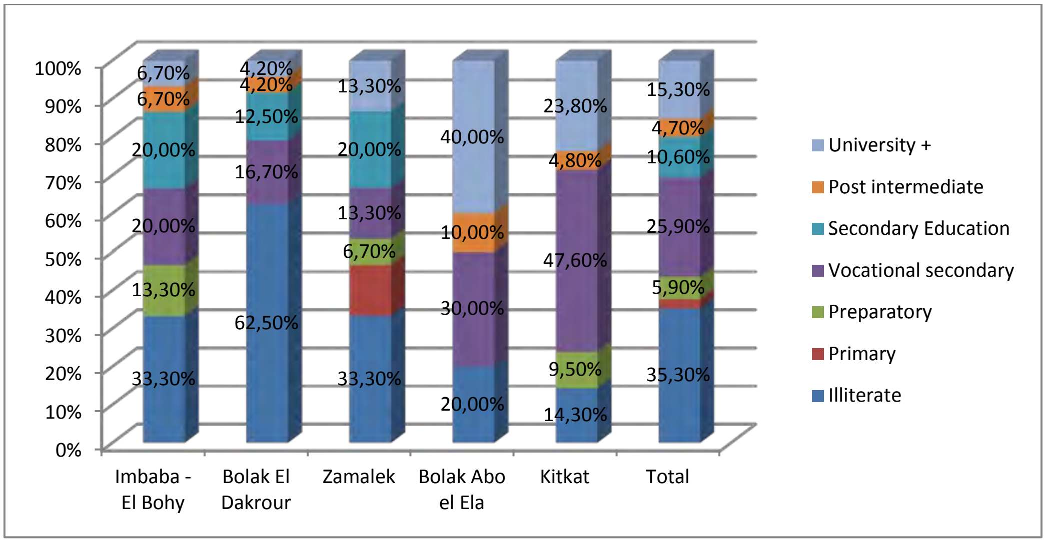

Figure 7-31: % distribution of the commercial and non-residential sample by educational level and area

The SESIA team tried to set focus on different commercials and non-residents. Vendors, drivers, skilled workers, shop owners sales people and students were highlighted. 21.6% of the total sample were among shop owners, while 17.2% were among vendors. Kiosk owners in Kit Kat were interviewed. In Zamalek, servants, garage boys and skilled workers were interviewed. This diversity enriched the study results.

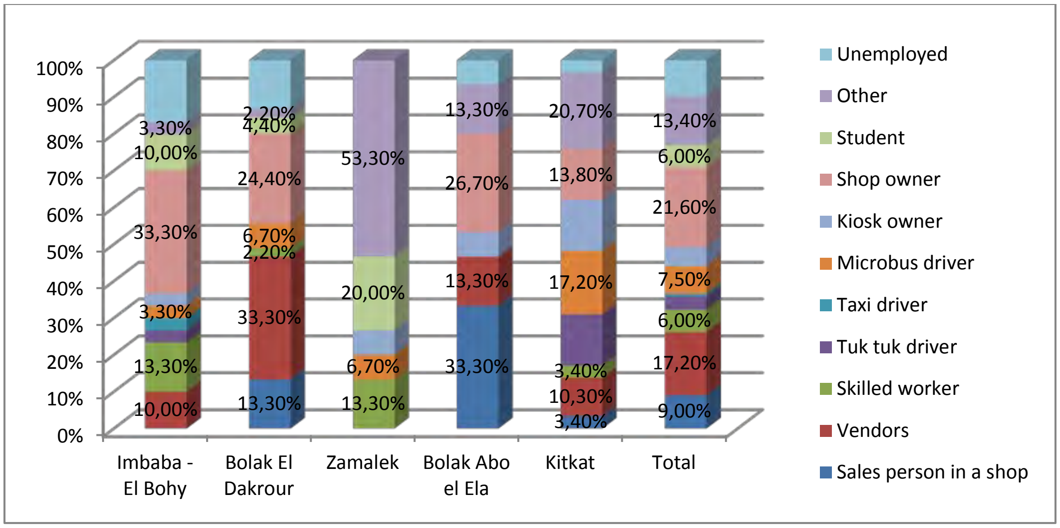

Figure 7-32: % distribution of the commercial and non-residential sample by occupation and area

It was crucial to cover with those daily commuters their main method of transportation they use on daily basis. The microbus was the most dominant method used, particularly, in Kitkat 60.0% and Imbaba 50.0%. However, 24.4% of the sample in Boulak relies upon the Metro in Behos Station near by then they use a microbus to drop them to their area. In Zamalek the bus was one of the most used means as 33.3% of the sample their mentioned using it.

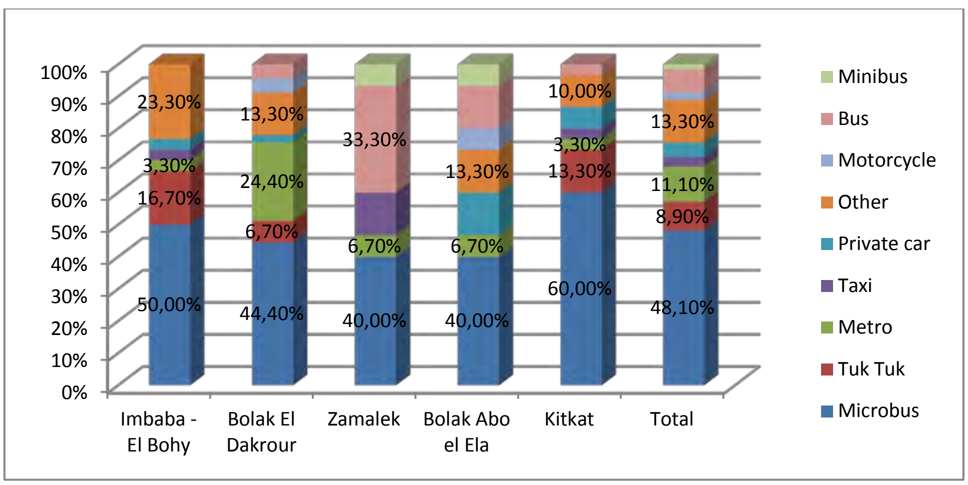

Figure 7-33: % distribution of the commercial and non-residential sample by main transportation means they used and area

The perception of the majority of the sample was positive towards the project as it is a quick comfortable cheap and modernized means of transportation. However, the vendors especially in Boulak Abo El Ela were reluctant to have it due to the bad impact during the construction phase " The digging will affect the market… you try to deprive us from the solo source of income we have" reported a vendor in Boulak Abu El Ela.

All of Zamalek sample were with the project as they suffer due to the lack of public transportation. However, they noted that the residents will not welcome the project as it might affect the areas severely. Moreover, the low standard people will be more willing to invade the areas "The houses might be affected during the construction and we might be sent to remote areas" reported an owner of a shop in Boulak El Dakrour. However the majority of the sample were much in favour for the project.

"You will save us from the inhuman treatment of the microbus drivers" reported a female in Kit Kat. The microbus drivers were very much in favour to the metro, which was not anticipated, as the metro will reduce the traffic jam and facilitates moving for other means of transport.

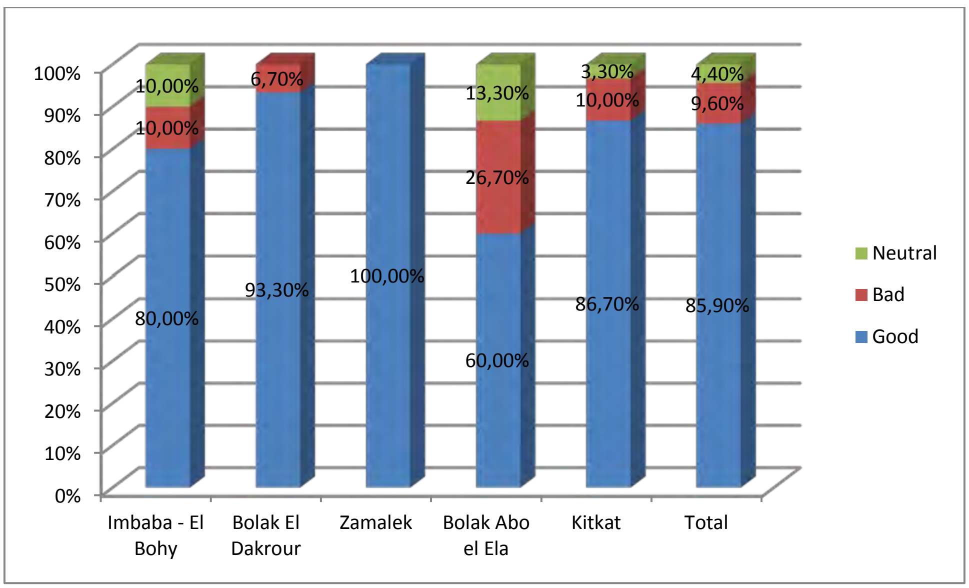

Figure 7-34: % distribution of the commercial and non-residential sample by perception towards the project and area

7.4 Urban Development

Description of station locations

Metro line 3A

Nasser
The area houses the Supreme Court and some recreational facilities like cinemas and a good number of hotels. Compared to other districts, this area is not primarily residential. The majority of commutes to this area are from other parts of the city and do not live in it. The area houses vintage buildings as old as 100 years or more.

Maspero
It is a residential and commercial area. The area has a high prevalence of informal expansions of existing shops, making pavements an open ground market rather than for pedestrians. It is a highly populated area with both middle and low income earners with no green areas or spaces.
Maspero also houses many vintage buildings some of which are frail to the extent of collapse.

Zamalek
Zamalek station lies along the path of the Bahrani Embassy through to Ismail Mohamed street, the Spanish and Algerian Embassies and the Dar El Tarbiya School. For this reason there are not many residential units in spite of the traffic congestion of Ismail Mohamed street which is a main entrance to the southern part of Zamalek and it is also a reason why Mohamed Mazher street was transferred to a one-way street to facilitate traffic.
The majority of residents in Zamalek with whom the survey team spoke do not use the metro asa means of transportation and see the metro as a humiliating means of transportation because in their view the metro was not carried out bearing in mind the same parameters as the metro abroad. Because they do not use the metro they do not wish to see a station being constructed in Zamalek. The idea of digging for the construction of the station and the negative impacts of that on the traffic flow and deterioration of the conditions of the streets was a frequently reported concern. In light of this respondents suggested an alternative location for Zamalek station in Sidky Sqaure. The latter being wider and can be used as a station. Also respondents were afraid of soil subsidence because of the older buildings which are frequent in Zamalek. Some buildings were reported to be as 120 years old and newer buildings were reported as being unstable in their foundations to the extent that would withstand digging. Respondents compared foundations of older buildings which were built using piles that were inserted up to 14m deep. This was said in light of the fact that the soil in Zamalek (being an island) is mainly comprised of mud and hence requires construction in a certain way.

Many of the residential units are vacant and expatriates also comprise a good portion of the tenants which makes the units occupied only part of the time. Although there is a good number of respondents who do not see the direct benefit of the metro on them, there were those who see that the metro project will decrease the number of public buses and school buses which will facilitate the flow of traffic. This is in addition to facilitating transportation for a significant number of workers who commute to Zamalek from Kit Kat, and Imbaba for work mainly as domestic help in the homes. For these the metro is a reliable, affordable and regular means of transportation and will have an impact on the quality and regularity of workers as well as attract newcomers to work thereby providing ample source of workers.

Kitkat

The station lies on Sudan street beginning to the east from the Post Office building and Khaled Ibn Al Walid Library to the west and the Swiss Club. The street is a two-way street heavily congested with traffic and is characterized by a very high level of noise. The area where the proposed station will lie is a commercial area with much hustle and bustle. Almost all ground floors in buildings are comprised of shops displaying a variety of trade related activities as well asclinics, lawyers'ofices, bank-branches and pharmacies. In addition to the shops there is aabundance of street vendors on either side of the street, mainly selling food items.The area is also densely populated and low income housing buildings exist on one side of the street. These buildings comprise small flats which are rented but attract low income earners while on the other side of the street there are towers which comprise flats that are larger and more expensive. The latter attract business owners, doctors administrative offices etc. The majority of residents interviewed in this community were in favour of the metro project however, there was concern with the older buildings especially if they would withstand the repercussions of digging and construction works during the implementation of the project.

Metro line 3B

Sudan

The station begins at the Technical Secondary School and Gowad Hosny School. The station passes through Sudan Street which is comprised of numerous commercial shops and workshops related to car repairs. The area is a middle income area housing the Students' City and hence many of the apartments in Sudan Street are rented furnished to students. However, some parts of it are of a high middle income level. The area is also crowded and noisy and during the survey it was not easy to find respondents because they are at work. However, when approached respondents were found to be in favour of the metro project.

Imbaba

The area is densely populated with heavy traffic congestion. The state owns a significant number of the buildings in this area and other parts resemble the slums. Some buildings are old and may not withstand digging and others will be demolished for the metro project. The area also houses many commercial shops and street peddlers are abundant. The income level of the area is low compared to other areas.

El Bouhy

El Bouhy street runs is located in Imbaba. Running down the middle of the street is an array of services including shops, mosque, school, youth center, market. Buildings in this area are of average condition and residents are from the low middle to low income bracket. There is heavy traffic congestion and interviewees were attracted to the idea of the metro project and some already know about. They made reference to the market and services center running down the middle of the road which they understood would be demolished for the sake of the metro. They are in favour of the metro project with what it entails in upgrading of the area and in decreasing the number of Tok Toks in the street, but were clear to point out that they would need an alternative for the market and services that may be affected by the implementation of the project.

El Wehda

El Wehda station is located in Imbaba. It is densely populated with heavy traffic congestion.

Buildings in this area are old and provide low income housing for its residents. The majority of the population belongs to the low income to low middle income bracket. The area also comprises commercial shops and manufacturing workshops. Public transportation and other means of transportation are available in this area.

The Ring Road, Rod El Farag Corridor

The area is characterized by more agricultural land than buildings. There is no population and traffic is minimal. Residents of this area breed livestock and poultry and work in agriculture related businesses and farming. The number of buildings is also scarce. However, buildings that do exist are owned by families whereby each house is comprised of an extended family where

smaller families live in apartments. Income levels are low in this area.

Metro line 3C

Tawfiqiya

The station begins at the Water and Sanitation Plant and garage from the pedestrian island and passes through Ahmed Orabi and Rasheed streets and ends by the Tersana Club. The Water plant represents a significant part of the area and housing is less prevalent due to this. The area comprised both middle income housing and low income housing representing two socioeconomic levels. It is also a commercial area and houses a low income section which is Meet Okba. The latter houses many traditional coffee shops, and car repair workshops. In this section, buildings are low income housing facilities and residents believe that the steel constructions in these buildings will not withstand digging and consequent vibrations.

Interviewed residents were in favour of the metro project and think it is a project that is long overdue and will facilitate transportation in general allowing family and kin to visit each other more easily.

Wadi El Nil

The proposed station will begin near the Meet Okba Primary school until the first intersecting street to Wadi El Nil street. The area has land that is currently being built on, one adjacent to the school and two other plots opposite it. One of the residents of the area commented on the construction works on these plots of land indicating that during the digging of the foundations for the buildings being constructed people thought there was an earthquake from the extent of vibrations felt. Other residents commented on the width of Wadi El Nil street which they see as too narrow to accommodate the digging and diversion of traffic as compared to Gamet El Doual El Arabia Street and Ahmed Orabi Street. They also commented on the tunnel in Wadi El Nil street which they recalled had a bad memory in their minds because of the traffic diversion and consequent congestion to its construction.

The majority of buildings and villas in Wadi El Nil street has closed gates and do not have porters like in Zamalek. However, when residents did arrive from work and were interviewed they were interested and keen to know more about the project. Buildings in Wadi El Nil street were built with the intention of not rising high and with construction taking place on only 40% of the area of the plot of land. The area is quiet and comprises villas and some buildings under construction. Some residents did not favour the metro project – being a cheap means of transportation-for fear of attracting commuters who might be of lower income backgrounds and criminal offenders as the residents heard of mugging in metro stations elsewhere in the country. Other concerns mentioned by residents had to do with the vibrations during the digging and the impact of that on buildings.

The area also houses the Awqaf buildings which are middle income housing facilities but whose tenants are educated. The area also comprises higher income earners of higher socio-economic levels. Questions and concerns were relayed by the residents of this area about the metro project with suggestions for including escalators in the design of stations for the elderly and disabled.

Gamet El Doual El Arabia

Traffic congestion in Gamet El Doual Arabia is high particularly during the rush hours. The area is comprised of buildings that range from 7 to 15 floors and are in good to very good condition.

A vast majority of buildings in Gamet El Doual El Arabia comprise commercial shops and banks where also many administrative offices and companies are located. There is a green area running through the middle of the road with plenty of trees. Residents in this area are from the middle to upper middle socio economic levels.

Boulak El Dakrour

The location of the station passes through Zomor Canal Street and begins with Fares street from the market side which intersects at several streets like Mohamed Ragab, Hanafiya, Bostagy. Zomor Canal Street comprises an open market which is frequented by residents. Hence it is a very busy street with all sorts of vehicles, Tok Toks, cars, transportation vehicles, microbuses, trucks etc.

The area where the street is located is heavily congested and resembles a semi informal area. There is much noise, populated densely and streets are congested with traffic. Most of the streets intersecting with Zomor Canal Street are narrow streets or alleys, houses are small with the exception of those on the main street which are a little bigger and the street a little wider. Most of the respondents in the survey were keen as to the purpose of the study demonstrating willingness and interest in the idea of the metro line phase 3. For them, the project is beneficial and will facilitate transportation. It will also alleviate them from crossing the railway tracks which is dangerous. Respondents also view the project as bringing about change to the community in terms of upgrading and cleanliness as opposed to those in Zamalek who hold the opposite view.
Residents of this community are low income earners and know each other well especially in side streets and alleys. However, there was a concern for the market and whether or not it will be relocated or removed and some expressed their concern for the viability of buildings and whether it would withstand digging and construction works during the implementation of the project.

Cairo University
The location of the station at Cairo University will pass through Zomor Canal which is the extension of Boulak El Dakrour. It lies only minutes away from Boulak El Dakrour hospital and the police station. The station ends in Cairo University metro station and is in an area called Abu Qatada. Abu Qatada is a highly populated shiakha of Boulak El Dakrour. Perpendicular to the Zomor Canal Street is Mohamed Ibrahim Street and Mohamed Metwaly Street and Hussein Mansour Street ending with Masr El Horra Street. The area is an informal settlement with residential and commercial establishments and markets. Transportation is available on the Zomor Canal Street and it is very noisy. Many residential units are rented to students. Interviewees in this area claim that the buildings they live in are mainly built using bearing walls and hence are more vulnerable to digging and vibrations. Interviewees were keen to mention that what keeps the buildings standing strong is their attachment to one another and not the steel and concrete beams. The vast majority of residents in this area are low income earners and they welcomed the idea of the metro project but were apprehensive about the fragility of the buildings and the ensuing heavy traffic and diversions during implementation of the project to an already heavily congested area (EQI 2012).

7.4.1 Land use along the alignment of Line 3

Through applying different site visits and reviewing EQI ESIA report, it was notable that the land use in the project areas diverse according to each and every part of the area. Therefore, the SESIA team relied upon land use maps provided by the EQI, in additional, further description was added based on the site visit to provide ides about the following:
1. Different land use activities
2. Type of dwelling
3. Dwelling condition
4. Recreational lands

The data collected from the field survey work and the EQI results were analysed and reported in this section, trying to provide it in a comprehensive way that describes land use in the areas. That might enable the study team to predict the impacts on urban planning and potential change in the land use.

7.4.2 The Criteria for Assessment

Through analysing the different results and reports, it was notified that the project areas are divided into three main phases (the phases of the metro line 3). They are 3A, 3B and 3C.

The main criteria for the whole areas is that:

1. All areas are highly dense and populated areas,
2. Residential and commercial are mixed together,
3. Recreational gardens is limited,
4. All areas are rich in facilities and utilities,
5. The majority of areas contain unorganized informal dwellings,
6. The following section will contain more details about the land use in each area by project phase.

Sub-Phase 3A

As it was mentioned before the land use will be based on the sub-phases of the third line. That might give a clear idea about the potential impact on the urbanization and changing in the land using in the different areas which might add value to the project.

Metro line sub-phase 3A passes through

1. Cairo Downtown (Nasser and Maspero Stations)
2. Zamalek
3. Kit-Kat Square

They are all densely populated areas, with medium (4 – 9 floors), high-rise (more than 10 floors), residential, commercial and administrative buildings adjacent to the locations of the stations, or directly along the Metro alignment. Sub-phase 3A begins on 26th of July Street in the Downtown area, west of the existing Attaba station. This part of the Downtown area is well-planned, with well-maintained buildings and sidewalks, as well as some vegetated open spaces. Buildings in 26th of July Street mainly serve commercial, and administrative/service purposes, and this is a very busy area in general. In the vicinity of Nasser Station, there are large buildings such as Egypt's High Court (Dar el Qadaa el Aaly), El Galaa Maternity Hospital (established in 1934 during the reign of King Fouad), and other buildings including foreign institutes and educational centres. The Nasser Station for Line 3 will be adjacent to the High Court, occupying space beneath the Court's car park and 26th of July St, east of Ramsis St.
The High Court is on the left, with the Line 2 Nasser station, before the Ramsis Street crossing. The Ministry of Foreign affairs in the area of Maspero is visible in the the distance.

West of the Ramsis street and Galaa Street crossings, lies the wider district of Boulaq Abou Ela. In this area, 26th of July street is overlain with 15th of May Bridge, which is connected to 6th of October bridge (above Galaa street) and leads into Zamalek. Here buildings also date back to the late 119th Century, and are made of bearing walls (brick), with wooden roofs, terraces and balconies; however, these buildings are in poor conditions, due to the lack of maintenance over past decades, the low quality of building materials used, and the inadequate craftsmanship of their builders. Consequently, their foundations have been degraded by groundwater intrusion, and the buildings show clear signs of weathering. Most of these buildings are lower (3 – 5 floors on average) than those towards the east of Ramsis and Al Galaa streets (EQI 2012:112).

As a conclusion for the land use in 3A sub-phase, the majority of land is used for residential and commercial dwellings. However, some facilities were noted among which 9 schools are found, 3 court houses, 5 governmental buildings, 5 embassies, one hospital, one public library, two cinemas, 2 clubs and a museum in addition to one antiquate palace and one social cultural place.

Figure 7-35: Educational, recreational, cultural and administrative establishments, sub-phase 3A
Source: EQI 2012:108.

<u>Sub- phase 3B</u>
This sub-phase passes through the following areas:

1. Imbaba (El Bohy-El Matar- El Qawmwiah)
2. Ring Road

The main criteria of these areas are being densely populated. Lands are limited as the majority of area in Imbaba is completely constructed. After the 25th of January revolution all empty lands in the area were constructed. The expansion of construction is extended to the Ring Road. What was considered as agricultural land in the Ring Road is vanishing rapidly due to the feverish construction.

With the exception of the railways and Imbaba airport, which in its present state is a vast, empty, rubble-covered, desolate wasteland, these areas are crowded, and do not allow for expansive landscapes. It is important to emphasise the lack of opportunities for open views in these areas. Though some vegetation is present, if only to a small extent, some areas, such as southern Boulaq El Dakrour near Cairo University, are really a tangled mass of large unattractive buildings, access ramps, overpasses, flyovers, and concrete columns. Other areas, such as El Qawmeyya St. in Imbaba, are relatively wide, but the only visual line they offer is a seemingly unending procession of unfinished or broken building (EQI 2012:127).

The types of the building in the area are not the same. In El Matar street and El Bohy 5-9 floor unpainted building are the main dominant type. In El Qawmiah street new constructed high building might be noted with up to 12 floor buildings .
The agricultural land extending west of Imbaba towards the planned terminal of Rod El Farag Corridor is typical of the other peri-urban cultivated areas west of the Giza main agglomeration: cultivated fields with a few low-built constructions, and the informal settlements within sight several hundred meters away. In the vicinity of the Ring Road, however, there are warehouses and factorie (EQI 2012:107).

Figure 7-36: Ring Road agricultural lands with new building view (left) and Old building in the Ring Road (right)

The land use of line 3 phase 3B can be summarized as follow:
1. Majority of residential areas in Imbaba
2. Agricultural area with rapid urbanization in the Ring Road
3. 4 schools
4. 1 public library
5. 1 Youth center
6. 2 mosques
7. 2 Garage
8. 2 fuel stations
9. One medical center and one high court
10. Governmental market in the center of street
11. Almost no public gardens except for the middle road

Figure 7-37: Educational, recreational, cultural and administrative establishments, sub-phase 3B
Source: EQI 2012:109.

<u>Sub- phase 3C</u>

The third sub-phase is amazingly divers in its land use as it is distributed into some areas among which some are well organized area and the other is unorganized squatter. The areas located on this sub linear:

- Boulak El Dakrour where the landscape is unappealing, given the haphazard and uneven sprawl of their bare brick/concrete constructions, the accumulated solid waste, the dilapidated roads, and small extent of vegetated areas.
- The other areas are Agouza and Dokki that have an attractive landscape with tall nicely built and painted buildings. The middle of the areas are green

The majority of areas are densely populated areas. The discussion of the land use of the areas located in 3C is that:

1. All areas are populated
2. 5 schools are found,
3. 3 of the most prestigious club in the city
4. 3 gardens
5. 4 governmental places in addition to vast of facilities
6. One huge mosque
7. One of the most crowded commercial area in Gameat El Dewal

Figure 7-38: Educational, recreational, cultural and administrative establishments, sub-phase 3C
Source: EQI 2012:110.

7.5 Public and Private Infrastructure

7.5.1 Transportation in Greater Cairo Region

This section gives an overview of the current infrastructure and transportation network in Egypt, focusing on the GCR. It also presents the issue of traffic accidents in Egypt, and the MoT's attitude in this regard. It is important to stress the potential positive impacts of introducing Greater Cairo Metro Line 3 Phase 3 in alleviating transportation-related problems, such as traffic congestion, pollution, and road accidents.

Local Transportation Networks
Egypt has functioning and elaborate land, air, and maritime transportation networks. Its maritime transportation network, in particular through the Suez Canal, is one of the most important trade waterways in the world. Other port cities such as Alexandria are also of tremendous economic importance. In addition, a railway network connects Lower and Upper Egypt from north to south. According to official statistics of the MoT, the railway network transports around 4500 million ton/km and about 600 billion passengers/km. Greater Cairo Metro Line 1 (Helwan-El Marg) and 2 (Shubra el Kheima-El Moneib) are estimated to transport around 3 million passengers daily.

A huge public road network connects Egypt's entire region, usually via the GCR. Egypt's huge road network contributes significantly to its economic development by facilitating the transportation of goods and travellers, locally within the GCR, and internationally towards the east, west and south. These roads include:

- The Ring Road
- 26th of July Corridor
- Cairo-Alexandria-Matrouh Desert Highway
- Cairo-Alexandria Agricultural Highway
- Cairo-Ismailia Agricultural Highway
- Upper Egypt Agricultural Highway
- Upper Egypt Eastern Desert Road
- Upper Egypt Western Desert Highway

The Cairo Metro Line 3 – Phase 3 will facilitate access to some of these, and particularly the Ring Road and future Rod El Farag Corridor in the north-west. Line 3's north-eastern point will connect central Cairo to Cairo International Airport, in Heliopolis.

Road Accidents in Egypt
Road accidents are the second most prevalent cause of death in Egypt. 93% of these are caused by human mistake, and the remaining 7% are attributed to poor road maintenance or dangerous climatic conditions.

In order to minimize the incidence of road accidents, the Ministry of Internal Affairs increased traffic fines, collecting about LE 180 million in 2006 (a 33% over 2005), while the MoT upgraded existing highways (e.g. Sukhna-Hurgada Road) and introduced new ones (e.g. Cairo-Sukhna and Cairo- Alexandria-Matrouh Desert Road). These governmental efforts have had some success, reducing the number of road accidents from 25,600 to 18,700 between2000 and 2008. Nevertheless, road accidents remain an enduring problem in the country.

Table 7-32: Total number of accidents, deaths and injured 2000-2008

Year	**Total number of accidents**	**Total number of deaths**	***Total number of injured***
2000	25,670	5,673	20,749
2001	25,180	5,974	20,749
2002	26,700	5,960	27,450
2003	29,101	6,760	29,650
2004	26,100	6,020	30,079
2005	22,006	6,407	25,289
2006	19,200	6,200	26,600
2007	22,400	6,700	30,100
2008	18,701	4,651	43,616

Source: www.IDSC website

7.5.2 Public Utilities

The present chapter deals with the existing main public utilities along phases 3B and 3C which have to be considered in the different stages of the studies and design.
The location and identifications of the main public utilities described hereafter are based on the information, SYSTRA collected from the available data and drawings of each concerned authority.
The various types of the existing public utilities are shown as follows:

- Water distribution network (potable and raw water)
- Waste water network (Collectors tunnels etc.).
- Electrical network (High, medium and low voltage cables).
- Telephone network (Coaxial and junction cables etc.).
- Natural Gas pipelines (Steel, H.P)

Existing Public Utilities along the Metro 3 – Phase 3 alignment
The existing main public utilities and electro-mechanical networks running parallel to, or intersecting the alignment of the Cairo Metro Line 3 – Phase 3 sub-branches must be considered during the design of the Line to minimize disruptions and accidents during p
re- construction, construction and operation of the project. The design engineering Firm for Line 3 – Phase 3, Systra, has collected all necessary data and drawings from each respective authority. The utilities available in the area of influence of sub-phases 3A, 3B (urban area), and 3C comprise:

- *Potable water distribution network*
- *There are water distribution ductile iron pipelines servicing the areas along the 3 sub-phases of Line 3 – Phase 3. These pipes lie at a depth ranging from 2 to 3 m.*
- *Waste water network*
- *Gravity reinforced concrete sewage pipelines lying between 3 to 8 m deep cover the whole area. Electrical network (High, medium and low voltage cables). There is a water sewage treatment facility in el Bouhy Street.*
- *Electrical network*
- *Medium voltage copper cables lying at a depth of 1.20 m (66 V) run. High voltage cables run in the vicinity of Gamaet el Dowal. This network is relatively dense, with up to 12 cables running in the vicinity of Tawfiqeya Station, near Ahmed Oraby Street.*
- *Telephone network*
- *The communication network consists of coaxial and junction cables, running at a depth of 1.80 m to 2 m. This network is also fairly dense, with up to 9 main telephone cables running under El Bohy, Wadi El Nil and Gamaet El Dowal Streets.*
- *Natural Gas pipelines*
- *Steel pipelines run at a depth of 1.50 to 1.70 m, intersecting the planned lines. (EQI 2012:Section 4.4.6)*

Details of the public utilities for the Line 3B described by the Systra Study are as follows:

Table 7-33: Water Networks Pipelines Description – Phase 3B

Description	Location	Diameter	Depth (m)	Material
4 Water Networks pipelines	Sudan Street	1000mm 600mm 300mm 150mm	2.00	Ductile iron
3 Water Networks pipelines	El-Bohy Street	300mm 150mm 100 mm	2.00	Ductile iron

Table 7-34: Gravity Sewage Pipeline Description – Phase 3B

Description	Location	Diameter	Depth (m)	Material
Gravity sewage pipeline intersected with the Metro route.	El Bohy Street	2500mm	8.00	Reinforced concrete pipes
Gravity sewage pipeline	El-Kawmia Street	1200mm	3.00	Reinforced concrete pipes

Table 7-35: Medium Voltage Cables Description – Phase 3B

Description	Location	Diameter	Depth (m)	Material
5 Medium voltage cables (66 kv)	Sudan Street	3x240mm^2	1.20	XLPE/ Copper
8 Medium voltage cables (66 kv)	El Bohy Street	3x240mm^2	1.20	XLPE/ Copper

Table 7-36: Telephone Cable Description – Phase 3B

Description	Location	Diameter	Depth (m)	Material
9 Main telephone cables parallel to the Metro route	Between two telephone chambers No. 67 and 69 at El Bohy Street	7x2000+ 1x1000 1x800 pair	2.00	Jelly Field

Table 7-37: Natural Gas Pipeline Description – Phase 3B

Description	Location	Diameter	Depth (m)	Material
Natural Gas pipeline	El Bohy Street	450mm	1.50	Steel

Details of the public utilities for the Line 3C described by the Systra Study are as follows:

Waste Water Networks

Table 7-38: Gravity Sewage Pipeline Description – Phase 3C

Description	Location	Diameter	Depth (m)	Material
Gravity sewage pipeline parallel and intersected with the Metro Station	Tawfikia Station	1500mm	3.00	Reinforced concrete segments

Table 7-39: Water networks Pipeline Description – Phase 3 C

Description	Location	Diameter	Depth (m)	Material
1 Water Networks pipeline	Tawfikia Station	1000 mm	3.00	Ductile iron
1 Water Networks pipeline	Wadi El Nile Station	300 mm	2.00	Ductile iron

Electrical Cables

Table 7-40: Voltage Cables Description – Phase 3C

Description	Location	Diameter	Depth (m)	Material
High voltage cables between El Dokki power station and El Maatemdia power station.	Parallel to the Metro route at Gamat El Dowal Station	2(3x1x400) mm^2	1.20	XLPE/ Copper
8 Medium voltage cables	Wadi El Nile Street	3x240mm^2	1.20	XLPE/ Copper
12 Medium voltage cables	Tawfikia Station	3x240mm^2	1.20	XLPE/ Copper

Telephone Cables

Table 7-41: Telephone Cables Description – Phase 3C

Description	Location	Diameter	Depth (m)	Material
Crossing of 9 Main telephone cables	Wadi El Nile Station	9x2000 pair	2.00	Jelly Field
Crossing of 7 Main telephone cables	Between two telephone chambers No. 121 and 122 at the location of Mostafa Mahmoud Street	7x2000 pair	1.80	Jelly Field
9 main telephone cables intersected with the Metro route	Gamat El Dowal Station	9x2000 pair	2.00	Jelly Field

Natural Gas Pipelines

Table 7-42: Natural Gas Pipeline Description – Phase 3C

Description	Location	Diameter	Depth (m)	Material
Natural Gas pipeline intersected with the Metro route.	Between Mostafa Mahmoud street and the end of Mohandisine branch	200mm	1.50	steel
Natural Gas pipeline intersected with the Metro route.	At Sudan street (the end of Mohandisine branch)	450mm	1.70	steel

It should be noted that the construction contractor will have to carefully consider the erection of the viaduct columns along El Matar, El Bouhy, El Qawmeyya and Zomor Canal Streets to avoid interference with any of these relatively shallow lying networks.

The cultivated, peri-urban area at the western end of sub-phase 3B is not well serviced in terms of infrastructure and public facilities. For example, some of the residents of these areas rely on water merchants for their potable water supply, and have very limited access to electricity. (4.4.6)
The Public Utilities Authorities concerned by the 3 Phases are:

- *Cairo potable water and sanitary drainage authority – Holding Company for Water & Wastewater (HCWW)*
- *Cairo Telecommunication Authority*
- *Cairo Electricity Distribution Company*
- *Egyptian Gas Company*

(EQI 2012: Section 4.4.6)

7.6 Public Development Plans

7.6.1 Land use strategy of Greater Cairo

The land use affected by the Metro Line 3, Phase 3 is influenced by the future strategic urban development, as planned by the Strategic Urban Development Master Plan (SDMP) from 2008, developed by GOPP. This study recommends a multi-polarized urbanization, by articulating the development of Greater Cairo around three Urban Clusters: the City Centre, 6 October in the east and 10 Ramadan in the west. According to that strategy, the eastern corridor on Ismailia desert road has been identified as one of the five strategic urbanization corridors in the Greater Cairo Region.

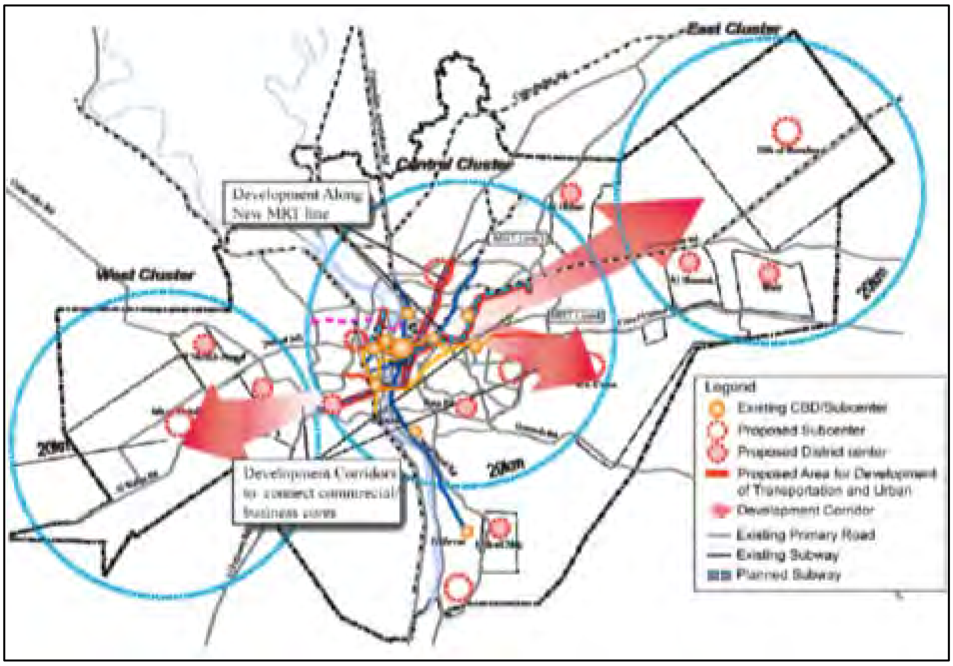

Figure 7-39: Strategic Urban Development Master Plan (SDMP) from 2008
Source: GOPP , Proposed development corridors for the Greater Cairo Region – SDMP 2008

The eastern part of Cairo, which includes Line 3 and Phase 3 corridor, comprises large surfaces owned by the military or airport authorities on its southern extremity, while the northern area is mostly made of housing. More importantly, it gathers a significant amount of industrial activities and Gisr El Suez road is a main artery, gateway to the eastern new cities: Al Obour, Al Shorouq, Al Badr and 10 Ramadan. A major part of the urban structure is also constituted of Cairo International Airport grounds, which occupies a large surface at the eastern end of Line 3 Phase 4 corridor. The East part would not change significantly as it is an already structured area from an urban point of view. Things are different on the western side, where many projects should take place. The map indicates for the area, where the Metro Line 3, Phase 3 is passing through, indicated as existing CBD/Sub centre the development of an additional new Sub centre in the East and the planned Subway.

7.6.2 The characteristics for assessment

The area around the 3rd phase of line 3 is located in the GC central area (as shown in the land use map below) and links different parts of the inner city. The metro line would serve the downtown area in Cairo Governorate, then would cross the Nile through Zamalek and finally serve Mohandesin, Imbaba area with the northern branch (3B), and Boulak El Dakrour area with the southern branch (3C).

Figure 7-40: Land use in the Metro Line 3, Phase 3 area
Source: Land use around Line 3 Phase 4 corridor – SYSTRA 2010

Analysing the results and reports available , it was notified that for all project areas (Phase 3A, 3B and 3C) the main characteristics can be described as follows:

1. All areas (with exception of the northern part of 3A) where the planned Metro line is passing through agriculture land) are highly dense and populated areas
2. There are no pure residential areas, residential and commercial areas are mixed together
3. Recreational areas are limited
4. All areas (with exception of Zamalehk and Mohandessin) need to be provided with additional public facilities and utilities
5. Some areas in 3C contain unorganized informal dwellings
6. Public green like parks and planted trees are available but need improvement

Mohandesin and Dokki are areas with high-rise buildings whereas the other parts contain lower buildings. Both mainly consist of housing constructions. Boulak El Dakrour and Imbaba are also mainly composed of private constructions, but with lower buildings (up to 6 or 7 floors) and often built illegally.

These two areas are rather poor with regard to equipment and services. Industrial activity is quite limited in the area of influence of the metro project; mainly concentrated along ENR railway tracks. However, some industrial areas are enclosed in wider perimeters of dense housing (more particularly in Boulak El Darkour)

The main public transport stations are located on the outskirts of Mohandesin, nearby railway tracks. The southern part of the study area is dedicated to educational activities, particularly noticeable around Cairo University station (245 000 students).

7.6.3 Major Development Projects Influencing Metro Line 3, Phase 3

As indicated in the map above, there are two major development projects influencing the development of the Metro Line 3, Phase 3:

- the planned development of the Imbaba Airport area
- the construction of the Express High Way, connected to El Farag Station.

Imbaba Airport Project

The Imbaba Airport is no more in use. It is envisaged to use the land to implement an important urban project, which includes housing and private investments but which is not committed yet.

As for Greater Cairo in general, the study area is very heterogeneous. It has been divided into homogeneous zones according to socioeconomic and morphological characteristics, to ease the analysis.

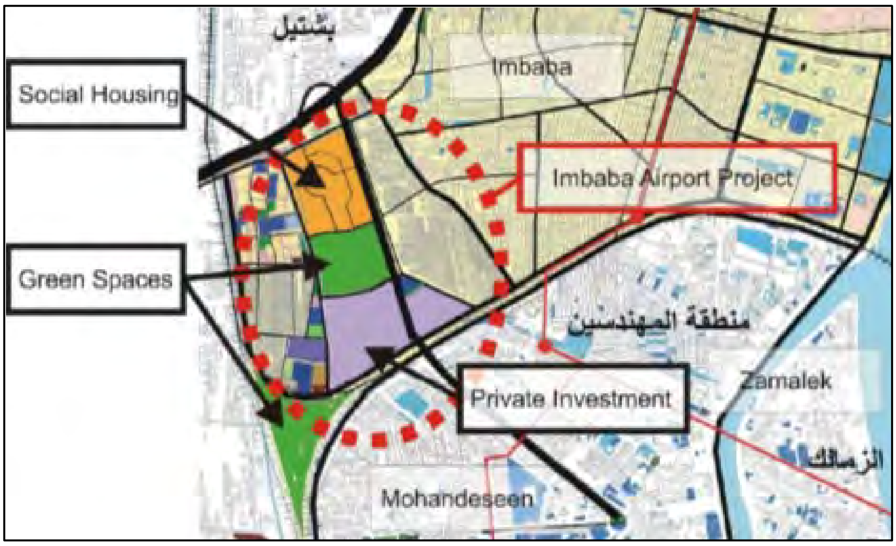

Figure 7-41: Imbaba Airport Project
Source: Transport Planning Study , Systra 2009

The project on the Imbaba Airport area is divided into three sectors which are two building areas articulated around a wide public garden as a green lung. The other two sectors:

- In the north: Social Housing Area
  This new housing area focuses on new affordable housing. This will allow lowering the density in this very crowded and sometimes insalubrious housing..
- In the south part: Private Investors Area
  For this area, the aim would be to sell this land to private sectors to provide funds to finance the rest of the project.

To complete the Imbaba airport development, it is proposed to revitalize all the neighbourhood of Imbaba. This plan will be based on the implementation of new public facilities, public spaces improvement and road network reorganization. The aim of Line 3 Phase 3 is to be the catalyst for the revitalization of Imbaba neighbourhood.

Rod El Farag
The planned Express Highway is connected to the El Farag Station of Metro Line 3, Phase three. The date for construction of this highway is not yet determined, but it can be expected that it will not be finished in this area before the station is constructed. Nevertheless will the Express Highway highly influence future land development in this area.

Figure 7-42: Express Highway connection to El Farag Station
Source: Drawings Systra

8 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND PROPOSED MITIGATION MEASURES

8.1 Introduction

This chapter describes in detail the different social and environmental impacts that potentially occur during the Cairo Metro Line 3 Phase 3 project. It is thus divided into the following sections:

- Soil
- Waste and Hazardous Waste
- Water Environment
- Air Quality and Dust
- Noise and Vibration
- Visual and Functional Intrusion
- Biodiversity and Nature Conservation
- Archeological and Cultural Heritage
- Public Utilities and Traffic
- Urban Development
- Involuntary Resettlement Including Vulnerable Groups
- Socio-Economic Effect
- Labour Standards and Occupational Health and Safety (OHS)
- Community Health and Safety
- Cumulative Impacts

Each social and environmental impact has been classified according to when it occurs during the project lifecycle, following the classification given in chapter 3:

- Preconstruction: Utilities Diversion and Preparation of Construction Sites
- Construction: Tunnelling, Construction of Cut and Cover for Tunnel and Underground Section, Diversion Structure west of Kit Kat Square, Viaducts, At-grade and Elevated Stations Construction
- Operations: Implementation and operation of the metro service

An assessment and evaluation of the potential impacts is then given, followed by descriptions of the recommended mitigation measures, the residual impacts and the costs of applying the mitigation measures. If an impact is not considered to occur during the preconstruction, construction or operations phases then this phase is omitted from the impact section. Where an impact is considered to be similar for one or more phases, then it is only described for one phase, and reference is made to that phase.

8.2 Soil

8.2.1 Identification of Impacts

Potential impacts on the soil can be classified as impacts on: 1) the excavated soil and 2) the soil surrounding the structural components of the project. These impacts could be generated during pre-construction, construction and operation phases. Impacts on soil are identified in this section as summarized in Table 8-1 below.

Table 8-1: Identification of Potential Impacts on the Soil

Potential impact	Activities causing the impact
During pre-construction	
Utilities diversion	Digging and earthwork in general
During the construction phase	

Potential impacts on the excavated soil	Digging, cutting and earthworks in general
	Handling, storage and disposal
	Exposure to environmental conditions
Potential impacts on the surrounding soil	Digging, cutting, filling and other earthworks
	Diversion of utility networks
	Construction of slurry walls
	Installation of project structural components including foundations
	The use of machinery and heavy construction equipment
During the operation phase	
Potential impacts on the excavated soil	n/a
	n/a
	n/a
Potential impacts on the surrounding soil	Normal train operation
	Maintenance and housekeeping
	Waste management
	Workshop operation

8.2.2 Pre-Construction

The main impact to soil during the pre-construction is related to earthwork from diversion of utilities. The impact is in general of the same nature as during construction, see section 8.2.3.

8.2.3 Construction

<u>Assessment, Description and Evaluation of Impacts</u>

Potential impacts on the excavated soil

Disturbance/contamination to the excavated soil during digging, handling and storage may occur. Assessment of these impacts is particularly important if the soil will be reused or recycled which will be discussed in detail in the following section.

Evaluation

- The excavated soil could come into contact with unmanaged waste effluents or oil spills or other types of hazardous waste which could be generated on site. It could also be subject to run-off water which may have been subject to contamination. The potential contamination of the excavated soil could render this soil hazardous. This will lead to other indirect impacts when the soil is handled, stored, dumped or reused. This could take place through leaching into water or through air emissions. This impact can potentially take place at construction sites, it will be of local effect, but it is of temporary nature but could have an irreversible impact if contamination has reached groundwater. It is considered of **minor** significance and can be controlled by applying proper mitigation measures.

- Mixing the different types of soil layers will affect the efficient reuse of such soil and will limit the available options. In particular, in agricultural areas, the top soil layer is usually rich in organic matter and mixing this layer with deeper layers will result in the loss of a high quality soil resource or a decreased chance of reuse/recycle of this top layer for cultivation purposes. The impact is likely to happen, local, temporary but irreversible. It is considered of **minor** significance.

Potential impacts to the surrounding soil

As mentioned in Table 8-1, the surrounding soil may be negatively affected during the different (pre-) construction activities as follows:

- The piezometric water level will undergo changes and this could affect the moisture content. The anticipated change in water level will be discussed in details in 8.4.
- The soil could be subjected to vibration during the different construction activities. However, the construction of slurry walls and other structural mitigation measures which will be implemented during the construction phase to protect the surrounding structures will minimize the impact on the soil due to vibration. The impact is likely to happen, temporary, local and reversible and could be considered minor.
- The soil could be subjected to increased levels of compaction due to the load of heavy construction equipment and machinery. The increased pressure due to heavy construction equipment is inevitable, but it is a local, temporary and partially reversible. Moreover, *the entire project areas fall within purely urban areas, only the section running from Ring Road Station to Rod El Farag Station (3B), including the train depot/shunting area is rural, so soil compaction impact may be significant.* This could therefore result *in impeding plant growth (reduced root, air and water penetration).*

  Due to this agricultural soil, the impact is considered to have a moderate significance, and can be considered to have minor significance at the rest of the areas *(EQI 2012: 167)*
- The soil will be subjected to general disturbance due to the construction of tunnels or cut offs, placement and construction of foundations. The disturbance in terms of installation of project components is a permanent one. The impact will be very local along the edge of the tunnel and the station boundaries. This impact is considered of **minor** significance
- Soils can become contaminated by chemicals/construction materials. Some of the chemicals, construction materials may be hazardous in nature. The spent lubrication oil is hazardous. Soil contamination with such materials, could lead to local pollution and migration of contaminants to the groundwater. Given the relatively long construction period, this impact is considered of **minor** significance.

<u>Mitigation of Impacts</u>

Most of the impacts evaluated in the previous section can be mitigated and controlled by developing a soil handling and waste management plan and applying the mitigation measures which will be presented in details in 8.3. This will ensure that all construction and maintenance waste are stored, managed, transported, reused or disposed of in an appropriate manner by licensed contractors in accordance with relevant waste legislation. These include the following;

- *Select suitable dumpsite areas for safe disposal.*

- *Transport and dispose the construction waste in designated, approved Disposal sites to minimize negative environmental and health impacts.*
- *Solid waste and oil spill management measures will comply with national laws and international guidelines.(EQI 2012: 198)*

In addition, in order to understand the vibration impacts on the soil, a monitoring programme should be put in place to monitor vibrations during construction. Building inspection surveys should also be carried out on the right-of-way in order to assess and control vibration impacts on buildings.

Residual Impacts and Costs of applying mitigation measure

The proposed measures will minimise adverse impacts, however the impact on agricultural land due to applied pressure caused by the heavy construction equipment is difficult to mitigate.

8.2.4 Operations

Assessment, Description and Evaluation of Impacts

Impacts to the excavated soil

This is not applicable.

Impacts to the surrounding soil

During the operation phase, impacts to the surrounding soil could be summarised as follows:

- Disturbance due to induced vibration resulting from normal train operation and maintenance works. This is inevitable, but expected to have minimal impact on the soil so the impact is considered **minor** but should be verified by monitoring.
- Leakage of wastewater effluents during maintenance activities or oil/water mix from activities at the workshop. This could be a source of pollution to the soil and groundwater. Given the potential toxicity nature of such effluent, and the high probability and high frequency of occurrence if not properly managed, this impact could be considered of **minor** significance.
- Leakage in wastewater effluents resulting from normal operation activities. This could be a source of pollution to the soil and groundwater. Given the expected low amount and non-toxicity nature of such effluents, the impact is considered of **minor** significance.

Mitigation of Impacts

Monitoring of vibrations should continue into the operations phase. Building inspections should also be carried out in order to follow-up on the surveys conducted during the pre-construction and construction phases, and thereby assess and control vibration impacts on buildings during operations.

A good management of the wastewater effluents from the workshop is proposed and will be discussed in details in 8.4. This could comprise of an oil separation, isolated and installed on the wastewater discharge pipe to separate the oil from oily wastewater.

Residual Impacts and Costs of applying mitigation measure

The residual impacts after applying the mitigation measures are negligible, under normal operation conditions. As such, no additional costs are, i.e. the costs needed to apply mitigation measures for waste and hazardous waste management.

8.3 Waste and hazardous waste

8.3.1 Identification of Impacts

Land excavations, tunnel boring are expected to generate large quantities of construction waste, solid and liquid, solid waste in the form of earth and rocks, waste from machinery and from human activities on the construction site through the construction process (EQI 2012: Section 7.2.34).

Of those waste types, some of the waste may be contaminated and need special treatment. It is expected that most of the excavated material will be transported to a specially designated, official dump site. The handling, transport and disposal of this solid waste can potentially pose environmental risks and risk to the human health, if not properly done. This constitutes a localized, direct, residual negative impact of high magnitude if not properly managed.

8.3.2 Pre-Construction

Before the construction of the Metro can start, the safe disposal and treatment of construction waste generated has to be guaranteed. NAT in cooperation with the responsible District authority therefore has to consider several steps, which will be necessary to be arranged before construction can start. These are:

1. Discuss a sound waste collection system for the future metro stations and their surrounding areas
2. Find the proper locations, where the construction waste can be disposed;
3. Assess the locations where potential hazardous waste can be disposed and treated;
4. Arrange all administrative procedures for licensing the transport and disposal of waste;
5. Agree on the routes, where the waste will be transported.

Assessment, Description and Evaluation of Impacts

Solid waste typically for the areas where the Metro line passes, includes domestic, industrial and construction waste. It is a common source of pollution, particularly in the periphery of Cairo, such as along access ramps of the Ring Road, or along the major road axis in informal settlements as Boulaq El Dakrour and poorer formal settlements as Imbaba, where illegal dumping has been a common practice for many years. Due to this fact, it can be expected that the waste management around the Metro stations will be in a poor condition, if no improvement is happening.

The waste with origin from the construction sites of the Metro Line 3, Phase 3 has at present only one site for construction waste and soil waste in Cairo Governorate and two for solid waste each in Cairo and Giza Governorate. There is at present no safe treatment possibility for hazardous waste in Cairo so that all hazardous waste generated from the construction sites has to be transported to the landfill in Alexandria , which is the only engineered landfill available and which also can handle big amounts of hazardous waste. This post a big constraint to the contractor, who – in case of excavating contaminated soil has to use this official landfill site. Smaller amounts of hazardous waste can be transported and disposed to the official solid waste landfills, depending on the carrying capacity for hazardous wastes. The landfill sites are described below.

Collection of waste

The National Environmental Action Plan (2000) reports that only some 60 per cent of municipal waste is collected in Cairo; of this about half is collected by Zaballin (garbage collectors). In effect, waste collection efficiencies range from 0 per cent in low-income rural areas to 90 per cent in high-income areas of large cities. The proportion of waste collected is much less in many other areas of the country, particularly in poorer areas as Imbaba and Boulaq El Dakrour, where the only means of solid waste disposal is often informal scavenging by people and animals, natural biodegradation and dispersion, burning at the primary point of disposal, and local self-help for disposal to informal (technically illegal) dumping sites.

The settlement structure in Boulaq El Dakrour and Imbaba is unattractive and in case of Boulaq El Dakrour totally unplanned, given the haphazard and uneven sprawl of their bare brick/concrete constructions, the accumulated solid waste, the dilapidated roads, and small extent of vegetated areas. With the exception of the railways and Imbaba airport, which in its present state is a vast, empty, rubble-covered, desolate wasteland, these areas are crowded, and are therefore producing a lot of waste.

Matar Street is full of waste and open waste collection points and does not host much vegetation, apart from a few well-maintained vegetated sections of the central reservation and small squares. Domestic/household waste is dumped in several sections of the central reservation, and the road itself is generally in very poor condition.
El Qawmeyya Street provides access from the Ring Road to the inner parts of Imbaba (Monira and El Warraq), and eventually central Cairo; as this is a commercial and densely populated area. Due to a poor waste management commercial waste is scattered around.

The Boulaq El Dakrour Station will be constructed on the current location of the market, on Zomor Canal St. This street is narrow, broken, and very congested. Market waste is discarded on the road side. Both pedestrians and vehicles amass dangerously close to each other. On the eastern side of the ENR, on Sudan Street, there is a formal bus station, which also do not benefit from a proper cleaning service and a waste collection (EQI 2012: section 4.4.8.1).

Disposal of construction waste and soil waste

Only those landfill sites are allowed to use for the disposal of wastes, which are agreed with the Giza and Cairo Cleaning and Beautification Authorities. Cairo´s designated dumpsite for construction waste and excavated soil is is Shaa El Teban landfill located in Maadi near the Helwan Road to Aswan.. This dump site will be only used for the disposal of excavated soil and other construction and demolition waste. The dump site has an area of 50 feddans (~200.000m2) and a depth of 20-25m. According to officials from Cairo CBA, the capacity of this landfill will be sufficient for the Metro line´s earthwork excavation.

Figure 8-1: Shaa El Teban - Maadi dump site for construction site
Source: CCBA, 2012

Solid waste disposal from the Giza Metro line stations should be disposed in the Shabramant Dumpsite Landfill.

Disposal of solid waste for Cairo and Giza Governorate

The Shabramant Dumpsite is the only official controlled dumpsite for Giza Governorate. It is located on an area of 714 feddan and is used for the final disposal of various types of waste from Giza. The road to the dumpsite is not paved at certain parts and the internal routes inside the dumpsite are very rough and are believed to be a serious hazard for the transfer vehicles, particularly for the old vehicles.

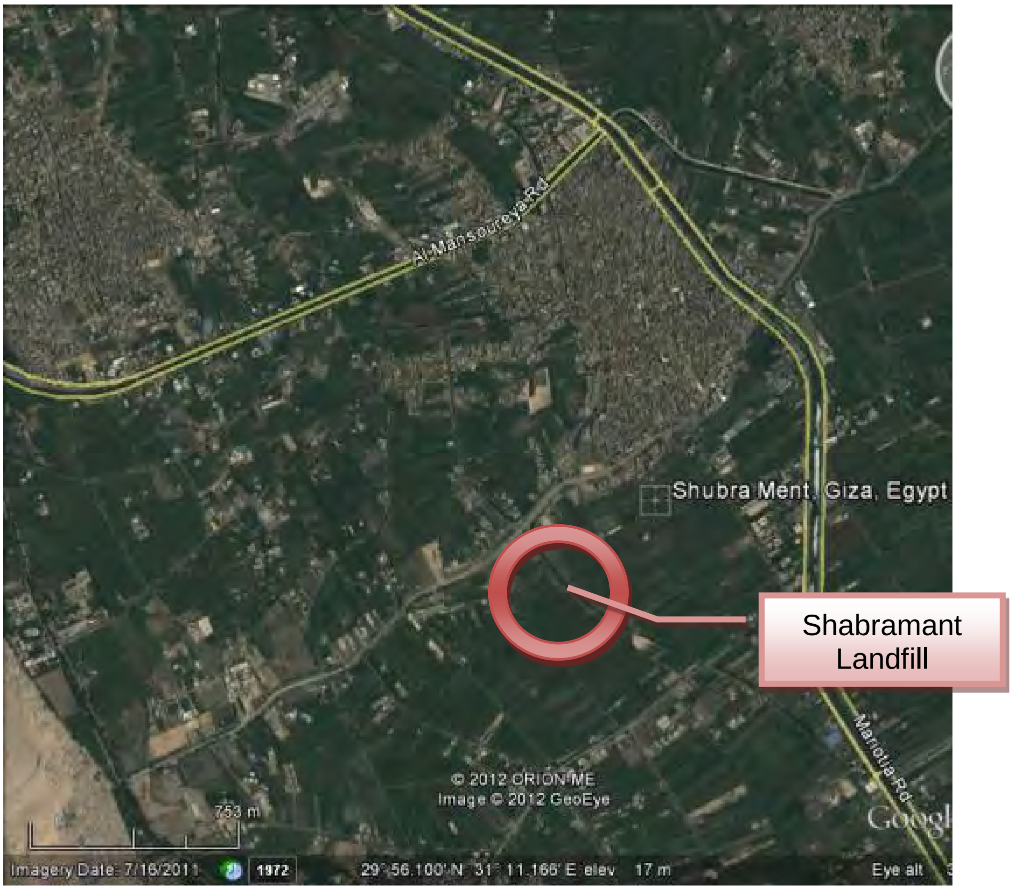

Figure 8-2: The Shabramant Dumpsite for Solid Waste
Source: Google Map

Since the 1990s the Government of Egypt has clearly opted for a policy of waste recovery, but focusing mainly on composting. Compost is considered an attractive product because of its possible use as a soil conditioner for desert reclamation schemes. The national policy comprises the construction of two windrow composting plants in each Governorate. However, most of the composting plants that have already been established do not operate efficiently or at full capacity. Sales revenues usually hardly cover operating expenses, let alone depreciation costs. Composting seems especially promising in the Delta Region, where there is a lack of land for land-filling, where the waste quantities generated are relatively large and where the proportion of dust in the waste is rather low.

The CBA is the main official authority in charge of the dumpsite's management. The dumpsite was established in 1989 and is composed of five landfill cells. Currently around 130 feddan composing four cells have been totally filled and closed. All types of municipal waste including markets, households, enterprises and construction waste, are disposed at Shabramant Dumpsite under the management of GCBA.

Parts of the waste are recycled in the composting plant, which was established in 1993 with an optimal daily capacity of 120 ton/day and actual capacity that does not exceed 75 tons/day.

Since 2004, GCBA sub-contracted one of the national companies which are working in the field of SWM in Giza Governorate and 6th of October Governorate, namely Al Farounia Company. Under this sub-contract, Al Farounia is allowed to recover and benefit from the non-organic recyclables from the dumped waste at the dumpsite. Under this subcontract which is renewed annually, Al Farounia is currently paying LE 163,000/month for using the dumpsite.

Solid waste disposal from the Cairo Metro line stations should be disposed in the Ekaro Landfill, which has two composting plants, where recycling and composting could be taken place.

Figure 8-3: The Ekaro Landfill site for Solid Waste, Recycling and Composting
Source: Google Map

Disposal of Hazardous Waste

Beside the engineered hazardous waste landfill in Alexandria, at the moment, there is for Cairo and Giza Governorate no nearby landfill designated for hazardous wastes but for the Cairo Governorate there are confirmed plans for the establishment of a 37 feddans landfill site for hazardous wastes in the southern area in 15th of May city close to the Ekaro landfill. All hazardous waste emerging from the Metro line construction has officially to be transported into the Alexandria Hazardous Landfill, which is the only engineered landfill for hazardous waste in Egypt.

License for transfer and disposal

The responsibility of the CBA´s relates to issuing a license for transfer and disposal of the solid non-hazardous wastes as well as hazardous wastes to the designated places. The CBA or a sub-contractor licensed by CBA provides the transport and/or disposal service. In interviews with the respective authorities, the places for the disposal of construction waste, appropriate routes, which will minimize the disturbance of the residents have to be indicated.

As a general problem, the disposal site for the Giza Metro construction places is far away and need long distances for transporting the waste. In addition will bigger amounts of hazardous wastes be transported for proper treatment to Alexandria, which constitutes high transport costs for the contractor.

Mitigation of Impacts

An environmentally sound waste collection must be agreed between NAT and the District authorities of Giza and Cairo in advance of the Metro construction, including the location of waste containers, the routing and timing of the collection cars and the regular street sweeping around the future Metro stations. This should be included in NAT's Environmental Management System, for example as a waste management procedure within the final pre-construction ESMP.

Construction waste sites and engineered landfill sites with opportunities for waste recycling and hazardous waste treatment must be appointed before the construction for the Metro line starts. The EEAA and the respective Governorates must accelerate the establishment of new operated and engineered land fill sites in Greater Cairo area. The project could benefit from the new locations, if they are operating in time with the construction phase of the Metro Line 3, Phase 3.

The contractors involved in the pre-construction phase are required to develop a construction ESMP including a Waste Management Plan.

Residual Impacts and Costs of applying mitigation measure

In case if the new engineered landfill sites in Greater Cairo are in operation when the construction for the Metro Line 3, Phase 3 starts, there will be no negative residual impacts from the transport, disposal and treatment of wastes generated from the Metro line. Nevertheless NAT, EEAA and the responsible District authorities from Giza and Cairo have to come to an environmentally sound solution before the construction work starts.

Cost generated by construction wastes and non toxic excavated soil are mainly transport costs and disposal fees, which depend on the amount generated. They are relevant during the construction phase.

8.3.3 Construction

Assessment, Description and Evaluation of Impacts

The assessment and description of waste and hazardous waste generated, has to consider two levels of impact:

1. The potential impact of waste generated through the construction of the Metro line

2. The capacity of handling the generated waste in the area, where the construction is taking place

Both levels have an influence on the evaluation of the impact and the proposed mitigation measures and will define the environmental and social management plan, which guides the contactor in his waste management activities.

Potential impact and evaluation of the waste generated by the Metro line

As outlined in the chapter 7.1.6, for an environmental sound storage, transport, recycling and disposal, all wastes produced during the construction phase have to be treated different according to their origin and kind.

Potential Impact from Waste from Excavated Soil

Soils may be affected by the construction activities. The following components of the proposed project may cause impacts on soils:

- Earthworks and construction of stations, at-grade tracks (including depot/shunting area), viaduct piles, tunnels, and annex structures that are in contact with the soil.
- Spoil storage and disposal.

While much of the project area falls within purely urban areas, the section running from Ring Road Station to Rod El Farag Station (3B), including the train depot/shunting area has semi-rural character, so soil compaction impact may be significant. Due to this agricultural soil, the impact is considered to have a moderate significance.

Of high significance are the long transport routes, which will pass through densely populated areas and the lack of safely disposal opportunities in an adequate construction waste landfill.

Potential Impact from Excavated Water Saturated Soil

The tunnel construction will necessitate the removal of water saturated soil. This will affect water levels and the flow direction of the surrounding groundwater in the vicinity of the underground structures. Piezometric levels will drop, potentially affecting the existing foundations of nearby buildings; and since the depth to the groundwater piezometric surface will increase, groundwater wells in the project area may have reduced discharge rates.

Changes in groundwater quality might take place indirectly as the tunnel construction will involve groundwater level reduction, followed by seepage from nearby surface waters sources into the aquifer. Thus, if the surface water is contaminated, it will pollute the underlying groundwater.

It can be expected, that he hydrologic system will tend to retain equilibrium, and impacts will be of local extent only. A high significance is the low capacity of quantification and analysis of its toxicity by relevant authorities. Continuous monitoring of the groundwater quality during construction would give an indicator of possible pollution that might have occurred due to changes in groundwater head.

This impact will be short term, direct, temporary, reversible, and overall should be considered minor. Furthermore, crossing below waterways with relatively shallow soil overburden does introduce additional construction risks, and amplifies the consequences and in case of failure. It will be necessary to monitor the river bed profile prior to construction works implementation in order to avoid long-term, regional and irreversible impacts.

Potential Impact from Waste produced by Workers
The construction force working within the boundaries of each station may be a potential source for generating solid waste and wastewater which - if not properly managed - will be a sources of pollution.

It can be expected that the waste produced by the workers (as e.g. construction wrapping material, food waste from kitchen and consumer goods) will be separated, recycled and transported to the landfill site, if waste containers are at place and instructions from the contractor to the workers is provided These impacts will be short term, direct, temporary, reversible, and overall should be considered as low significance

Potential impact from Waste generated by the Equipment
Potential impact from wastes generated by the equipment used to the construction of the Metro line can be stated on each construction site. These could be e.g. petrol, diesel, oil, hydraulic lubricates and chemical fluids, needed for the use for the tunnel boring machine and other machinery like cranes, generators, diesel engines etc.

This impact could cause a serious threat to the environment and the health of the workers, if not treated in a proper way. Contamination of soils by oil and other toxic lubricants and unprofessional handling of the construction machinery will have to be avoided during the whole construction period. These impacts will be long term, direct, temporary, but reversible, and should be considered as of high significance

Potential impact and assessment from the waste authorities' capacity in waste management

The capacity of the waste authorities in handling the wastes generated by the construction of the Metro line in an environmentally sound manner constitutes a major problem under the present conditions and can have a negative impact on the waste collection, treatment and disposal for the waste emerging from the construction of the Metro line.

Waste Collection
Waste collection during the construction phase of the Metro Line 3, Phase 3 is important because the construction generates a major amounts of waste, which has to be collected in a proper environmentally sound manner by containers of different waste types. The cleanliness around the those containers, the waste service to the citizens near the constructions sites – which are suffering already from the dust, noise and visual intrusion – are important factors for the acceptance of the construction nuisance.

The absence of a street sweeping system, the lack of waste containers, the irregular waste collection by waste subcontractors and the occasional burning of waste in the above mentioned areas are imposing not only a negative impact on the local landscape and the Metro station but also could be a serious threat to the health of the community, living in these areas. Furthermore can the contractor not count on a regular transport of domestic waste, originating from his construction sites.

Waste Segregation and Recovery

Waste segregation and separation practices are demanded by the EIB Guidelines, which recommends that the potential for resource recovery from wastes and residues should be discussed, including re-use, recycling or energy recovery from solid waste and liquid effluents (1.45).

Waste segregation and separation practices are evident throughout Egypt but are done mainly by the Zaballin, not by the household or the industry and contractors themselves. The poor settlement areas where the stations of Boulaq El Dakrour, Imbaba, El Bohi and El Qawmeyya are located are not of interest for the Zaballin and therefore segregation and recovery is taking place only on a minimum by local scavengers.

Although the separation of waste at the source is highly needed for the success of many treatment and recycling systems, especially for composting, there have only been a few pilot projects in Giza and Cairo Governorate.

The lack of nearby proper operating of waste segregation and recovery systems in the above mentioned areas, makes it difficult for the contractor of the Metro line to benefit from the presence of waste separation containers, where he can dispose his waste and to benefit from short transport routes to recycling stations.

Waste Treatment and Final Disposal

According to the recommendation of the EIB Guidelines, the methods for collecting, storing, treating, transporting and finally disposing of solid wastes should be described (1.35), and the locations for final disposal of all solid wastes should be defined in advance (1.36).

Treatment and disposal technologies such as sanitary land filling, composting and incineration are rare in Egypt, having been introduced only over the past two decades. Crude open dumping is the most common practice and dumpsites are commonly set alight to reduce the volume of accumulating waste, hence adding to the air pollution caused by the uncovered dumped waste itself.

The practice of sanitary land filling is still in its infancy in Egypt. However, controlled tipping has been successfully adopted in a number of cases.

At present, there are no landfill regulations or standards that provide a basis for compliance and monitoring, but national guidelines for these standards are prepared by the EEAA. For EEAA and NAT and the respective CBA´s , it will therefore be difficult under these conditions to control the amount and location of the construction waste and solid waste disposal.

Toxic Waste

According to the recommendation of the EIB Guidelines, hazardous materials used, stored, handled or produced by the Project should be identified and quantified (1.27) and the composition and toxicity or other hazards of all solid wastes produced by the Project should be discussed (1.34).

The range of proper hazardous waste treatment and disposal facilities available in Egypt is extremely limited. There are no landfills sites in Cairo and Giza Governorate, where the hazardous waste emerging from toxic soil and equipment used on the construction site are separated and treated properly.

In practice, hazardous wastes and non-hazardous wastes are treated by the same method without separation and it means that hazardous wastes are dumped into the municipal wastes dumping sites, which causes a major threat to the workers of the landfill as well as for the community due to toxic leachate triggering into the ground water.

Toxic Effluents Handling
Another relevant concern according to the EIB Guidelines, are toxic effluents, which might emerge from the soil during the excavation phase. The guidelines recommend that types and quantities of liquid effluents generated by the Project should be identified during construction, operation, and decommissioning, including site drainage, treated effluents, sewage (1.37)

Furthermore should the composition and toxicity or other hazards of all liquid effluents produced by the Project should be discussed (1.38) and the methods for collecting, storing, treating, transporting and finally disposing of these liquid effluents should be described (1.39). In addition should the locations for final disposal of all liquid effluents be discussed (1.40).

Toxic effluents during the construction phase of Metro Line 3, Phase 3 could mainly occur from excavated wet soil and depends largely on the level and quality of groundwater. Groundwater quality depends to a large extent on the quality of the recharge source. In the study area and GCR in general this source is the Nile, which itself is loaded to various degrees with salts, agro-chemicals, and other ions, based on the land use and water supply.

The vulnerability of groundwater to pollution from the surface is largely determined by the soil leaching capacity, the depth to groundwater, and the direction of natural vertical groundwater flow. In the study area, the groundwater vulnerability to surface pollution varies from moderate to high.

In the urban and sub-urban areas of the project, most of the pollution for groundwater could come from domestic and industrial sources and in the North of the project from agricultural activities and domestic wastewater which is disposed in pits.

The practice of analysing excavated soils regarding their grade of toxicity is nearly unknown in Egypt and might only be practised in bigger projects, where international standards are to be applied. If not properly implemented by qualified firms, his could cause a major threat to the workers on the construction site as well as for the workers responsible for transport and disposal and the population living near to the disposal sites

Summary of Identified main Gaps in the Waste Management System

Identified main gaps which have a potential negative impact on the waste management for the Cairo Metro Line and which demonstrate the weaknesses of waste management in Cairo and Giza Governorates includes:

- Properly engineered landfills which differentiate between construction waste, domestic waste and hazardous waste do not exist at this time in the influence area of the Metro line..
- It is a common practice that hazardous waste is dumped within the same landfill as for solid wastes, mostly without proper separation
- There seems to be a lack in quantity and quality control of dumped waste, especially regarding construction waste and hazardous waste, which needs taken care from the contractor side. Analysing liquid soils or sludge on their grade of toxicants is not a common praxis
- There is a lack of waste separation at source and poor recycling mechanisms, which do not foresee the necessary tools and equipment for separation and recycling
- Accessibility to landfills is difficult due to lack of nearby landfills and lack of road maintenance.
- There is a lack of alternative mechanisms for collection of service charges;
- The important role of local companies, NGOs and the informal sector (the Zaballin) has not been recognized by the municipal and national Governments
- There is a need for implementation of a long-term and focused sanitation awareness campaign and education in the waste management are

<u>Mitigation of Impacts</u>

Mitigation of waste management deficits during the construction phase depends mainly on the arrangements between NAT, the District authorities and the EEAA agreed in the preconstruction phase. Mitigation measures for the governmental waste management system cannot be influenced by this study. But the mitigation measures for the handling of the wastes with origin from the Metro line construction and operation under the responsibility of the contractor can be implemented within the Environmental and Social Management Plan, which should be part of the contractor´s contact with NAT.

The overall mitigation measures are:

- NAT should
    a. Provide waste management instructions for the contractor on how to handle the specific types of wastes considered in the contractors institutional set up;
    b. Ensure that waste quantities are registered and the final disposal is controlled by Waste Records; and
    c. Propose arrangements for waste storage, transport, recycling and treatment in close cooperation between the responsible Cleansing and Beautification Authorities of the respective Districts, and the contractor.
- Furthermore, the contractors are required to develop a waste management plan that covers their services as part of the tender process ESMP requirement.

Institutional Set-Up

In order to ensure that an efficient environment management system can be applied and maintained, which should in line with the Egyptian legislation and the EIB Guidelines, a Project Manager (PM) will be responsible for appointing an Occupational Health and Safety Manager (OHSM) in charge of environment management during the Construction and Follow up Phase. The tasks and responsibilities will be outlined in a separate chapter.
For each of the following instructions defined below, an Environment Assessment Program shall be installed which should ensure an effective waste management that is based on proper information data (e.g. outgoing waste quantities and type of waste and data about the transport and disposal of the wastes to specific waste landfill sites).The information of the Environment Assessment Program shall take into account at least all of the following:

- Type and quantity of waste, which leaves the construction site (in special designed forms)
- Type and quantity of waste delivered to the disposal sites or to recycling plants / companies (in special designed forms)
- Relevant Information that might arise from waste handling during the project activities under normal working conditions and their environmental impacts of these,
- Relevant information that might arise from waste handling as a result of work accidents such as, spill, scatter, disperse, blast and their environmental impacts of these,

Relevant information that might arise from waste handling in situations that can't be foreseen in advance such as, earthquake, fire, flood (natural disasters) and in emergency states and their environmental impacts

Mitigation measures for impacts from Solid Wastes

Mitigation measures for negative impacts resulting from solid wastes are divided into:

- Recyclable Solid Waste

  Recyclable Solid Wastes are e.g. glass, metal, plastics, paper and cardboards. These will be collected separately and sent to solid waste recycling plants.
- Non – Recyclable Solid Waste

  Non – Recyclable Solid Wastes are e.g. used batteries, fluorescent bulbs, cartridges / toners, medical materials. These should be collected separately and delivered to the solid waste collecting units in nearby transfer station.
- Hazardous Waste

  The main hazardous wastes are e.g. dye mud, dye waste, solvent waste; grinding mud, phosphate mud, oil metal mud; waste thinner and varnish sediments; accumulators and batteries; empty chemical barrels and hazardous substance barrels and other package wastes contaminated by hazardous substances, fabrics and gloves contaminated, category III waste oils and chemicals. In using chemical substances, it is beneficial to use environment friendly products. On the subject of hazardous wastes all indicated procedures of the manufacturer firms, if any, must be applied and should be accumulated in special indicated "Hazardous Waste Containers" to be provided in advance in the Worksite areas within the scope of the Project.
- Domestic Waste.

Domestic solid wastes are wastes coming out of the on-site dining hall and kitchens like food remains or from wastes created in offices. These will be poured off into the proper trash pouring containers in the worksite areas within the scope of the project. Food remains should be stored separately on cool places, so that they are not quickly rotten and can be collected private companies or Zaballeen

Mitigation measures for Wastes, resulting from excavation and the use of machinery and equipment

Mitigation measures for negative impacts resulting from this type of wastes can be divided into:

- Earthwork / Construction Wastes

  Earthwork / Construction wastes should be stored separately according to the type of the activity and the type of the waste. Earthwork wastes shall be evaluated as wastes origin from the tunnel earthworks and wastes origin from the station earthworks. Its temporary storage, its recycling and transporting to the final storage site will be determined as per the demanded procedures. Regarding the construction and road cover wastes, the wastes are origin from the result of demolition, like asphalt, border, pavement and similar materials. These should be separated in a special dumping site to be specified by the relevant District Municipality.
- Wet Soil Wastes

  Excavated wet soil, mixed with water / waste water might deteriorate the soil quality and could create contamination, if toxic. If mixed with the other dry excavated soil just like that, it could leave wastes of toxic character bearing any type of contamination. It therefore has to be stored separately and must be analysed regarding toxic substances. In case of containing toxic substances, it has to be registered and transported to the specific dump site for hazardous waste
- Fuel, Oil and other chemical substances for the use of machinery and equipment

  If there are alternatives in selecting the kind of oil used in the vehicles and machinery, the contractor should be careful in selecting only those ones which are less harmful to the environment. Waste Oil should be disposed of in line with the requirements of an environmentally friendly oil waste management and in a way just as it is specified by the instructions of the producer. Oil leaks should not be allowed and in case if it occurs, measures should be taken immediately to close the leakage. And the Environment Management Executive Officer of the company should be informed accordingly. The waste oils should all accumulated in a covered storage site protected against rain and wind. The used oil has to be delivered to specific locations based on contractual basis, as petrol stations, which are licensed to store and transport used oils and chemical substances.

<u>Residual Impacts and Costs of applying mitigation measure</u>

With proper management of waste and arrangements for waste storage, transport, recycling and treatment in place impacts are expected to be of minor magnitude.

The following calculation of excavated material and sewage generated for the construction can provide a rough quantification which could be the basis for price calculation for transport cost and dumping fees.

Table 8-2: Estimated soil and wastewater quantity generated through construction

Output Wastewater	Estimated Quantity
Average Wastewater per Station (m^3)	33,800 x 15 = 507,000
Total Wastewater from Tunnel by TBM (m^3)	58,000
Total (m^2)	**565,000**
Output Soil Excavation	Estimated Quantity
Average Excavation per Station (m^3)	10,300 x 15 = 154,500
Total Soil Excavation by Tunnel by TBM (m^3)	330,800
Total Soil Excavation from Fundaments	13,800
Total (m^2)	**499,100**

According to this estimations the outputs on wastewater through the construction of the station is 507,000 m^3 and for wastewater from the tunnel construction by TBM is 58,000 m^3. This add up to 565,000 m^3 wastewater during the construction phase which has to be discharged into the sewerage network..

In addition, to this the quantities of excavated soil from the

- Stations
- Tunnel by TBM and
- Fundament digging for piles

must be considered for transport and disposal, which adds up to a total volume of roughly 500,000 m^3.

8.4 Water Environment

8.4.1 Identification of Impacts

The potential impacts of the project on the water environment can induce physical or chemical changes to the water characteristics. Both surface and ground water may be susceptible to the construction and operation of the Metro line 3-phase 3 project. The key impacts on the water environment can be summarized as follows:

- Nile instability and bathymetric level changes
- Chemical and physical changes in the surface water characteristics
- Changes in the groundwater geometry (level, width and thickness) and to the existing production and observatory wells due to lowering of the groundwater table.
- Chemical Changes in the groundwater characteristics

Unintentional spill or discharge of hazards chemicals including oil and fuel from construction equipment:

- Contamination of the groundwater due to uncontrolled discharge of wastewater and oil from the workshop and the general maintenance activities.
- Poor Waste management.

8.4.2 Pre-Construction

<u>Assessment, Description and Evaluation of Impacts</u>

The main potential impact to the water environment during pre-construction is related to unintentional spill or discharge of hazards chemicals including oil and fuel from construction equipment during utilities diversion.

<u>Mitigation of Impacts</u>

Ensure proper maintainenance plans for construction equipment are in place.

<u>Residual Impacts and Costs of applying mitigation measure</u>

After the efficient implementation of the mitigation measures, impacts will be managed and controlled. The residual impacts will be minor.

8.4.3 Construction

<u>Assessment, Description and Evaluation of Impacts</u>

Potential Impact: Nile instability and bathymetric level changes

The proposed Metro line will pass below bed-level of the River Nile between the Kit Kat station in Giza Governorate and El Zamalek station in Cairo Governorate. The current depth of soil sediments and the rate of change of this depth is important to investigate in order to predict potential furture variations. This investigation would involve *carrying out geo-technical surveys and modelling, which could be done in coordination with the Nile Research Institute to determine any design or construction-specific measures (EQI 2012: 198).* These are normal technical and design procedures for such projects.

Potential impact: Physical changes to the characteristics of surface water

Physical changes to the Zomor Canal may take place, because the at-grade level which will pass in Boulaq El Dakrour may necessitate covering the Canal. This is under investigation with the Ministry of Agriculture. The significance of this impact depends on the current evaluation of the value of the canal water to the nearby residents, to local ecosystems and biodiversity as well as its main function as a water transmission mean for irrigation.

The Canal water is mainly used for agriculture purposes (main function). It has no apparent non-consumptive value such as use for recreation, boating or swimming. The Canal water may have a role in maintaining some equilibrium for the ecosystem in the area. As described in the baseline section part and based on the results of consultations with the public, its existence value is negative. This is because of the accumulation of wastes which poses diverse health risks. In this context, covering the Canal will induce a positive impact. The only significant consequence would be the cutting off of the water to agricultural lands which depends on this water for irrigation purposes. For the latter, the impact can be classified as major and needs an alternative mean of water transportation to be designed and installed prior to project construction.

Potential impact: chemical changes in the surface water characteristics

During the construction phase and as described in 8.1 and 8.2 it is likely that some waste, effluent discharge or some oil/hazardous effluents spills reach the surface water, particularly at the Bashteel and Zomor Canals.

The probability is very low if the recommendations and mitigation measures for waste and effluent management were implemented. However, if occurred, it will be a local impact, short term but the consequences are irreversible assuming water is a finite resource. The impact could be evaluated as a **moderate** impact.

Potential impact: Physical changes in the groundwater geometry and to the existing production and observatory wells

This involves potential changes in the depth of the aquifer and level of piezometric surface. Also, changes to the width and thickness. *The tunnel construction will necessitate the removal of water saturated soil. This will affect water levels and the flow direction of the surrounding groundwater in the vicinity of the underground structures. Piezometric levels will drop, potentially affecting the existing foundations of nearby buildings; and since the depth to the groundwater piezometric surface will increase, groundwater wells in the project area may have reduced discharge rates. However, the hydrologic system will tend to retain equilibrium, and impacts will be of local extent (EQI 2012, 168).*

This change is short term, direct, temporary and reversible as the hydrologic system will tend to retain equilibrium, and will be of local effect. It is therefore considered a **Minor** impact.

Potential impact: chemical changes in the groundwater characteristics

Changes in groundwater quality might take place indirectly as the tunnel construction will involve groundwater level reduction, followed by seepage from nearby surface waters sources into the aquifer. Thus, if the surface water is contaminated, it will pollute the underlying groundwater. Continuous monitoring of the groundwater quality during construction would give an indicator of possible pollution that might have occurred due to changes in groundwater head. These impacts will be short term, direct, temporary, reversible, and overall should be considered minor. Furthermore, crossing below waterways with relatively shallow soil overburden does introduce additional construction risks, and amplifies the consequences and in case of failure. It will be necessary to monitor the river bed profile prior to construction works implementation in order to avoid long-term, regional and irreversible impacts (EQI 2012 : 168)

Unintentional spill or discharge of hazards chemicals including oil and fuel from construction equipment during utilities diversion.

Mitigation of Impacts

- Apply all measures recommended in 8.2 and 8.3 to mitigate the impacts on the soil quality and waste management. This includes applying competent measures to prevent accidental spills and process discharges. It also includes applying strict measures to protect water courses from any expected pollution due to illegal dumping of waste.
- Monitor groundwater depth and substitute damaged wells if any.

Residual Impacts and Costs of applying mitigation measure

After the efficient implementation of the mitigation measures, all impacts will be Managed and controlled. The residual impacts will be minor.

No additional costs are needed to those stated under section 8.3, i.e. the costs needed to apply mitigation measures for waste and hazardous waste management.

8.4.4 Operations

Assessment, Description and Evaluation of Impacts

Potential impact: Contamination of the groundwater

This could be due to uncontrolled discharge of wastewater and oil from the workshop and the general maintenance activities or from poor waste management practise.

A similar impact was expected during the construction. As previously discussed, the probability is very low if the recommendations and mitigation measures for waste and effluent management were implemented. However, if it occurs, it will be a local impact, short term but the consequences to the surface and groundwater quality are irreversible assuming water is a finite resource. The impact could be evaluated as a **minor** impact.

Mitigation of Impacts

- Apply all measures recommended in 8.2 and 8.3 to mitigate the impacts on the soil quality and waste management. This includes applying competent measures to prevent accidental spills and process discharges. It also includes applying strict measures to protect water courses from any expected pollution due to illegal dumping of waste.
- Monitor groundwater depth and substitute damaged wells if any.

Residual Impacts and Costs of applying mitigation measure

After the efficient implementation of the mitigation measures, all impacts will be Managed and controlled. The residual impacts will be minor.

No additional costs are needed to those stated under section 8.3, i.e. the costs needed to apply mitigation measures for waste and hazardous waste management.

8.5 Air Quality and Dust

8.5.1 Identification of Impacts

Air quality, including levels of common air pollutants resulting from motor vehicles and a multitude of industrial emissions, such as gaseous and particulate matter emissions is among the key environmental elements of the project area (EQI 2012: 156)

[In the preconstruction phase] all utilities are identified and diverted, which may cause [..] construction impacts such as [..] air pollution (EQI 2012: 158).

[One of] the most obvious impacts of the construction phase are tied to the large quantities of dust and air emissions,[including] fumes, gases, vapours and odours from asphalting, welding, vehicles exhaust (EQI 2012: 166).

During operation air emissions will result from the production of electricity for the metro. However, the modal shift in means of transportation will lead to a reduction in the total number of kilometres travelled by cars, taxis, shared taxis, minibuses and buses and thereby lead to reduction in the emissions that would have resulted from fuel combustion in these vehicles (EQI 2012: 175f).

8.5.2 Pre-Construction

Assessment, Description and Evaluation of Impacts

In the preconstruction phase air pollution will result from machinery and vehicles involved in the utility diversion activities. These impacts are similar to the impacts during the construction phase and are not analysed independently.

8.5.3 Construction

Assessment, Description and Evaluation of Impacts

In the construction phase air emissions will result from emissions from machinery and vehicles used during construction and dust emissions from construction and transportation to and from construction sites. In addition there will be emissions from asphalting, evaporation and emissions from polluted soil, and additional vehicle emissions caused by traffic diversion.

The negative impacts on air quality will be most significant at construction sites, which will include the cut and cover construction sites for metro stations, diversion structure, and underground sections, the shafts, the tunnel construction sites where construction waste from the tunnel boring will be stored and transported, the construction sites for at-grade sections and stations, and the construction sites for elevated sections and stations.

Hot spots with respect to air quality and dust are defined as localities, where it is estimated that the construction work and activities will lead to nuisances, based on consideration of the distance to residences, conditions related to dispersion, existing air quality data and background levels, type and extent of construction works. The most critical parameters are, based on the existing air quality data, particulate matter and NOx.

Based on similar studies the critical distance between construction sites and residences have been defined as 100 meters (see for example Trafikstyrelsen, 2008). This means that buildings, including residences, businesses, etc. within a distance from 100 hundred meters from the construction site are considered within a hotspot.

Dust emissions will result from construction activities on site, in particular earthworks, loading and unloading-, storage-, and transportation of construction materials and waste from construction sites. As evidenced in the existing data on ambient air quality and in the air quality monitoring results conducted by the EQI study team, Cairo is already experiencing high PM_{10} concentrations in ambient air. Further, as the climate is arid with little rain fall there will be little in the form of naturally occurring easing of dust emissions. Therefore, dust emissions are considered to have a significant potential impact.

Vehicle emissions from transportation to and from construction sites and traffic diversion will increase locally and traffic diversion will also displace vehicle emissions locally. The use of construction machinery and equipment on construction sites will result in the emission of gaseous air pollutants and particulate matter (soot). Diesel-powered but also petrol-powered machinery will result in emissions of nitrogen oxides (NO_x) sulphur dioxide (SO_2) carbon monoxide (CO), hydrocarbons (HC), and particulate matter. As evidenced in the existing data on ambient air quality and in the air quality monitoring results conducted by the EQI study team, Cairo is already experiencing high concentrations of NO_x in ambient air. Therefore, emissions from vehicles, machinery, and equipment during the construction phase are considered to have a significant potential impact.

Asphalting will result in the emission of hydrocarbons (HC) and polyaromatic hydrocarbons (PAH). These are not considered a significant potential impact and are not evaluated further.

Evaporation and emissions from contaminated soil may result in local air pollution. This impact is considered in the section 8.3 on Waste and hazardous waste.

Evaluation of the impact

As identified above the potential significant impacts with respect to air quality and dust emissions during construction include dust emissions and emissions of gaseous air pollutants and particulate matter (soot) from vehicles and machinery.

These impacts are evaluated in Table 8-3 below according to the proposed significance criteria.

Table 8-3: Air quality and dust impacts during construction

	Dust emissions from construction activities, storage, and transportation	**Emissions of gaseous air pollutants and particulate matter (soot) from vehicles and machinery**
Level of certainty	Certain	Certain
Extent of impact	Local	Local
Duration and frequency	Isolated: Continuous during the construction phase	Isolated: Continuous during the construction phase
Reversibility and mitigation	Reversible and possible to mitigate	Reversible and possible to mitigate

Sensitivity of receptors	Sensitive – limits for PM_{10} in national standards and international guidelines are exceeded at most localities	Sensitive – limits are exceeded for PM_{10} at most localities and high levels of NOx have been identified
Significance of impact	Major	Major

Source: Grontmij evaluation of impacts

Both dust emissions from construction activities, storage, and transportation and emissions of gaseous air pollutants and black carbon from vehicles and machinery are certain to occur. Their impact is local and isolated to the construction, but will be continuous throughout the construction period. The impacts are reversible and possible to mitigate as further elaborated in the section below.

Regarding the sensitivity of receptors it is important to note that limits for PM_{10} in national standards and international guidelines are exceeded at most localities and that NOx levels are high. Therefore, the receptors are considered sensitive as further pollution will degrade the air shed or locality even further. Also of critical importance to the sensitivity of the receptor is specific conditions and behaviour of the particular air shed or locality with respect to dispersion of the emissions. The dispersion of the dust emissions, gaseous air pollutants, and black carbon will to a large extent depend on the locality. In relatively open areas with low rise buildings and considerable air exchange due to wind, the emitted pollutants will disperse faster than in relatively closed of areas or streets with higher buildings and less wind.

<u>Mitigation of Impacts</u>

General air pollution mitigation measures are proposed as well as specific mitigation measures to reduce dust emissions from construction activities, storage, and transportation and for reduction of emissions of gaseous air pollutants and particulate matter (soot) from vehicles and machinery. In addition an ambient air quality monitoring programme is proposed.

General air pollution mitigation measures on construction sites

- Prohibit use of open fire to burn materials or waste on sites
- Carry out fuel filling in designated areas with hard surface or containment bonding. Eliminate fuel spills in the process of filling the construction machinery.

Proposed mitigation measures related to dust emissions management

Dust emission stemming construction activities, storage, and transportation are considered to be controllable during construction through construction site planning, control and mitigatory measures. The following management measure are proposed included in the Environmental and Social Management Plan (ESMP) and made as requirements to contractors concerning their management of dust emissions:

- Preparation of Dust Management Plan for each specific site as part of the Contractor ESMP, including site map indicating location of physical barriers such as fencing, location of stockpiles and storage areas, traffic routes and stabilised site access/exit points, presentation of dust control measures to be used on site, and dust management checklist[1].

[1] further elaboration of dust management measures can be found at: http://www.parracity.nsw.gov.au/__data/assets/pdf_file/0020/4295/NoDust_Fact_Sheets.pdf

The following specific mitigation measures are proposed included in the final framework Environmental and Social Management Plan (ESMP) for construction, as an integral part of NAT's Environmental Management System:

- Erect effective barriers around dusty activities or at the site boundary
- Plan site layout to locate dust causing activities away from sensitive receptors
- Control for loose materials when transporting and storing materials , especially excavated materials
- Cover loads entering and leaving site
- Minimise site runoff of water or mud
- Minimise movement of construction traffic around site and maintain appropriate speed limits
- Use hard surface haul routes and effective cleaning of haul routes
- Following planning of site layout, cover areas where trucks and construction machinery and trucks are to drive, e.g. with steel slaps to minimise driving on earth or sand
- Pave areas to be paved as soon as possible – this should be considered in the design and planning
- Use water as dust suppressant where applicable, including periodic spraying of water during transfer of excavated materials
- Keep stockpiles for the shortest possible time
- Cover or fence stockpiles
- Install facility for washing of wheels, where vehicles are entering and leaving site and washing of trucks and construction machinery before leaving site
- Regular street sweeping/cleaning of access roads to site

Proposed mitigation measures to manage emissions of gaseous air pollutants and black carbon from vehicles and machinery

Emissions of gaseous air pollutants and particles from vehicles and machinery used for construction and transportation of construction materials and waste can be greatly reduced through control and mitigation measures. The following mitigation measures are proposed included in the Environmental and Social Management Plan (ESMP) and made as requirements to contractors concerning their management of gaseous air pollutants and particles from machinery and vehicles:

- Use of equipment, construction machinery and transport vehicles during the construction period that comply with emission requirements, standards, and specifications of manufacturers in relation to exhaust gas emissions
- In the planning of construction activities it may be considered to adopt stricter emission requirements especially with respect to emissions of particulate matter and NOx such as the EURO V for heavy vehicles and EU requirements to mobile construction machinery and equipment (Non-road mobile machinery: gaseous pollutants Directive 97/68/EC, as amended – Annex III, Appendix 5).
- Use of diesel particulate filters on diesel engines, including construction machinery, compressors, and generators
- Use of NOx Control Technologies such as selective catalytic reduction, NOx absorbers, DeNOx catalysts on construction machinery, compressors, and trucks
- Regular inspection and adjustment of fuel systems to minimise exhaust of emissions will be carried out in due time

- Visual inspection of exhaust gases from construction machinery and vehicles
- Establish a documented maintenance programme for construction machinery used on sites. The maintenance programme should give particular attention to verification and adjustment of fuel feedstock, ignition and gas distribution systems of engines to ensure complete fuel combustion that will reduce fuel requirement and decrease exhaust of emissions.

Proposed monitoring programme with respect to air quality and emissions

An ambient air quality monitoring programme for the construction phase will monitor air quality parameters at selected monitoring points at the construction sites and enable a continuous monitoring of ambient air quality. The programme will monitor the total effect on the air quality with respect to the parameters and the results will therefore not only be affected by the construction activities, but also by air pollution from other sources. Ambient air quality monitoring should commence prior to the commencement of construction activities in order to establish a baseline that results during construction can be compared with.

The EQI consultant proposed monitoring of the parameters TSP, PM_{10}, CO, NOx, SOx before construction and at regular intervals during the construction phase. Given the considerable scope for variation this is considered insufficient. Therefore, a continuous monitoring programme is proposed. It is also proposed to consider the utilisation of existing and permanent monitoring stations of EEAA in the monitoring of air emissions, where feasible and practical. This could for example include the monitoring station at Cairo University Station (see section 7.15 on Air quality for a description of EEAA's air quality monitoring).

Residual Impacts and Costs of applying mitigation measure

In this section residual impacts after application of the proposed mitigation measures are estimated.

Dust emission control measures

Implementation of dust management measures can reduce the dust emitted from construction sites to a very significant extent. The residual impact after application of dust emission control measures will vary greatly depending on the degree of application of each individual measure.

Vehicle and construction machinery emission control measures
Implementation of emission control measures for vehicles and construction machinery can reduce the emission of pollutants to a significant extent. The residual impact after application of the measures will vary greatly depending on the degree of application of each individual measure.

The application of diesel particulate filters can reduce the emission of particulate matter with more than 80%[2].

[2] http://www.trafikstyrelsen.dk/DA/Groen-Transport/Luftforurening-fra-biler/Partikelfiltre-tunge-koeretoerjer.aspx

The residual impact after application of NOx Control Technologies will vary greatly depending on the specific technology. It should be noted that the EURO V requirements (2008) regarding NOx emission compared with EURO I requirements (1992) corresponds to a reduction by 75% in g/kWh and that the EURO VI requirements (2013) will require a further reduction by 80%, i.e. a total stepwise reduction by 95% in g/kWh[3].

Cost of applying mitigation measure

Below the cost of applying the mitigation measures are estimated for the mitigation measures outlined above.

General air pollution mitigation measures on construction sites
The proposed mitigation and control measures as outlined above are considered integral elements of good industry practice with respect to construction site management and control. No extra costs are therefore foreseen in applying these measures. Nevertheless, they should be included as specific management measures in the ESMP.

Dust emission control measures

The dust emission control measures as outlined above are considered integral elements of good industry practice with respect to construction site management and control. No extra costs are therefore foreseen in applying these measures. Nevertheless, they should be included as specific management measures in the ESMP.

Residual Impacts after applying the proposed mitigation measures

Vehicle and construction machinery emission control measures
The vehicle and construction machinery emission control measures as outlined above are a combination of management practices, inspection, and maintenance measures as well as recommendations for specific reduction equipment. No extra costs are expected incurred by applying the management practices, inspection, and maintenance measures. Requirements to use of diesel particulate filters and NOx Control Technologies will incur extra costs on the construction contractors, which will vary dependent on the specific system and technology. Particulate filters and NOx control are likely to be fitted on newer equipment and can be retrofitted on older vehicles, machinery, and equipment at the cost of the contractor. The costs associated with retrofitting of diesel particulate filters are estimated to be in the range of 5,000 to 10,000 EUR. Costs associated with NOx Control Technologies will vary greatly depending on specific technology.

Air quality monitoring measures

The proposed air quality monitoring scheme will incur costs on the contractor. The costs have been estimated by the consultant and are presented in Table 8-4. Other than the specific cost incurred by the contractor, NAT will incur indirect costs in terms of supervising the monitoring programme and in terms of compiling the reported monitoring data. These costs are considered part of the costs of the NAT HSE unit and are not further estimated.

[3] http://www.dieselnet.com/standards/eu/hd.php

Table 8-4: Proposed air quality monitoring scheme

Monitoring parameters	Monitoring location	Cost of measure /EUR	Frequency	Party incurring the cost	Party implementing the measure
TSP, PM10, CO, NOx, SOx	Construction sites	€250-300) per location/per 8 hour shift (EcoConServ estimate)	Continuous	Construction contractor	Construction contractor, supervised by NAT HSE unit

Source: Consultant's estimate

8.5.4 Operations

Assessment, Description and Evaluation of Impacts

In the operation phase the project will indirectly emit emissions to air through the production of electricity. This is, however, not considered to be a significant potential impact and is not evaluated. The modal shift in in means of transportation will lead to a reduction in the total number of kilometres travelled by cars, taxis, shared taxis, minibuses and buses and thereby lead to reduction in the emissions that would have resulted from fuel combustion in these vehicles. SYSTRA have assessed the total cumulative emissions economised due to the modal shift for the period 2012 to 2052. The cumulative reductions in fuel consumption and the associated reductions in emissions of pollutants are presented in Table 8-5 below.

Table 8-5: Total Cumulative Emissions economised due to modal shift, 2012-2052

Polluants	Cumulative 2012-2052 emissions economised due to modal shift	Units
CO_2	11 631 913	t CO_2
CO	200 702	t CO
NOx	7 080	t NOx
HC	16 899	t Eq.CH_4
SO_2	91	t SO_2
PM	741	t PM
Fuel consumption	4 064 189	t

Source: Systra, Feasibility Study, Cairo Metro Line 3 – Phase 3, 2009

The impact of the reduction in fuel consumption and associated emission reduction is further evaluated below.

Evaluation of the impact

As identified above the potential significant impacts with respect to air quality and dust emissions during operation include reduction in emissions resulting from the modal shift in means of transportation.

The reduction in fuel consumption and emissions is considered likely and the extent of the impact is considered local as reductions will impact on the local air quality. The impact is considered continuous during the operation phase and is therefore a long term impact.

Table 8-6: Air quality and dust impacts during operation

	Reduction in emissions resulting from the modal shift in means of transportation
Level of certainty	Likely
Extent of impact	Local
Duration and frequency	Continuous during the operation phase
Reversibility and mitigation	-
Sensitivity of receptors	-
Significance of impact	Positive

Source: Grontmij evaluation of impacts

Mitigation of Impacts

The impact on air quality during operation phase is likely to be positive due to the reduction in emissions resulting from the modal shift in means of transportation. Therefore, no mitigation is foreseen.

8.6 Noise and Vibration

8.6.1 Identification of Impacts

Noise and vibration impacts are associated with activities in the preconstruction phase, the construction phase, and the operation phase.

Noise is another common environmental nuisance in the area near major roads and railway lines. Project construction sites in areas with high human population densities are expected to present a noise pollution problem (EQI 2012: 156).

Noise impacts are also associated with the construction activities associated with the utility diversion undertaken in the preconstruction phase (EQI 2012: 158). These noise impacts are similar to those of the construction phase and are not analysed separately. Noise impacts during construction will impact on site workers and areas surrounding the construction sites. Vibration impacts will impact on site workers, surrounding residents as well as buildings.

During the operation phase there will be noise and vibration emissions from the operation of the metro line. Especially, the at-grade and elevated sections of phases 3B and 3C will emit noise and vibration very close to residents.

8.6.2 Pre-Construction

Assessment, Description and Evaluation of Impacts

In the preconstruction phase noise and vibration impacts will result from machinery and vehicles involved in the utility diversion activities. These impacts are similar to the impacts during the construction phase, although of a lower magnitude and duration, and are not analysed independently.

8.6.3 Construction

Assessment, Description and Evaluation of Impacts

In the construction phase noise and vibrations will be emitted from the construction activities and will result from the use of construction machinery, equipment, and vehicles as well as transportation and construction activities such as the laying of tracks, excavations, tunnelling, and construction of new concrete constructions. In addition there will be noise emission associated with the demolition of buildings.

The noise impacts during the construction phase will be at the construction sites and in the surrounding areas. Noise impacts are expected along the entire alignment of Phase 3 and will include the cut and cover construction sites for metro stations, the diversion structure, underground sections, and the shafts as well as tunnel boring and construction of the at-grade sections and stations and the elevated sections and stations. Given the high background levels it is considered possible to carry out the construction without significantly increasing ambient noise.

Vibration impacts are expected in the same areas as the noise impacts, but significant vibration impacts are associated with specific construction activities such as sheet pilling in connection with the cut and cover construction sites and the tunneling. Experiences from tunneling in Copenhagen and in Malmö showed that vibrations from the tunnel boring machine (TBM) only were perceptible for the time it took the TBM to pass underneath the buildings , but it did not result in any complaints (Metroselskabet I/S 2005: 170). Vibrations are normally divided in two overall types: Vibrations which may be damaging to foundations and bearing structures in buildings and vibrations which are transmitted through the building resulting in nuisance to people in the buildings. Negative vibration impacts will depend largely on the type of buildings and the type soil. The sandy loam and coarse gravel/sand in the upper layers of the GCR soil (EQI 2012: 52) is expected to limit the spread of vibrations.

Evaluation of Impacts

As identified above the potential significant impacts with respect to noise and vibration during construction include noise emissions from construction activities and transportation and vibration impacts from specific construction activities such as tunneling and sheet lining.

These impacts are evaluated in Table 8-7 according to the proposed significance criteria.

Table 8-7: Noise and vibration impacts during construction

	Noise impact during construction	**Vibration impact during construction**
Level of certainty	Likely	Likely
Extent of impact	Local	Local
Duration and frequency	Continuous over the construction phase	Isolated, periodic and short term
Reversibility and mitigation	Possible to mitigate	Difficult to mitigate
Sensitivity of receptors	Less sensitive	Less sensitive
Significance of impact	Major	Minor

Source: Consultant's evaluation of impacts

Noise emissions from construction activities and transportation are local impacts which will be periodic for the period of construction at the specific site. The impact will vary greatly with the type of construction activities taking place. The impact is possible to mitigate and the receptors can be described as less sensitive given the high background levels.

Vibration impacts are local impacts from specific construction activities. They are isolated to the construction phase but will only occur for short periods as they are associated with specific activities. The impact is difficult to mitigate and receptors can be described as less sensitive based on experience from other metro projects and based on an assessment of soil conditions. The significance of the impact is there assessed as minor.

Mitigation of Impacts

In this section mitigation measures are proposed for the construction activities, which will include both management measures, specific mitigation measures, and a monitoring programme. Mitigation measures are also outlined for the operation phase. However, due to the limitations with respect to the basis upon which to base the noise impact assessment, it is proposed that a detailed study of the noise impact on buildings and residences along the alignment is carried out. Also considering the high costs associated with the erection of noise barriers and/or installation of triple layer glassing in critically affected buildings the implementation of such mitigation measures should not be proposed without adequate assessment.

General management measures to include in the final Construction ESMP as part of NAT's EMS are to:

- Establish a schedule (hours during the day) of construction activities, acknowledging daytime and night time noise limits. Construction should be limited to the day time during weekdays. Weekends and night time should be kept to a minimum.
- Minimize noise intrusive impacts during most noise sensitive hours
- Organise the construction traffic and access points to construction sites and select truck routes that limit the frequency of passage through sensitive areas
- Schedule truck loading, unloading, and hauling operations so as to minimize noise impact near noise sensitive locations and surrounding communities
- Configure the construction site in a manner that keeps noisier equipment and activities as far as possible from noise sensitive locations and nearby buildings and reduce the amount of equipment operating in critical areas close to noise sensitive receptors. Orient plant and equipment known to emit noise strongly in one direction in a direction away from noise sensitive receptors.
- Maximise physical separation, as far as practicable, between noise generators and noise receptors
- Provide for and use of temporary noise-insulating barriers where necessary – the reduction in noise level increases with height of barrier.
- Provide acoustic enclosures for diesel generators
- Minimize the use of impact devices, such as jackhammers (pneumatic drills), and pavement breakers. Where possible, use of concrete crushers or pavement saws for tasks such as concrete deck removal and retaining wall demolition.
- Equip noise producing equipment such as jackhammers and pavement breakers with acoustically attenuating shields or shrouds
- Pneumatic impact tools and equipment used at the construction site shall have intake and exhaust mufflers
- Map sensitive buildings by photo to map existing damage caused by subsidence prior to the pre-construction phase.
- Construction equipment manufactured or modified to reduce noise and vibration emissions shall be favored, such as: Electric instead of diesel-powered equipment or Hydraulic tools instead of pneumatic impact tools.

Noise and vibration monitoring during construction

Noise monitoring during construction should be carried out both at the construction sites and in the surrounding areas at critical receptor points.

A noise monitoring programme for the construction phase will monitor ambient noise at selected monitoring points at the construction sites and at critical receptors in surrounding areas. Noise monitoring should commence prior to the commencement of construction activities in order to establish a baseline that results during construction can be compared with.

The EQI consultant proposed monitoring noise pressure at the construction sites and in surrounding areas to be carried out monthly for 24 hours. In addition vibration monitoring was proposed. Noise monitoring should be carried out against a limit established prior to the construction activities, considering existing noise conditions and expected impact. This impact should at receptor not be higher than 75-80 dB.. The noise monitoring in surrounding areas should acknowledge the existing background levels prior to commencement of construction and a baseline should therefore be established.

In addition, in order to better understand the vibration impacts of construction works, a monitoring programme should be put in place to monitor vibrations during construction. Building inspection surveys should also be carried out on the right-of-way in order to assess and control vibration impacts on buildings.

<u>Residual Impacts and Costs of applying mitigation measure</u>

The SYSTRA draft specifications to contractors assume that the implementation of specific mitigation measures can reduce the noise impact to 3 dB(A) on existing background levels (SYSTRA 2012: 54). This corresponds to a noise impact equal to the existing background noise. Based on the high levels of background noise and experience from similar metro projects this is considered a likely residual impact after mitigation. A difference in 3 dB for the receiver is considered a noticeable increase. Therefore, the residual impact after applying the proposed mitigation measures is considered to be minor.

Cost of applying mitigation measure

The noise emission control measures as outlined above are considered integral elements of good industry practice with respect to construction site management and control. No extra costs are therefore foreseen in applying these measures. Nevertheless, they should be included as specific management measures in the ESMP.

The noise and vibration monitoring measures and the associated costs as identified by the EQI consultant are presented in the below table. Prices have been converted to euros.

Table 8-8: Proposed noise and vibration monitoring scheme

Monitoring parameters	Monitoring location	Cost of measure /EUR	Duration and Frequency	Party incurring the cost	Party implementing the measure
Noise	Construction site, critical receptor in surrounding area	1250 per location	24 hours and monthly	Construction contractor	Construction contractor supervised by NAT HSE unit

Vibration	Construction site	420 per location	24 hours and monthly	Construction contractor	Construction contractor supervised by NAT HSE unit
	Building survey on right-of-way	To be determined	tbd	tbd	NAT HSE unit

Source: EQI 2012 estimate

8.6.4 Operations

<u>Assessment, Description and Evaluation of Impacts</u>

Noise impacts from the operation of the metro will impact on the areas along the at-grade and elevated alignment. The stations and the associated increase in activity and traffic will also increase noise levels to some extent. No noise modeling has been carried out and the noise impact uring operations and conditions and design criteria with respect to noise impacts have not been made available for the preparation of this ESIA. Therefore, an indicative noise impact assessment is here presented based on experience from other metro projects. Since the noise impact will vary significantly depending on the design criteria of the metro train and the tracks this assessment cannot replace a proper noise impact assessment, which is proposed at the end of this section.

The EIA for the at-grade and elevated metro section on Eastern Amager in Copenhagen carried out an assessment of the noise impact during the operations phase (Hovedstadens udviklingsraad 2001). The conditions for the noise impact from the metro were set at $L_{Aeq,24}$ = 60 dB for the equivalent continuous A-weighted noise level and $L_{pA,max}$ = 85 dB for the maximum noise level. Based hereupon the $L_{Aeq,24}$ = 60 dB was found to be exceeded within a distance that varied between 10-15 meters from the tracks and between 6-10 meters at the sections where the metro is entering and leaving the stations. The $L_{pA,max}$ for the same distances were found to be approximately 79 dB and 85 dB, respectively. (Hovedstadens udviklingsraad 2001: 59). It should be noted that these calculations included in their basis a 1 meter high noise barrier along the alignment. Train type, track conditions, number of trains and speed should also kept in mind

Assuming a similar noise impact and similar conditions for the noise impact, hot spots with respect to the noise impact during operation can be defined. Considering the noise barrier and that design criteria of the train and facility are not known a further margin of 5-10 meters is included. Thereby, the hotspots can be defined as sections of the at-grade and elevated alignment where building facades are within 20-25 meters from the tracks. This would include building facades along the section of the sub-phase 3B from Imbaba station to near the end of the El Kawmeya street. It will potentially also include sections of the sub-phase 3C from the at-grade Boulaq El Dakrour Station to the Cairo University station. The planned alignment rise immediately after the Boulaq El Dakrour Station and run along the ENR track to the Cairo University station. The entire sub-phase 3A is underground and will therefore not have a similar noise impact.

Vibration impacts from the operation of the metro may occur along the alignment. Given that no vibration modeling has been carried out of the impact during operations and conditions and design criteria with respect to vibrations have not been made available for the preparation of this ESIA, the impact is assessed based on experience from other metro projects. Operational vibration is generally only considered significant in relation to structural vibration within a short distance. For underground sections and elevated sections the structural impact is not considered significant. But there may be an impact to properties located very close to at-grade sections of the metro. In the EIA for the metro section on Eastern Amager in Copenhagen the vibration modeling indicated that there was risk of vibration nuisance in properties located less than 15 meters from the alignment. Given that at-grade sections of the metro are located along existing rail tracks or in the agricultural area in the north west it is not considered likely that the metro will cause vibration nuisance during operations.

Evaluation of Impacts

As identified above the potential significant impacts with respect to noise and vibration during operation include noise emissions from at-grade and elevated sections of the metro and vibrations from at-grade sections of the metro.

These impacts are evaluated in Table 8-9 according to the proposed significance criteria.

Table 8-9: Noise and vibration impacts during operation

	Noise impact during operation	**Vibration impact during operation**
Level of certainty	Likely	Unlikely
Extent of impact	Local	Local
Duration and frequency	Continuous over the operation phase	Continuous over the operation phase
Reversibility and mitigation	Possible to mitigate	Possible to mitigate
Sensitivity of receptors	Sensitive	Not sensitive
Significance of impact	Major	Minor

Source: Consultant's evaluation of impacts

Noise emissions from operations are local impacts which will occur along the at-grade and elevated sections of the alignment. The impacts will be continuous over the operation phase. The impact is possible to mitigate and the receptors can be described as sensitive as background noise level are already exceeded at the localities. The significance of the impact is assessed as major.

Vibration impacts associated with the operations are considered unlikely to occur at a magnitude where they will impact significantly on local receptors. The vibration impacts are continuous over the operation phase. The impact is difficult to mitigate except in the design of the metro line and receptors can be described as not sensitive based on experience from other metro projects and taking geological conditions into account. The significance of the impact is there assessed as minor.

Mitigation of Impacts

Noise impact study

A noise impact study is proposed to adequately assess the impact of the metro in areas along the at-grade and elevated sections of the metro line. The study will include the following basic steps:

1. Noise emission: To carry out a noise study, the noise emission including speed dependence of the rolling stock at relevant track conditions must be known. Vendor data can be applied. As an alternative measurements on the existing metro line can be used to specify the sound power (ISO 3095 Measurements of noise emitted by railbound vehicles).
2. Operating Requirements: For each section, information on the operational conditions is provided. This includes the number of trains, train length and speed distributions corresponding to the noise terms as per Law no. 4, 1994.
3. Calculation method: It is presently unclear whether there is a preferred method for calculating noise from railways in Egypt. There are many methods of the world. Choice of method is not considered to be crucial in this situation because there is likely a relatively short distance to the noise limit. The noise will primarily depend on the sound effect, traffic volume, speed and track position.
4. Screening of noise exposure along at-grade and elevated sections of the metro line: Based on noise emission of the trains and operational conditions a screening of the noise impact along at-grade and elevated sections of the metro line will be carried out to assess noise impacts along the metro line. The screening will consider the geometry of tracks and the surrounding areas. To quantify the noise impact predictions should be carried out on the facade of each building along the metro line within an appropriate corridor. It is recommended to visualise the noise impact as noise contours superimposed on a map to show the extent and location of noise problem areas. As an alternative to the facade calculations, the amount of dwellings and other noise sensitive buildings affected by noise above the limit, can be estimated based upon the noise contour lines.
5. Noise impact assessment: The noise impact assessment will compare the results of the screening with the legal requirements for different types of areas and in the reference time periods as indicated in Law no. 4, 1994 as amended. It should be considered to prepare a Weighted Noise Index to quantify the noise annoyance of residences along a given section of the metro line. A Weighted Noise Index multiplies the number of residences exposed by a certain noise level with an annoyance factor. The index can even be normalized to a length unit. The noise index can be helpful to compare different areas along the metro line and be a guideline of where noise barriers are needed most. It is assumed that the type of mitigation that will be applied will be noise barriers along the at-grade and elevated sections of the metro.
6. Control measurements: Control measurements of the actual noise impact following the implementation of noise mitigation measures should be carried out. Correction measures should be adopted if noise pollution still results from the metro at critical receptors.

Noise barriers

Establish noise barriers along the at-grade and elevated sections of the metro where the noise impact study has identified that noise reduction measures are required. Noise barriers are used along noise roads and along the existing metro lines in Cairo and may also serve safety purposes by limiting access to the tracks.

Figure 8-4 shows an example of the use of noise barriers along the 26th of July Corridor in Cairo and Figure 8-5 and Figure 8-6 show noise and safety barriers along the metro lines 1 and 2.

Figure 8-4: Example of the use of noise barriers along the 26th of July Corridor in Cairo
Source: EEAA 2008: 44

Figure 8-5: Noise barriers along the existing metro line 1 (Helmyet El Zeitoun)
Source: Consultant's own research

Figure 8-6: Noise barriers along the existing metro line 2 (Cairo University)
Source: Consultant's own research

Regular maintenance of rail tracks, metro trains, and facilities

Lack of maintenance of rail tracks, metro trains, and facilities is likely to increase noise emissions from the metro line. Regular maintenance will ensure that such increase in noise impacts are reduced to a minimum. The preparation of a maintenance programme for the rail tracks will greatly reduce the increase in noise emissions.

Noise and vibration monitoring during operations

It is expected that ECM will carry out noise monitoring along the alignment at critical receptor points. It should be noted as the geometry of the landscape along the alignment changes the resulting noise impacts from the metro may also change. In addition changes in the conditions of the metro train and rail tracks resulting from lack of maintenance may also affect the noise impact of the metro.

In addition, a monitoring programme should be put in place to monitor vibrations during operations. The building inspection surveys should also be updated in order to assess and control vibration impacts on buildings.

Residual Impacts and Costs of applying mitigation measure

Based on the experience from similar projects and estimates made in connection with similar situations, it is estimated that the noise barriers can reduce the noise impact by up to 5 dB. The installation of triple layer glassing can reduce the indoor noise impact by 5 dB(A) (Hovedstadens udviklingsraad 2001: 61). With the application of noise barriers it is estimated that the project can reduce noise impacts to a level that comply with Law 4/1994. Therefore, the residual impact after applying the proposed mitigation measures is considered to be minor.

Cost of applying mitigation measure

Costs associated with the implementation of the noise impact study are estimated at approximately 10,000 EUR by local consultant.

Costs associated with erection of noise barriers are significant and the implementation hereof should be subject to adequate assessment and studying of the identified hot spots along the alignment. The costs have been estimated at approximately 200 EUR by local consultant.

Noise monitoring during operations will be part of the standard environmental monitoring measures associated with the operation of the metro. Additional costs therefore not foreseen.

8.7 Visual and Functional Intrusion

8.7.1 Identifications of Impacts

Visual intrusion caused by the Metro line will occur before and during the construction phase. The urban landscape with its greeneries, trees and public spaces is affected during the construction when a large quantity of planted green space has to be destroyed and used for the construction area, but re-greenery has to be planned and agreed during the pre-construction phase.

The same strategy is valid for the urban landscaping and reorganization of urban land use in the immediate surrounding of the Metro stations to avoid functional intrusion. Before the facilities and land uses are re-arranged to optimize access and commercial opportunities avoiding loss of urban landscape in connection to the Metro stations, urban facility plans have to be designed and agreed during the pre-construction phase, before they can be implemented after the constructions have been finished.

In addition to the loss of urban landscape emerges the need for avoidance of visual intrusion during the construction phase caused by the construction site itself. Negative impacts as noise and dust emerge during the construction and demand for protection measures on the construction site, which could cause a visual intrusion during the whole construction period.

Visual intrusion caused by the construction of elevated alignments will fully appear and be obvious during the operation phase, but plans for minimizing the intrusion by construction details have to be planned in advance during the pre-construction phase.

8.7.2 Pre-Construction

Design guidelines for the Metro stations were drawn by SYSTRA and were integrated into a Feasibility Study. [4] All guidelines mentioned in this study should be considered by an Urban Management Plan before the construction (see ESMP) and agreed with NAT and the respective Urban Development Section of the Ministry of Housing and Planning.

This chapter describes the impact, evaluates it and proposes mitigation measures, during the pre-construction phase. It will concentrate its assessment on:

1. Pre-construction plans to re-green the lost spaces by replanting them with trees and create public spaces in the way that recreation and recreation furniture (as e.g. banks, pavilions etc.) is again available for the public;
2. Pre-construction plans to re-organizing the urban land use in the vicinity of the stations to allow safe accessibility as e.g. connections to other traffic modes and needs for street crossings, improvement to accessibility to commercial facilities and construction of pedestrian lanes;
3. Pre-construction plans for minimization of visual intrusion where the construction of the Metro station is at grade and elevated, which could be felt as disturbance for the people, living close to the Metro line.

<u>Assessment, Description and Evaluation of Impacts</u>

Potential impact on visual intrusion through loss of green space and public places

Most of the stations are built in locations, where public green with grass, flowers, trees and bushes combined with urban furniture like banks and pavilions are available either in the middle of the street or on both sides of the street. During the construction phase those elements have to be removed to enable a safe and professional construction. The population which is used to make advantage of these green elements in form of recreation elements will temporarily not be able to benefit from them. In addition will the removal of plants and trees besides creating a negative view contribute to a negative balance to CO^2 emission.

Attention must be given not only to the urban landscaping around the stations, but also to those areas, where the viaduct will create the necessity for re-greenery of those areas, used for storage of construction material, generally under the viaducts, in the middle green stripe of the streets. This situation can be encountered in the viaducts in El Bohi and El Kawmeya Street.

The central reservation in El Bohi serves as an important hub for community or recreational activities, services and businesses for stakeholders. Even if the expropriation/land acquisitions do not, strictly speaking, concern the totality of buildings along its length, many of the services will be lost, or confined beneath the viaduct. This street contains a succession of public gardens that are otherwise absent from the surrounding areas, and that will be destroyed. The aesthetic value of this street will be degraded (EQI 2012: Section 5.2.1)

[4] GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, SYSTRA , DECEMBER 2009

Evaluation

This impact causes a temporarily missing urban landscaping and will be direct visible because it is expected to be largely localized but reversible. It is therefore recommended to agree on the re-vegetation plan with the respective authorities and re-structure the location immediately after the construction phase and even try to improve it. Without a replacement valuation process for the trees needed to be cut down and the loss of greenery a serious degradation of urban landscaping will occur.

Potential impact on functional intrusion through loss of urban facilities

Stations of a metro line are integrated into the urban context of a city. Therefore their implementation needs to be assessed not only at the metro station level itself but also at the surrounding context in order to provide a good access to the station both for other public transport modes and pedestrians but also to improve urban space function and quality.

In the vicinity of the Metro stations urban facilities can cover several elements as described below:

- The "metro station access" element proposes the optimum location for the metro entry from a passenger point of view.
- The "bus stop" and "taxis" element proposes the optimum location for taxis and bus stops in connection with the metro entry.
- "Drop-off and pick-up zones" are recommended areas for private cars to drop off or pick up passengers from a private car to the Metro station.
- "Additional commercial facilities" are areas where locations for commercial facilities should be implemented with the aim to avoid informal commercial facilities to sprawl.
- "Pedestrian crossings" are recommendations to safety cross the street for pedestrians. All the pedestrian crossings are proposed at grade and are provided with traffic lights as well as zebra crossings.
- "Pedestrian friendly zones" are raised platforms on the road to facilitate pedestrian crossing and slow down car traffic
- "Public space upgrade" is the area where the Consultant recommends improving the public space: green spaces, square, urban furniture, etc.

In the area where the Metro Line 3, Phase 3 is located, urban landscaping and urban land use planning is developed rarely on a medium level. The construction of the Metro could therefore have a positive impact on the urban landscape. which leads to an improvement of the urban functionality and makes it aesthetically and economically more attractive.

Evaluation

This impact causes a permanent positive urban landscaping and development and will be directly visible because it is expected to be largely localized. Nevertheless it is a long-term impact and needs intensive cooperation with the District authorities and the Ministry of Planning and Housing. It is therefore recommended to develop together with the respective Ministry and District authority Urban Development Plans for the vicinity of all Metro stations, based on the design proposals, made by SYSTRA´s feasibility study.

Potential impact on visual intrusion through the construction appearance

The decision to construct viaducts in densely populated areas, especially in El Bohi and El Kawmeya St. will have an important visual impact. These areas are already crammed, and aesthetically unattractive. The viaducts will obliterate the relatively open visual lines that the two streets provide. This visual intrusion could be considered as a loss to the affected community, because much the surrounding area consists of a labyrinth of narrow alleys, and the need for a wider open street appears as an important compensation. The street with the construction of the viaduct can reduce the open and wide "boulevard" appearance of the street and reduces the visibility for some of the inhabitants, who live in those areas, where the station and the viaduct is close to the existing 4-5 story houses (see the following schemes).

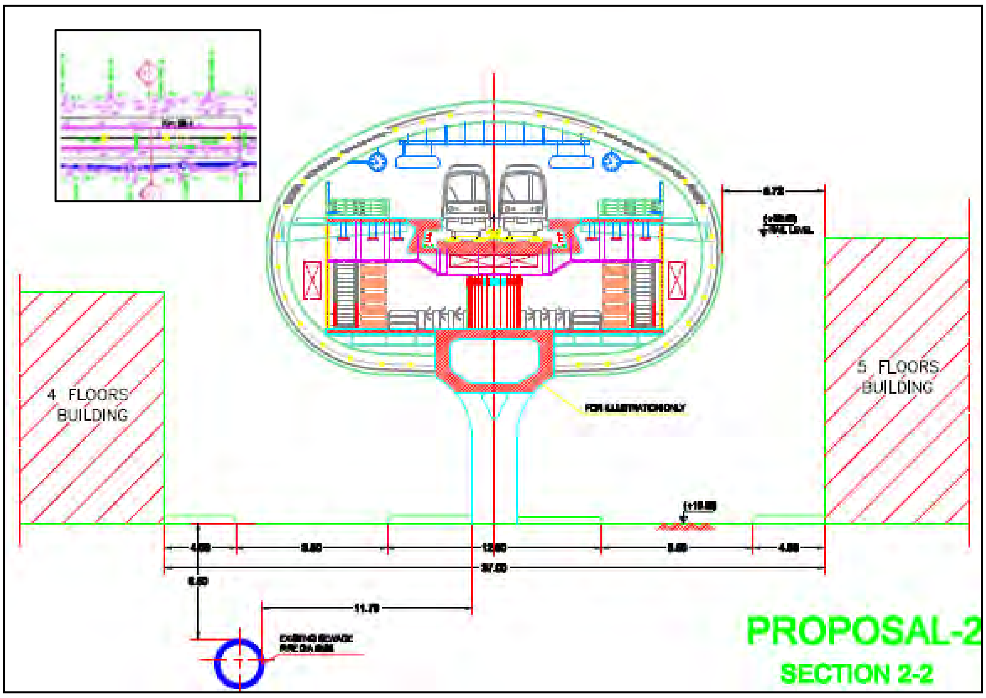

Figure 8-7: Metro Station El Bohi Street, Cross Section
Source: Information from SYSTRA in August 2012.

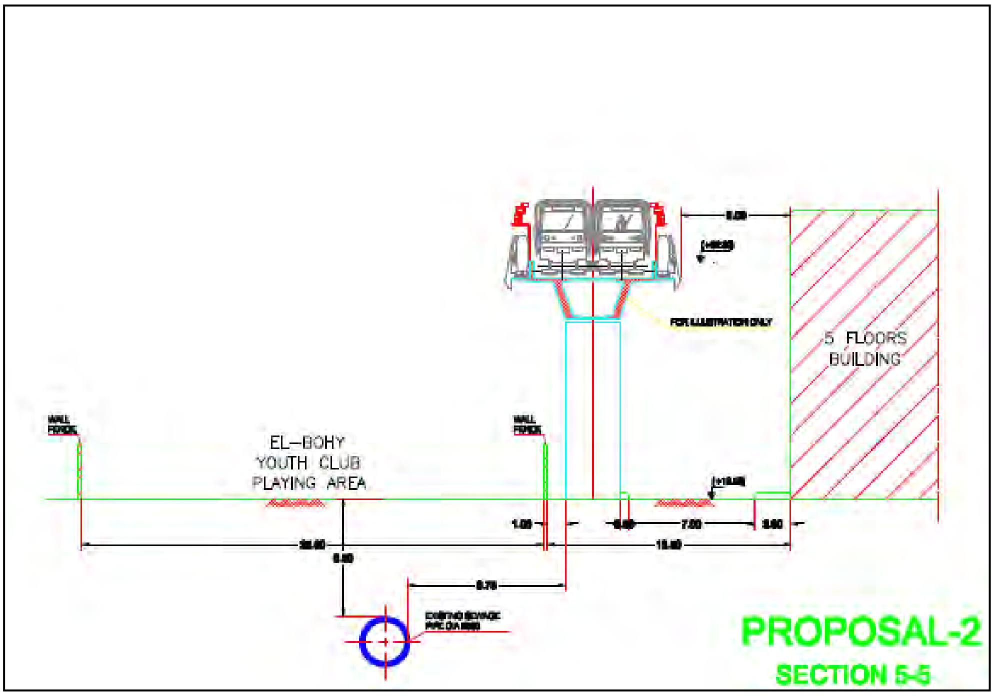

Figure 8-8: Metro Alignment El Bohi Street, Cross Section
Source: Information from SYSTRA in August 2012

Evaluation

The viaduct´s construction appearance will be a long-term, direct, local, irreversible and severe impact once the viaducts are erected, if not compensation in form of re-furniture and additional shopping and recreation opportunities will be provided. A design, which minimizes the visual intrusion has to be agreed before the construction starts.

<u>Mitigation of Impacts</u>

Mitigation measures of visual intrusion caused by the demolition of public green and public spaces

NAT in cooperation with the Ministry of Housing and the EEAA shall prepare Environmental Management Plans for each station. Based on these plans of general guideline character shall NAT, prior to the commencement of construction works in the relevant area, submit for the approval by the District a detailed Re-Vegetation Management Plan for the surface facility sites of the stations and the elevated alignments, based on the proposals by the feasibility study of SYSTRA and prepared by a qualified person. The plan shall include, but is not be limited to:

- Details of the establishment of vegetation and the construction of mounding or bundling, for the purposes of maintaining satisfactory visual amenity, ecological functioning and habitat provision;
- Consideration of re-vegetation works along elevated alignments;
- Use of indigenous species;

Mitigation measures of visual intrusion caused by the demolition of public green and public spaces vary from Metro station to Metro station and therefore will be outlined in the following for each individual station. The following sub-chapter highlights the improvements for beautification for the four stations of the Metro Line3, Phase 3A.

These stations are:

1. Nasser station
2. Maspero station
3. Zamalek station
4. Kitkat station

Beautification Nasser Station
According to the Re-Vegetation Management Plan, the negative impact of destroyed greenery and destroyed trees, bushes and flowers has to be compensated by a new plantations and beautification above and around the stations. The following new plantation and re-vegetation is proposed for the Nasser station[5].

Improvement measures

- Link the station surroundings to the existing green spaces in the north-east through appropriate pedestrian paths and improve them with sidewalks implementation, trees, etc. to form a consistent public space network;
- The northern part of the station is already used for specialized commercial activities as it includes car accessories and food markets. The pedestrian and commercial character of this zone can be enhanced and linked to the public space network.

Figure 8-9: Re-Vegetation Management Plan Nasser Station
Source: SYSTRA 2009

Beautification Maspero Station
According to the Re-Vegetation Management Plan, plantations and beautification above and around the stations should be created. The following new plantation and re-vegetation is proposed for the Maspero station[6].

Improvement measures

[5] GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, SYSTRA , DECEMBER 2009
[6] GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, SYSTRA , DECEMBER 2009

- Provide a quality central public space with link to the metro which makes it accessible to pedestrian metro users;
- Stress the urban continuity and current landmarks by organizing the area into a dense public space network, linked through proper pedestrian paths and roads;
- Provide a main public space: the island at the intersection of 26 July street and El Antakhna Square where the exits are located;
- Secondary public spaces linked through commercial pedestrian-oriented streets.

Figure 8-10: Re-Vegetation Management Plan Maspero Station
Source: SYSTRA 2009

Beautification Zamalek Station
The negative impact of the destroyed greenery and destroyed trees in the Ismael Mohammed Street has to be compensated by new plantations and beautification above and around the stations. A design is not yet available, because the station location had been changed recently. Independent from the new location, which are now about 100 m east wards of the old design, improvement measures are outline below.

Improvement measures
- Preserve the calm and small scale character of the neighbourhood and making green spaces more accessible;
- Connect the different spaces with the main streets using appropriate pedestrian walkways to promote accessibility to the station;
- Improve current sidewalks to achieve walk-ability and create shaded spaces;
- Reorganize the entries of the station into public space to provide a waiting area and structured green space, which can reinforce the identity of Zamalek as a calm and green neighbourhood;

Beautification Kitkat Square Station
According to the Re-Vegetation Management Plan, the negative impact of destroyed greenery and destroyed trees, bushes and flowers has to be compensated by a new plantations and beautification above and around the stations. The following new plantation and re-vegetation is proposed for the Kitkat station[7].

Figure 8-11: Re-Vegetation Management Plan Kitkat Station
Source: SYSTRA 2009

Improvement measures
- Create an attractive public space and integrate pedestrians in the design.
- Ensure the pedestrian links with already existing markets, public and green spaces network and provide market facilities near metro exits.

The following sub-chapter highlights the improvements for beautification for the six stations of Metro Line3, Phase 3B. These stations are:
1. Sudan station
2. Imbaba station
3. El Bohi station
4. El Kawmia station
5. Ring Road station
6. Rod El Farag station

[7] Greater Cairo Public Transport Study Update And Line 3 Phase 3 Design Study, Systra , December 2009

Beautification Sudan Station
According to the Re-Vegetation Management Plan, the negative impact of destroyed greenery and destroyed trees, bushes and flowers has to be compensated by a new plantations and beautification above and around the stations. The following new plantation and re-vegetation is proposed for the Sudan Street station[8].

Figure 8-12: Re-Vegetation Management Sudan Station
Source: SYSTRA 2009

Improvement measures

- Achieve the link with the denser area north of the station by offsetting physical barriers and improving public space quality.
- Improve the urban environment and public spaces

Beautification Imbaba Station
The first elevated station of Line 3B is the Imbaba Station, here according to the Re-Vegetation Management Plan, the negative impact of destroyed greenery and destroyed trees, bushes and flowers will be compensated by a new plantations and beautification above and around the stations. The following new plantation and re-vegetation is proposed for the Imbaba station[9].

Improvement measures

- Organize an accessible metro station as a catalyst for urban development: public space and local economy.
- Create public space on main access streets and around the station.

[8] GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, SYSTRA , DECEMBER 2009
[9] GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, SYSTRA , DECEMBER 2009

Figure 8-13: Re-Vegetation Management Imbaba Station
Source: SYSTRA 2009

Beautification El Bohi Station
The station is located on El Bohi Street, where several facilities are situated: covered market, mosque, and schools After construction of the metro station, the negative impact of destroyed greenery and destroyed trees, bushes and flowers in the middle of the street has to be compensated by a new plantations and beautification around the station. The following recommendations for the re-beautification are - according to the Re-Vegetation Management Plan - proposed for the El Bohi Station[10].

[10] GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, SYSTRA , DECEMBER 2009

Figure 8-14: Re-Vegetation Management El Bohi Station (here named Monira, as old design)
Source: SYSTRA 2009

The Re-Vegetation Management Plan has to be updated due to the new designs of the alignment. But general proposals for the improvement of beautification measures can be summarized as follows:

- Improve public space and enhance the pedestrian-friendly character of the neighbourhood.
- Replanting of the green space in the middle of the street combined with public places for recreation and shops.

Beautification El Kawmeya Station
According to the Re-Vegetation Management Plan, the negative impact of destroyed greenery and destroyed trees, bushes and flowers in the middle of the street and alongside the buildings will be compensated by a new plantations and beautification around the station. A new Re- Vegetation Management Plan still has to be prepared by SYSTRA, because the location of this station was shifted.

The following general improvement measures for the beautification are suggested:

- Organize the new public space to integrate pedestrian and taxi drop-off & pick-up;

- Replanting of the green space in the middle of the street combined with public places for recreation and shops.

Beautification Ring Road Station
The station is still subject to further investigation from the general authority for roads and bridges as well as not yet approved method of construction of the station. Nevertheless, the latest design shows the station above the Ring Road with access from both sides of the road. Regarding the beautification, the following objectives should be considered:

- Shorten and secure pedestrian accesses and paths, embedded in greenery and trees;
- Plan parking facilities with trees to provide shade;
- Implement urbanization guidelines and rules for the area to prevent unwanted sprawl into the existing green areas.

Beautification Rod El Farag Station
The Rod El Farag station is located in agricultural land. The at grade alignment and the rolling stock area starting shortly after the Ring Road station as well as the construction of the station itself will not create major destruction of planted greenery and trees because mainly agriculture land is used. Nevertheless adequate plantation around the station is needed, with the objective to integrate the station into the semi urban landscape with its natural grown trees and bushes.

The following sub-chapter highlights the improvements for beautification for the six stations of Metro Line3, Phase 3C. These stations are:

1. Tawfikia station
2. Wadi El Nil station
3. Gamet El Dowal station
4. Boulaq El Dakrour station
5. Cairo University station

Beautification Tawfika Station
The station is located on Rasheed Street at the intersection with Orabi Street. The Tawfikia station is connected to two neighbourhoods of relatively different scale: the spaced-out buildings on Orabi Street and the dense neighbourhood of Mitoaba at the west boundary of Rasheed Street.

According to the Re-Vegetation Management Plan, the negative impact of destroyed greenery and destroyed trees, bushes and flowers has to be compensated by a new plantations and beautification around and above the station.

Figure 8-15: Re-Vegetation Management Tawfika Station
Source: SYSTRA 2009

Main objectives for beautification are:

- Enhance the public space on Orabi street;
- Allow greened pedestrian roads, linked with the metro station on Orabi Street;
- Reclaim public space on medium strip of Orabi Street.

Beautification Wadi El Nil Station

The station is located on Wadi El Nile Street. At a larger scale Wadi El Nile station will attract residents of the southern part of Mitoaba, as the Tawfikia station is further north and separated by 26 July street.

According to the Re-Vegetation Management Plan, the negative impact of destroyed greenery and destroyed trees, bushes and flowers has to be compensated by a new plantations and beautification around and above the station.

Figure 8-16: Re-Vegetation Management Wadi El Nil Station
Source: SYSTRA 2009

The general objective for the beautification of this station can be summarized as follows:

- Provide a more pedestrian-oriented public space;
- Improve green pedestrian links and already existing public space on traffic islands.

Beautification Gamat El Dowal
The design and location of the station was changed. The new station is now located on Gamat El Dowal El Arabia Street, about 100m westwards of the square Mostafa Mahmoud at the southern junction with Abu Ezz Street. The street is characterized by high-rise accommodating mainly offices and shops on ground floors and a green middle part, planted with trees and greenery.

A new Re-Vegetation Management Plan has to be prepared with the general objectives:

- Improve public space accessibility for pedestrian and encourage local commercial development;
- Accommodate pedestrian moves and include the pedestrian into the scattered public space mainly by achieving its continuity and insuring secure crossings.

Beautification Boulaq El Dakrour
An actual Re-Vegetation Management Plan was not available - the station was shifted during the planning phase - but has to be agreed before the start of the construction. Missing greenery as trees, bushes and flowers has to be compensated by new plantations and beautification around the stations.

The general objective of the station´s beautification is proposed as follows:

- Improve the market space by providing clusters of trees for shading;
- Provide greenery and trees at the beginning of the crossing of the railway for pedestrian.

Beautification Cairo University
Cairo University is the station which combines the line 2 with the line 3. It is located in Giza west of the ENR railway track. A pedestrian bridge allows reaching the university east of the tracks. The major neighbouring road axes are El Sudan street and Abd El Salam Aref street east of the railway and Ahmed Zewel street west of the railway. The Sarwat bridge links the two sides.

An actual Re-Vegetation Management Plan was not available but has to be agreed before the start of the construction, This plan shall compensate the negative impact of destroyed greenery and destroyed trees, bushes and flowers by new plantations and beautification around the stations. The general objective of the station´s beautification is proposed as follows:

- Providing clusters of trees for shading in connection with the parking space;
- Provide greenery and trees at the entrance of the pedestrian roads to the station.

Mitigation measures for improvement of urban functionality and urban facilities

Regarding the measures for the urban functions and facilities proposed, it is important to agree on the measure before the construction is implemented. Only then an improvement of the urban facilities have a chance to be implemented.

NAT in cooperation with the Ministry of Housing and Planning shall prepare Urban Management Plans for each station. Based on these plans, which have a general guideline character for improvement of urban functions shall NAT, prior to the commencement of construction works in the relevant area, submit for the approval of the District a detailed Urban Facility Plan for the surface sites of the stations and the elevated alignments prepared by a suitably qualified person. The plan shall include, but is not limited to:

- Details of proposals for secure street crossing, provision of public spaces, pedestrian zones and market facilities around the stations;
- Provide secure pedestrian accessibility between the entrances to the Metro stations and the PT modes;
- Details of transfers between PT modes and the Metro station;
- Details of the visual appearance of all structures, facilities or works (including paint colours and specifications). Buildings and structures shall be designed and constructed so as to blend as far as possible with the surrounding landscape;
- Details, specifications and staged work programs to be undertaken, including a maintenance program of all landscape works, building materials and cladding.

Improvement measures for urban facilities caused by the new Metro line vary from Metro station to Metro station and therefore will be outlined in the following for each individual station. The following sub-chapter highlights the improvements for beautification for the four stations of Metro Line3, Phase 3A. These stations are:

1. Nasser station.
2. Maspero station.
3. Zamalek station.
4. Kitkat station

Urban facilities Nasser Station

According to the Urban Facility Plan – approved by the Ministry of Housing and Planning and coordinated with the District authority before construction starts - the following improvement is proposed for the Nasser station[11].

Improvement measures

- Reintegrate the pedestrian in the design and lessen the space devoted to parking as to provide a generous public space;
- Manage connection with line 1 and other modes: bus and shared taxis and increase pedestrian accessibility;
- Implement two multi-modal exchange zones (at the eastern and western ends of the station) to organize the exchange with the other PT modes as well as to provide kiss and ride areas and taxi stops;
- Adopt a parking management strategy to ban unwanted parking and allocate more space for public transport and pedestrians;
- The northern part of the station is already used for specialized commercial activities as it includes car accessories and food markets. But the pedestrian and commercial character of this zone can be enhanced and linked to the public space network.

Figure 8-17: Urban Facilities Nasser Station
Source: SYSTRA 2009

Urban facilities Maspero Station

[11] GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, SYSTRA , DECEMBER 2009

According to the Urban Facility Plan – approved by the Ministry of Housing and Planning and coordinated with the District authority before construction starts - the following improvement is proposed for the Maspero station12.

Improvement measures

- Underline the historical character of the built environment which is now countered by the flyover and lack of public space;
- Provide a pedestrian-friendly environment, which is adapted to the dense urban fabric;
- Provide a central public space close to the Metro exits, which is accessible to the Metro users;
- Emphasise the urban continuity and current landmarks by organizing the area into a dense public space network, linked through proper pedestrian paths and roads;
- Connect the three main urban spaces to create attractive centres in the vicinity of the station.

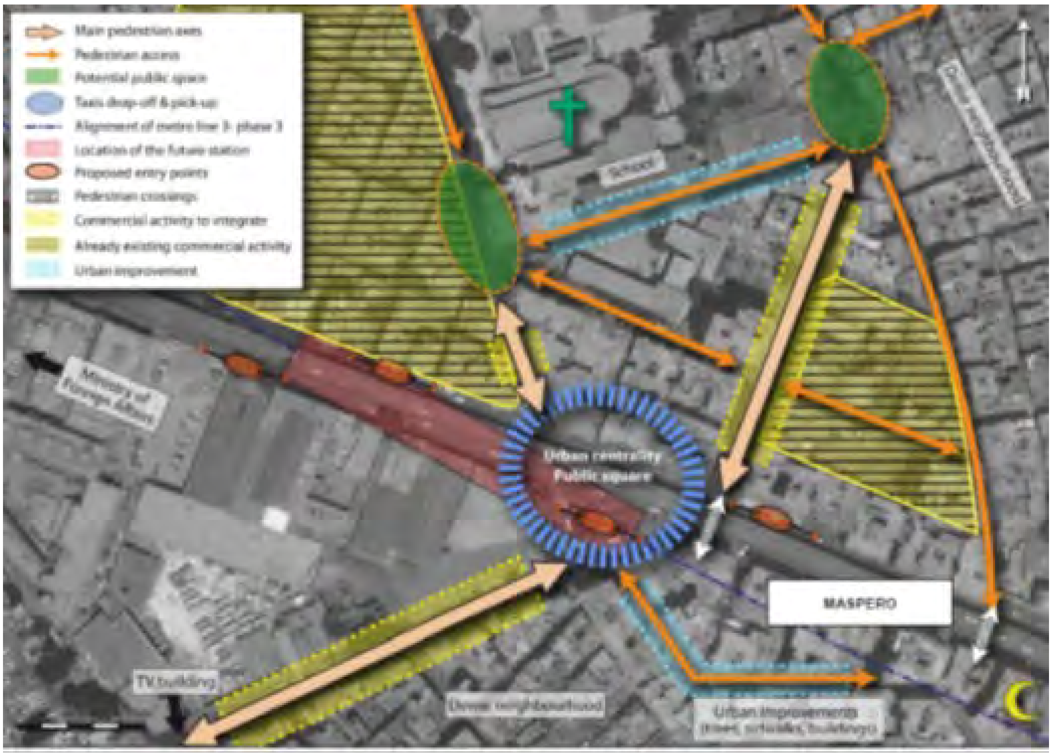

Figure 8-18: Urban Facilities Maspero Station
Source: SYSTRA 2009

Urban facilities Zamalek Station
A design for urban facilities is not yet available, because the station location had been changed recently. Independent from the new location, which are now about 100 m eastwards of the old design, improvement measures are outline below.

Improvement measures

- Ease pedestrian access to the station and drop-off with private modes and taxis;
- Implement the kiss and ride area as well as taxi waiting areas near the exits of the station placed on two major access axes for the neighbourhood;

[12] GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, SYSTRA , DECEMBER 2009

- Encourage commercial development on adjacent streets.

Urban facilities Kitkat Square Station
According to the Urban Facility Plan – approved by the Ministry of Housing and Planning and coordinated with the District authority before construction starts - the following improvement is proposed for the Kitkat station[13].

Improvement measures

- Connect the surface PT modes with the metro station and secure the modal switch, especially at the crossing of Corniche El Nil and Sudan streets;
- Organize convenient and efficient transit interchange nodes on the main square by reorganization space modal share and pedestrian crossings;
- Improve the pedestrian paths on main street and access streets;
- Ensure pedestrian links with already existing markets, public and green spaces network and provide market facilities near metro exits.

Figure 8-19: Urban Facilities Kitkat Station
Source: SYSTRA 2009

Improvement measures for urban facilities caused by the new Metro line vary from Metro station to Metro station and therefore will be outlined in the following for each individual station. The following sub-chapter highlights the improvements for beautification for the four stations of Metro Line3, Phase 3B. These stations are:

1. Sudan station
2. Imbaba station
3. El Bohi station
4. El Kawmia station
5. Ring Road station
6. Rod El Farag station

[13] GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, SYSTRA , DECEMBER 2009

Urban facilities Sudan Station
According to the Urban Facility Plan – approved by the Ministry of Housing and Planning and coordinated with the District authority before construction starts - the following improvement is proposed for the Sudan Street station[14].

Improvement measures

- Achieve the link with the denser area North of the station by offsetting physical barriers and improving public space quality;
- Shorten walking time to the station entrances and provide equal access to transportation services;
- Provide drop-off and pick-up areas for passengers and bus stops on the main road axes.
- Implement a pedestrian path between the CTA workshop and the school to ensure accessibility for the northwest part of the neighbourhood.

Figure 8-20: Urban Facilities Sudan Station
Source: SYSTRA 2009

Urban facilities Imbaba Station
According to the Urban Facility Plan – approved by the Ministry of Housing and Planning and coordinated with the District authority before construction starts - the following improvement is proposed for the Imbaba station[15].

Improvement measures

- Organize an accessible metro station as a catalyst for urban development;
- Facilitate modal switch to other PT modes;
- Offset the physical barrier constituted by the ENR railway by implementing a pedestrian bridge at the eastern entrance of the station;

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14 GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, SYSTRA , DECEMBER 2009
15 GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, SYSTRA , DECEMBER 2009

- Implement drop-off and pick-up areas for taxis and tuk-tuks.
- Plan market facilities around the station.

Figure 8-21: Urban Facilities Imbaba Station
Source: SYSTRA 2009

Urban facilities El Bohi Station
The station is located on El Bohi Street, where several facilities are situated: a covered market, a mosque, a youth club and a school.
According to the Urban Facility Plan, addition care will be taken for the improvement of the accessibility to the station, the influence of nearby hospitals, the accessibility to the youth Centre and the market under the elevated areas, which demand frequent foot passenger crossing. The link to the other traffic modes as taxis and busses shall also be considered, to improve a safe and quick interchange of passengers from the metro line. The following improvement is proposed for the El Bohi station[16].

- Consider nearby main pedestrian axes and the major commercial street, securing:
  - Crossings at the major intersection
  - Improved sidewalks and access paths to the exits on El Bohi street
  - Improved pedestrian paths within the urban fabric.
- Ensure proper crossings and accessibility to the station from the various access streets.

[16] GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, SYSTRA , DECEMBER 2009

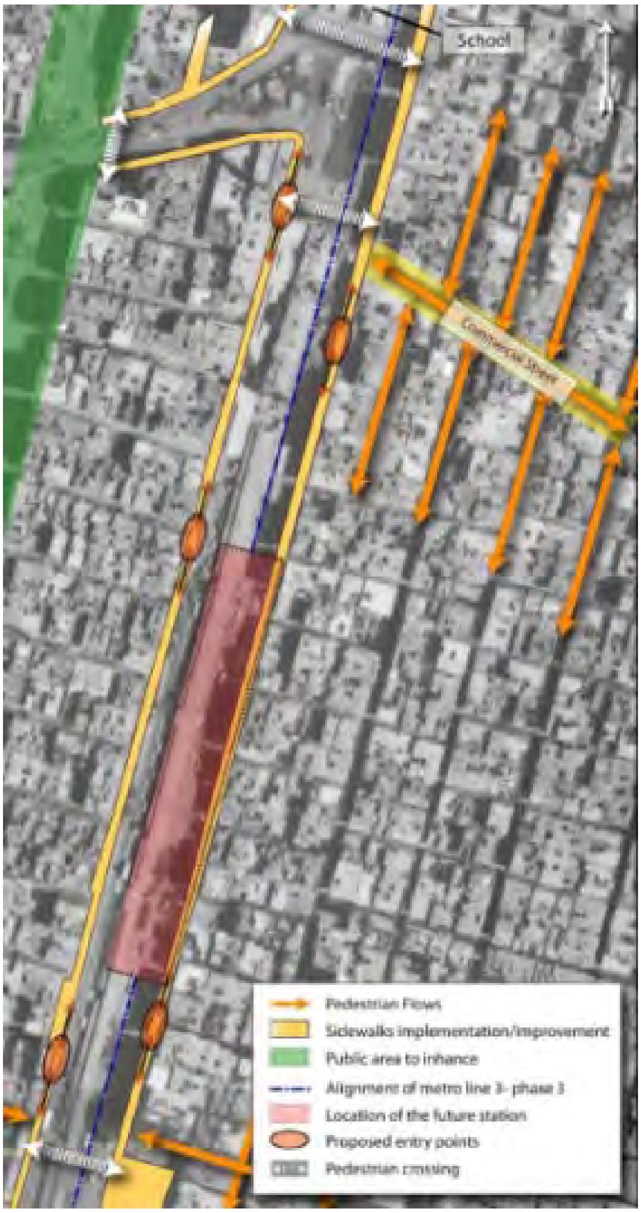

Figure 8-22: Urban Facilities El Bohi Station (here named Monira, as old design)
Source: SYSTRA

Urban facilities El Kawmeya Station
Due to the change of the location, an Urban Facility Plan – approved by the Ministry of Housing and Planning and coordinated with the District authority before construction starts – has to be developed. This plan should consider the following general improvement measures:

- Organize a new public space to integrate pedestrian and taxi drop-off & pick-up;
- Secure crossings at the major intersection;
- Anticipate the implementation of market or small commercial activity nearby.

Urban facilities Ring Road Station
The station is still subject to further investigation from the general authority for roads and bridges as well as method of construction of the station. Nevertheless, the latest design shows the station above the Ring Road with access from both sides. Regarding the interface with other transport modes and the Ring Road itself, the following objectives should be considered:

- Organize development around transportation and road axes to counter urban sprawl;
- Ensure a good connection with the station, both for pedestrian and other PT modes;
- Shorten and secure pedestrian accesses and paths;
- Optimize the routes and stops of the public transport modes within the multi-modal hub;
  Consider parking facilities;
- Anticipate the development of market/commercial activities around the station.

Urban facilities Rod El Farag Station
The Rod El Farag station is located in agricultural land. The at grade alignment and the rolling stock area starting shortly after the Ring Road station as well as the construction of the station itself will not create major improvements, but will create future development which should already be considered with the construction of the Metro station. Regarding the interface with other transport modes and the planned highway, the following objectives should be considered:

- Organize planned development of settlements and shops around the transportation and road axes to counter urban sprawl;
- Ensure the connection between the station and Rod El Farag Corridor, by including all the PT modes, providing a convenient and efficient inter-modal hub.

Improvement measures for urban facilities caused by the new Metro line vary from Metro station to Metro station and therefore will be outlined in the following for each individual station. The following sub-chapter highlights the improvements for beautification for the four stations of Metro Line3, Phase 3C. These stations are:

1. Tawfikia station
2. Wadi El Nil station
3. Gamet El Dowal station
4. Boulaq El Dakrour station
5. Cairo University station

Urban facilities Tawfika Station
According to the Urban Facility Plan – approved by the Ministry of Housing and Planning and coordinated with the District authority before construction starts - the following improvement is proposed for the Tawfica Station.

- Organize convenient and efficient public transit stops on the main road (Orabi Street) linked with the metro station;
- Ensure the access from/to Mitoaba by providing appropriate pedestrian links from the square to the station entrances and Orabi Street;
- Manage pedestrian crossings on major intersection and integrate them with the other pedestrian flows, applying traffic-slowing design;
- Manage parking spaces and locations to facilitate all traffic flows;
- Consider commercial areas alongside the streets adjacent to the Rasheed Street as the station will create a quite intensive pedestrian traffic flow;

Figure 8-23: Urban Facilities Tawfika Station
Source: SYSTRA 2009

Urban facilities Wadi El Nil Station

According to the Urban Facility Plan – approved by the Ministry of Housing and Planning and coordinated with the District authority before construction starts - the following improvement is proposed for the Wadi El Nil Station.

- Provide secure pedestrian accessibility between the South of Mitoaba and the northern entrances of the station;
- Implement taxi drop-off and pick-up zones;
- Provide at the northern entrance the possibility for U-turns around the existing traffic island;
- Ensure the link with Gamat El Dowal El Arabia at the southern entrances of the station;

Figure 8-24: Urban Facilities Wadi El Nil Station
Source: SYSTRA 2009

Urban facilities Gamat El Dowal
A new Urban Facility Plan – approved by the Ministry of Housing and Planning and coordinated with the District authority before construction starts – has to be developed, due to the shift of the station about 100 m westwards. The development of this plan should consider the following general improvement for the Gamat El Dowal station:

- Organize a transfer station with other PT modes and provide kiss and ride areas;
- Consider pedestrian flows and provide pedestrian facilities (benches, pavilions etc.) into the scattered public space mainly by ensuring secure crossings;
- Manage on-street parking as it limits access to sidewalks and planned crossings;
- Use secondary streets such as Abu Ezz Street to accommodate market facilities and prevent informal businesses from settling in unwanted locations near the station.

Urban facilities Boulaq El Dakrour
An Urban Facility Plan is not available and has to be developed and approved by the Ministry of Housing and Planning and coordinated with the District authority before the construction starts. This plan should consider the following general objective:

- Improve the market space accessibility and the crossing of the railway for the pedestrian and encourage local commercial development
- Optimize transfers between PT modes and the Metro station.

Urban facilities Cairo University
An Urban Facility Plan is not available and has to be developed and approved by the Ministry of Housing and Planning and coordinated with the District authority before the construction starts. This plan should consider the following general objective:

- Improvement of the accessibility to the station from the connected other line 2;
- links to the other traffic modes as taxis and busses shall also be considered, to improve a safe and quick interchange of passengers from the Metro line.

Mitigation measures of visual intrusion by the elevated Metro line

The design of the elevated part in the Metro Line 3, Phase 3B has been subject to several changes. The changes in the design considered both, the economic and the visual aspects. Under economic aspect, the cost of the removal of the utilities as gas, water and sewerage pipes in the street as well as the lower costs for elevated construction compared to underground tunnelling played a major role in selecting the elevation construction. Under the visual aspect, the selection of filigree mono-piles, which are substituting the normal square multi-piles and the design of noise barriers are relevant.

Improvement of measures for the visual Intrusion generated by the elevated alignment for the residents close to the alignment can be summarized as follows:

- Establish a visual barrier on the elevated alignment and the elevated stations, which minimizes the noise and the vibration emerging from the train;
- Avoid a distance from less than 5 m between the alignment and the buildings;
- Compensate loss of visibility by increase of outside measures for urban landscaping, like public places, provision of urban furniture, like sears, pavilions, banks, water fountains etc.;
- Provide an attractive design of the alignment and the station, by minimized concrete structures.

<u>Residual Impacts and Costs of applying mitigation measure</u>

Cost of applying mitigation measures depend on the actual implementation of the proposed mitigation measures, which involve mainly the public authorities. It is estimated that the provided measures, aiming at minimizing the visual intrusion through construction measures of the elevated stations and alignments in Imbaba, El Bohi and Kawmeya will increase the construction cost in the relevant mitigation areas up to 1-2% in that area.

Costs for implementation of measures for the Re-Vegetation Management Plans and Urban Facility Plans on each Metro station have to be included into the annual budget of the Districts. They depend on the final agreed plans and cannot be estimated in this study.

It can be expected that even a proper applying of the proposed mitigation measures for beautification measures by the local authorities will take some time until the location around and above the stations and under the elevated stations and alignments are fully greened und regained their urban landscaping character. Nevertheless the re-greening and the re-organisation of the urban environment is a chance for improvement of the actual situation.

Regarding the measures for the urban facilities proposed, it is important to agree on the measure before the construction is implemented. Only then an improvement of the urban facilities have a chance to be implemented.

8.7.3 Construction

Protection measures against noise, dust and airborne particulates will help the citizens against both a significant health hazard and public nuisance. But it will create on the other hand visual intrusion by the protection measures. The grade of protection of the construction site against dust and airborne particulates depends mainly on the type of the Metro station and differs accordingly: underground stations only need a small area of protection compared to the cut and cover and elevated construction sites.

Potential visual impacts from protection activities during the construction phase

This chapter describes this impact, evaluates it and proposes mitigation measures, during the construction phase. It will concentrate its assessment on:

- avoidance of visual intrusion during the construction phase caused by protecting the population from noise, dust and airborne particulates.

Assessment, Description and Evaluation of Impacts

The construction of all Metro stations of the Line 3, Phase 3 and in particularly the elevated line and stations of Phase 3B will generate very significant dust and airborne particulates that are both a significant health hazard and public nuisance. To minimize this impact, the contractor will have to provide fences and covers around and above the construction site. During the construction phase those elements have to be erected to enable a safe and professional construction and to minimize noise, dust and airborne particulates. This will be more intensive, where the construction will be in close proximity to residential buildings and at ground and elevated levels.

The appearance of this so covered construction site will create a significant visual intrusion for the population during the construction period, which could last from 1 to 2 years.

Evaluation
This impact on temporarily disturbed urban landscaping will be direct visible because it is expected to be largely localized but reversible. The immediate removal of all protection material and the restoration of the construction area is part of the contractors duty laid down in the Environmental and Social Management Plan.

Mitigation measures

Protection measures against the exposure of the citizens to these activities do not exist, because these activities are essential to protect the citizen. But the citizen´s tolerance towards these activities can be generated and can lead to a higher acceptance of the awkwardness caused by construction activities. Increased tolerance can be generated by:

- An intensive public consultation;
- In-time information about the construction activities;
- Well established Information flow by a complaint redress mechanism;
- Open –Door Days to inform interested citizens about the construction;
- Beautification measures (e.g. painting the fence by school classes).

Whatever type of station and elevated alignment, NAT will require the construction contractor to have visual attractive protection measures, which integrate as much as possible to construction into the urban landscape. - by:

- Install attractive visual barriers for e.g. sound shields, heavy canvas tenting, etc. – at elevated locations during construction activities.
- Use steel sheets (slabs) laid on bare ground to minimize heavy vehicle traffic on exposed earth.
- Ensure increased / more frequent street sweeping and cleaning of construction access roads and traffic roads.
- Dampening waste or excavated soils before front-end loading into trucks.
- Repaving streets as soon as possible after construction.

Residual Impacts and Costs of applying mitigation measure

Cost of applying mitigation measures are part of the contractors duty and is included in the contract.

8.7.4 Operations

Assessment, Description and Evaluation of Impacts

Relevant impacts through visual and functional measures generated by the implementation of re- vegetation and functional improvements during the operation of the Metro line are mainly of positive nature and can be summarized as follows:

Due to the improved re-vegetation of the Metro stations the following positive impacts can be expected:

- Availability of secure pedestrian accesses and paths, embedded in greenery and trees;
- Replanting of the green space in the middle of the streets combined with public places for recreation and shops
- Availability of parking facilities with trees to provide shade;
- Implemented urbanization guidelines and rules for the area to prevent unwanted sprawl into the existing green areas.

Due to the improved urban functionality of the Metro stations the following positive impacts can be expected:

- Availability of functional public spaces combined with pedestrian roads;
- Improved market space accessibility and local commercial development;
- Improved pedestrian crossings on major intersection and integrate them with the other pedestrian flows, applying traffic-slowing design;
- Availability of transfer station with other PT modes and kiss and ride areas;
- Improved pedestrian flows and provision of pedestrian facilities (benches, pavilions etc.) into the scattered public space;
- Availability of taxi drop-off and pick-up zones;
- Manageable on-street parking as it limits access to sidewalks and planned crossings.

Relevant impacts through visual intrusion generated during the construction period have no relevance during the operation of the Metro line, assuming the immediate removal of the protection walls and barriers.

Due to minimizing the negative impressions from the elevated alignments for the citizens the following positive impacts can be expected:

- The construction is accepted by the citizens;
- Compensation measures in form of green spaces, attractive public places with furniture and a functional market under the construction are accepted and in use;
- The general cleanliness in the elevated part has improved considerably and contributed to an upgrading of the area image.

Residual Impacts and Costs of applying mitigation measure

Cost of applying mitigation measures are not relevant, expecting only positive impacts. Costs for operation and maintenance of the greenery and urban facilities have to be considered in the annual household plans of the responsible public agencies.

8.8 Biodiversity and Nature Conservation

8.8.1 Identification of Impacts

[L]and clearance, levelling and excavation works will directly impact the flora and fauna of the study area [and] roadside trees will have to be cut down for the construction of some of the stations [..],cut-and-cover operations, and the at-grade and viaduct sections of the Metro alignment (EQI 2012: 168).

8.8.2 Pre-Construction

In the preconstruction phase impacts on biodiversity will result from the construction activities undertaken in connection with the utility diversion activities. These impacts are similar to the impacts during the construction phase, although of a lower magnitude and duration, and are not analysed independently.

8.8.3 Construction

Assessment, Description and Evaluation of Impacts

None of [the] habitats [in the project area are] considered threatened; and none seems to be necessary for the survival of any species of animals or plants. The common and relatively poor nature of the animal and plant communities present renders these impacts [to flora and fauna] insignificant. Wildlife of this highly urbanized area of the Nile Valley and the adjacent rural areas consists mainly of species that are able to tolerate man's activities and manage to survive in the habitats he created. Most of the alignment cuts through fully urban or peri-urban areas, with the exception of Nile/water courses banks (EQI 2012: 168).

There is no indication that construction work and subsequent operation of the Metro will have any irreversible or significantly adverse impacts on wildlife and habitats in areas adjacent to these lines. Impacts to biodiversity should therefore be considered short-term, direct, temporary and reversible (EQI 2012: 168).

[Construction activities] will directly impact the flora and fauna of the study area [and] roadside trees will have to be cut down for the construction of some of the stations [..],cut-and-cover operations, and the at-grade and viaduct sections of the Metro alignment (EQI 2012: 168).

As the impacts to biodiversity are considered short-term, direct, temporary and reversible they are considered a minor impact. However, compensation measures are proposed below.

Mitigation of Impacts

[T]he impact of vegetation clearance and habitat destruction within the site boundaries should be compensated for, as the loss of vegetated areas is important in terms of lost recreational amenities (EQI 2012: 168).

Therefore, land that is cleared and roadside trees that are cut down as part of the construction activities should be compensated by planting of new trees and reestablishment of green areas.

Residual impact after applying the proposed mitigation measures

Given that uprooting and replanting of the old Ficus species (Malay Banyan, Spotted Ficus, Rubber Tree), the Bombax ceiba (Silk-cotton Tree), and the palm trees found along the alignment is very costly and complicated due to deep root systems and the size of these trees (EQI 2012: 73), replanting is only likely to happen in few cases. Therefore, the project will cause damage, which however is reversible as trees can be regrown. Therefore, the residual impact is considered minor.

Cost of applying mitigation measure

Costs associated with the replanting of trees and reestablishment of green areas, should be included in construction contracts. The Environmental Officer to be employed in the E&S unit should supervise the removal of valuable trees and the replantation activities during and after the construction phase as well as the maintenance and creation of new green areas in and around the above-ground Metro railways and stations.

8.8.4 Operations

No significant impacts to biodiversity will result from activities during the operations phase. The mitigation measures related to replanting and reestablishment of green areas to be undertaken in relation to the impacts of the construction phase will continue into the operations phase.

8.9 Archaeological and Cultural Heritage

8.9.1 Identification of Impacts

Potential key impacts on archaeological and cultural heritage are mainly expected during the construction phase, and can be identified as follows:

- Potential impact on historic and/or sites of architectural significance
- Risk of Damaging Chance-Find buried Artefacts

However, because the actions necessary to mitigate archaeological and cultural heritage risk must be taken during the pre-construction phase, they are described in the pre-construction section below.

8.9.2 Pre-Construction

<u>Assessment, Description and Evaluation of Impacts</u>

Potential impacts include:

- Total or partial damage incurred to buried artefacts
- Prevent future exploration possibilities of new archaeological sites

During the construction of the Metro Line 3, extensive excavation works will be carried out which could lead to chance finds of antiquities or buried artefacts. The possibilities for such chance-finds may be high in some locations.

Such chance-finds generally need special care in handling so as to keep their condition that will support the cultural value it represents, therefore in the unlikely finding of such objects the Ministry of Tourism and Antiquities should be informed so as to adequately handle this object. This impact is considered of **major** significance.

Due to the high tangible and intangible value of the sites of historic and/or architectural significance, this impact is considered **major** and should be mitigated.

<u>Mitigation of Impacts</u>

According to law 117/1983 and law 119/2008, approvals must be obtained during the pre-construction phase of the project from both SCA and NOUH. These ensure that the project will not negatively affect:

- Sites with historic significance
- Sites with architectural significance
- Potential impacts on the sites listed above could be :
- Total or partial expropriation.
- Structural impact in the forms of cracks, tilting or other forms of structural instability.
- Total or partial structural failure during the construction phase.
- Visual intrusion at the areas where the metro line passes at grade or at an elevated grade level.

Potential impact on sites of historic and/or architectural significance

An additional study is required to perform a thorough investigation of the potential impact of the project on sites with historic and/or architectural significance. This will be used to obtain the approval of authorities such as the SCA and NOUH. The required study would comprise of the following:

1. Review/identify all buildings to be expropriated during the construction of the Metro Line 3 – phase 3
2. Review the registered buildings (building of architectural significance) database in Egypt with the assistance of NOUH and other relevant organizations and/or review of existing survey studies.
3. Determine if any building to be expropriated or may be affected in anyway by the construction activities is actually a registered building. The potential impact of the different construction activities on these buildings shall be assessed including visual intrusion. The study shall include a survey of the existing condition (cracks, partial failure, etc.) of these buildings in order to be the basis of evaluation of future monitoring of their condition during the construction and operation of the Metro Line.
4. Review and describe the historic sites within the buffer zone determined by SCA
5. Determine if any component of the Metro project passes at a distance less than the allowable buffer from any existing historic site. As noted for the buildings of architectural significance, the potential impact of the different construction activities on the historic sites shall be assessed including visual intrusion. The study shall document the existing condition of these historic sites in order to be the basis of evaluation of future monitoring of their condition during the construction and operation of the Metro Line.
6. A geophysical survey must be consequently carried on during the pre-construction phase around and inside the specified locations stated in the historic sites survey. If this geophysical survey confirms the existence of buried monuments, its location should be connected – in dimension and altitude – with both the designed altitude of Metro line 3 phase 3 and the monument on the surface. These relations are very important in the assessment of the impact of the design parameters on archaeological site.
7. Additional field visits to confirm/complete findings
8. Assess the effect of diversion of utilities and road traffic on archaeological sites
9. Obtain the approval of the SCA on the study; a detailed report - containing maps of all the outputs of historic, urban, geophysical and topographical survey - that defines the relation between these studies and the route of the Metro 3-Phase 3 must be submitted to the SCA who will examine the report through its permanent committees. The SCA has to submit a written approval to the previously mentioned demand and has to sign and put a stamp on submitted maps as a matter of approval to the proposed alignment of the Metro Line 3 – Phase 3 project.
10. Obtain the approval of NOUH on the Urban Study; NOUH must be consulted during the pre-construction phase – according to the unified building Law no. 119 of the year 2008- for the listed buildings and the modifications that will be carried in the urban texture due to the demolition plan to construct stations or Metro.

Risk of Damaging Chance-Find buried artefact

Law 17/1983 stipulates that, in situations where any culturally valuable object/monument is discovered during excavation works, the works should be stopped by the contractor and the nearest administrative authority must be informed within 48 hours. An SCA inspector shall then supervise any excavation on the site following any evident of artefacts or antiquities traces. NAT includes in its contracts for the various lots within the Cairo Metro Line 3 Phase 3 project, a term referring to the national law.

A chance find procedure should be drawn-up prior to construction start that addresses and protects cultural heritage finds made during the construction phase.

The chance find procedure should outline the chain of events put in motion if previously unknown heritage resources, particularly archaeological resources, are encountered during the project's construction phase. The procedure should include provisions for:

- record keeping
- expert verification procedures
- chain of custody instructions for movable finds
- clear criteria for potential temporary work stoppages that could be required for rapid disposition of issues related to the finds.

The procedure should also outline the roles and responsibilities and the response times required on the part of both project staff and any relevant heritage authority, as well as any agreed consultation procedures.

Residual Impacts and Costs of applying mitigation measure

When all the mitigation measures proposed above are applied, no residual impact is expected.

The main cost of applying the mitigation measure for the additional study on sites with historic and/or architectural significance would be the consultancy fee for carrying the recommended studies including field visits and measurements.

NAT has integrated national legislative requirements into the tender documentation for concessionaires. The development and implementation of a chance find procedure is estimated to cost EUR 5,500.

8.9.3 Construction

The nature of the risks and their management is described in the above section on preconstruction.

8.9.4 Operations

No significant impacts to archaeological and cultural heritage are expected to occur during the operations phase. The vibration monitoring and building surveys recommended to mitigate vibration impacts will help verify this.

8.10 Public Utilities and Traffic

8.10.1 Identification of Impacts

Public services and infrastructure represent another important impact area that might potentially be affected by the project. This includes elements such as other modes of public transportation, local traffic, utility networks, emergency services and public safety, urban landscaping and to a lesser extent education, health care, shopping, and employment opportunities, which can all be indirectly influenced by the project activities (EQI 2012: Section 5.1.1).

In the following, impacts are identified, described and evaluated for public utility diversions and traffic diversions during the pre-construction and construction of the Metro Line 3, Phase. Mitigation measures for the traffic diversion, which will be planned in the pre-construction phase and implemented during the construction phase of the metro line.

Meanwhile the utility diversions are mainly occur in the pre-construction phase, many of the potentially adverse impacts for the traffic of the project are expected to occur during the construction phase of the project. *Construction will disturb and delay the traffic flow that may affect the local communities and environmental conditions at the construction sites and may also directly or indirectly affect the surrounding areas. These activities include general construction work, such as excavation and foundation work; concrete mixing, casting, and curing operations; and the installation of the project's infrastructure components, which will require the use of heavy construction equipment.*

In addition, construction work includes a variety of secondary activities that might represent significant environmental risks. These include the transport and storage of construction material; the storage, transport and disposal of construction waste; and the on-site use or disposal of excavation waste. These are expected to produce air polluting emissions, noise, and dust that may impact environmental quality locally during the construction process (see relevant sections of impact assessment). The storage and maintenance of construction equipment at the site may also potentially cause local soil pollution problems (EQI 2012: Section 5.2.1).

8.10.2 Pre-Construction

<u>Assessment, Description and Evaluation of Impacts</u>

Utility Diversion

At the pre-construction stage, utilities will have to be diverted, and this might disrupt services in neighbouring buildings, lead to soil and water contaminations, as well as cause increased congestion. The latter will generate air and noise pollution, and increase commuting time. Utilities include water supply networks, sewer pipelines, telecommunication cables, natural gas pipelines, and overhead transmission lines including electric poles, traffic signals etc.

Utility diversion plans are important instruments for NAT to inform the population in time about possible nuisance which will emerge from the construction and are important plans for the utility companies for implementation of utility diversions in the pre-construction phase but also during the construction phase. In addition will the diversion plans inform the contractor about the type and dimension of the connecting utility to his construction sites.

Evaluation
Impacts resulting from utilities diversion on infrastructural services during the pre-construction phase provided to the local community will be short-term, direct, local to regional, temporary and reversible. This impact is therefore considered slight.

Traffic Diversion

Traffic Diversion Plans as they are proposed by the consultant SYSTRA in their feasibility study[17] have to be finalized and agreed before the construction starts. The diversion plans show the exact location of the Metro stations with the surrounding access streets and the proposed diversion of traffic is indicated for each diversion. The diversion plans are playing a major role in the public consultations, where the affected citizens are informed about the different activities emerging from the construction of the Metro line in their area of influence and therefore have to be finalized before the construction is taking place..
Traffic diversion plans are important instruments for NAT to inform the population in time about possible traffic nuisance which will emerge from the construction and are important plans for the Ministry of Transportation and its coordination partners for implementation of traffic diversion during the construction phase. In addition will the diversion plans inform the contractor about future traffic flow which must be coordinated with the traffic flows from the construction site.

Evaluation
Impacts resulting from traffic diversion during the pre-construction phase provided to the local community will be short-term, direct, local to regional, temporary and reversible. This impact is therefore considered slight.

<u>Mitigation of Impacts</u>

Utilities Diversion

Mitigation measures are of minor importance, because they can be seen as part of the general maintenance and operation activities of the Water and Sewage, Gas Companies, Telecommunication and the Electricity Companies of the District. NAT has to inform those companies in time and agree on a Coordination and Implementation Plan for the utilities of each construction location.

Traffic Diversion

There are no major mitigation measures to be implemented for the traffic diversion during the pre construction phase. Most important is the coordination of the diversion plans. NAT has to inform the Ministry of transportation in time and agree on the Traffic Diversion Plans of each construction location.

<u>Residual Impacts and Costs of applying mitigation measure</u>

Utilities Diversion

It can be expected that associated costs of applying mitigation measures are minor and no residual impacts will emerge.

[17] **GREATER CAIRO PUBLIC TRANSPORT STUDY UPDATE AND LINE 3 PHASE 3 DESIGN STUDY, SYSTRA , DECEMBER 2009**

Traffic Diversion

It can be expected that associated costs of applying mitigation measures are minor and no residual impacts will emerge.

8.10.3 Construction

Assessment, Description and Evaluation of Impacts

Utilities Diversion

Public utilities are essential and have to be maintained in working conditions during different stages of construction, by temporary/permanent diversions or by supporting in position. This is applicable for stations and parts of the metro line that would be constructed at grade due to the use of cut and cover methods. Impacts will include service disruption/reduction, and physical/environmental impacts. During this phase, all utilities have to identified and diverted, which may cause service disruptions and construction impacts such as noise, air pollution similar to those described in sections 8.2 to 8.5 (EQI 2012:Section 5.1.2.1). '

Impacts resulting from utilities diversion on infrastructural services during the construction phase provided to the local community can be assessed as minor and will be short-term, direct, local to regional, temporary and reversible. This impact is therefore considered slight.

Traffic Diversion

Construction activities are expected to have impacts on traffic conditions, especially in the vicinity of the stations, and along the viaducts. Despite the fact that these impacts are temporary, traffic problems frequently become acute in Cairo, especially when compounded with other matters unrelated to the Metro alignment. This will increase commuting time, and might affect solid waste collection services, as well as emergency service (EQI 2012: section 5.1.1.2).

The construction of the Metro stations and their alignments will affect all traffic modes including general car traffic, buses, taxis and freight and transport of material. In addition to road closure necessary for the construction of the Metro line stations and the elevated alignment areas, road closures may also occur as a result of a number of emergency situations including, but not limited, to: a utility failure, a road traffic collision, a security alert or emergency services incident response. Traffic conditions may change as such potential diversion routes may be subject to change

This impact for the traffic during the construction work is direct, indirect, reversible and temporary, and – even if this impact is of temporarily nature - is considered of serious significance because a lot of mitigation measures have to be planned and implemented to secure the safety of the population whether they are pedestrian or public and private traffic passengers. .

The impacts of polluting activities are expected to be largely localized, reversible, direct as well as indirect, but will only occur during the actual construction process. As such, since the air in the GCR is already degraded and noise levels are already in excess of allowable limits due to high traffic, these impacts are of minor significance. Although, many of these impacts are temporary, the construction of the stations takes about 2 years to complete, which will restrict access to various services, especially to local populations.

The daily transportation of workers and employees is not expected to have a significant impact on traffic during the construction phase. This impact will be both direct, indirect, temporary and reversible.
The impact of the transportation of construction material/waste on traffic will be more visible, given the fact that the incoming and out-going journeys will be more frequent.

Of greater concern is the necessity to divert traffic in the vicinity of the planned stations. As far as construction activities are concerned, however, transportation will be limited to workers, construction materials, and equipment. Most equipment will be mobilized and demobilized at the beginning and end of the construction stage only (EQI 2012: Section 5.2.2).

<u>Mitigation of Impacts</u>

Utilities Diversion

The mitigation measures for utilities diversions are rather technical and will not be outlined in this document. For those, reference is provided to the Systra Feasibility Study “New Feasibility Study, Volume 6/7 – Utility Drawings.

Traffic Diversion

The following mitigation measures concentrate on the proposals for traffic diversion plans for each station on the Metro Line3, Phase 3.

Traffic Diversion Plans for Phase 3A
Diversion Plans for the Metro Stations and the at grade level and elevated alignments for the Metro Line 3, Phase 3 were elaborated by SYSTRA[18] and were approved by NAT. The report highlights the traffic diversion needed for construction of civil works for the four stations, where modifications in corridors were studied to keep as much as possible sufficient vehicular movement with minimum impacts.

Diversion plans for Phase 3A, line.3 from Nasser station to Kitkat station comprises four stations and the Kitkat diversion shaft, These stations are as follows:

1. Nasser station.
2. Maspero station.
3. Zamalek station.
4. Kitkat station and diversion shaft.

[18] **Diversion Studies Traffic Diversion Report, 01-12-2010**

From those, not all diversion plans will be outlined in this study. Only for those which are creating some major traffic diversion activities, traffic diversion plans are added. In case of more detailed information for all stations, the reports can be obtained by SYSTRA.

Nasser Station

The Nasser station is located at 26th of July street to the east side of the High Court the traffic diversion at Nasser station location, is going to utilize most of the street in addition to the parking area beside the High Court at the intersection of 26th of July street and Champollion Street. The traffic diversion plan suggested for Nasser station is presented in the following drawing.

The drawing indicates that the traffic in the 26th of July street will be diverted mainly in Champollion Street up to its intersection point with Mahmoud Bassiony Street where parking will be prohibited completely at that section of Champollion Street, street width at that section ranges between 12 to 15 meters which represents four traffic lanes, then traffic will follow Mahmoud Bassiony Street up to Abdel Moniem Ryad Square then back to Ramsis Street. Tallat Harb Street could be also used as an alternative route up to Tallat Harb Square, then traffic will follow Mahmoud Bassiony street as mentioned before up to Abdel Moniem Ryad square then back to Ramsis Street.

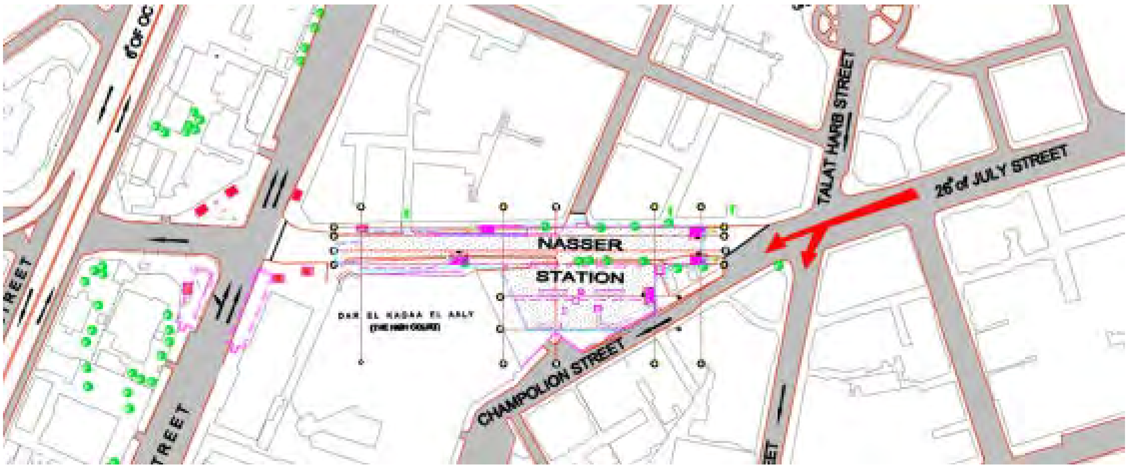

Figure 8-25: Traffic Diversion at Nasser Station Location

Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Maspero Station

The Maspero Station is located at 26th of July street to the west side of its intersection with El Antkhana Street. Most of the station is located outside the 26th of July carriage way as shown in the following drawing, where the cinema Corsal and other storage buildings (no residential) will be demolished and there land will be expropriated to be used for the station.

Figure 8-26: Traffic Diversion at MasperoStation Location
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3

Phase 3 Design Study, 2010
Traffic diversion doesn't put a major disturbance to the traffic, because during construction, the 26th of July street in front of the station will be 5.0 meters width instead of 5.10 to 6.50 meter at the current situation, which represents 2 traffic lanes.

Zamalek Station
The Zamalek station is located at Ismail Mohamed street in front of the Algerian Embassy and the Spanish Embassy. During construction, Ismail Mohamed street from Brasil Street to Ahmed Heshmat Street will be completely utilized.
The suggested traffic diversion during construction of Zamalek station is presented in the following drawings:

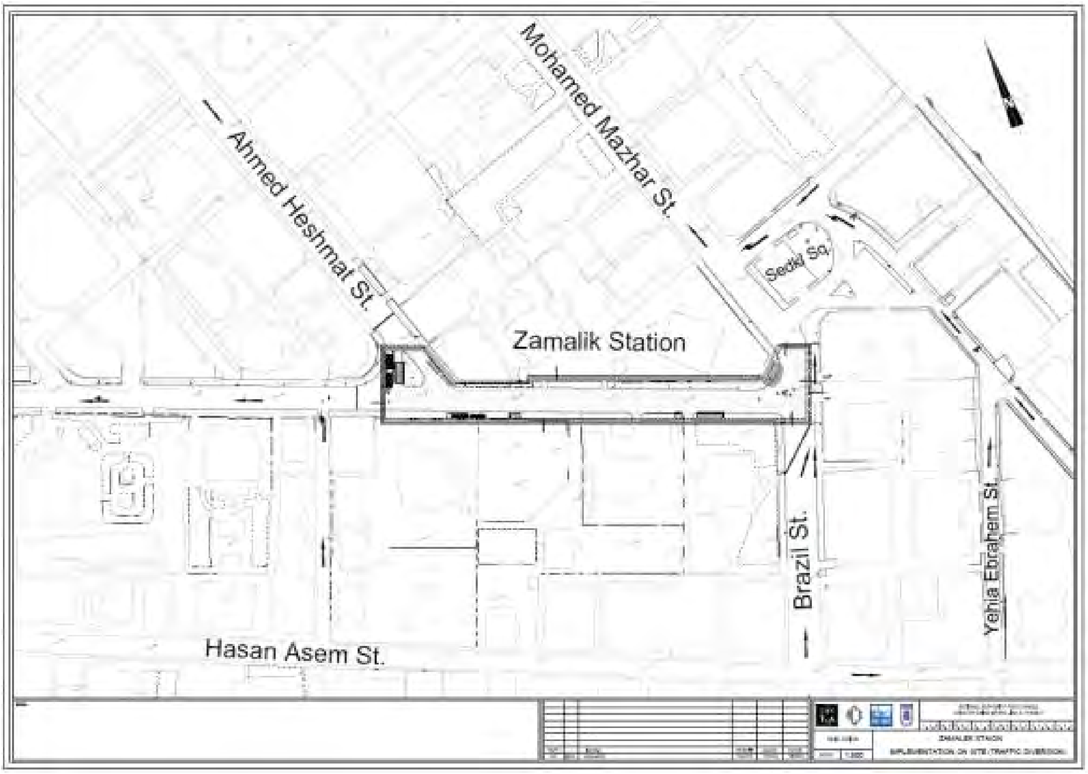

Figure 8-27: Traffic Diversion at Zamalek Station Location
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

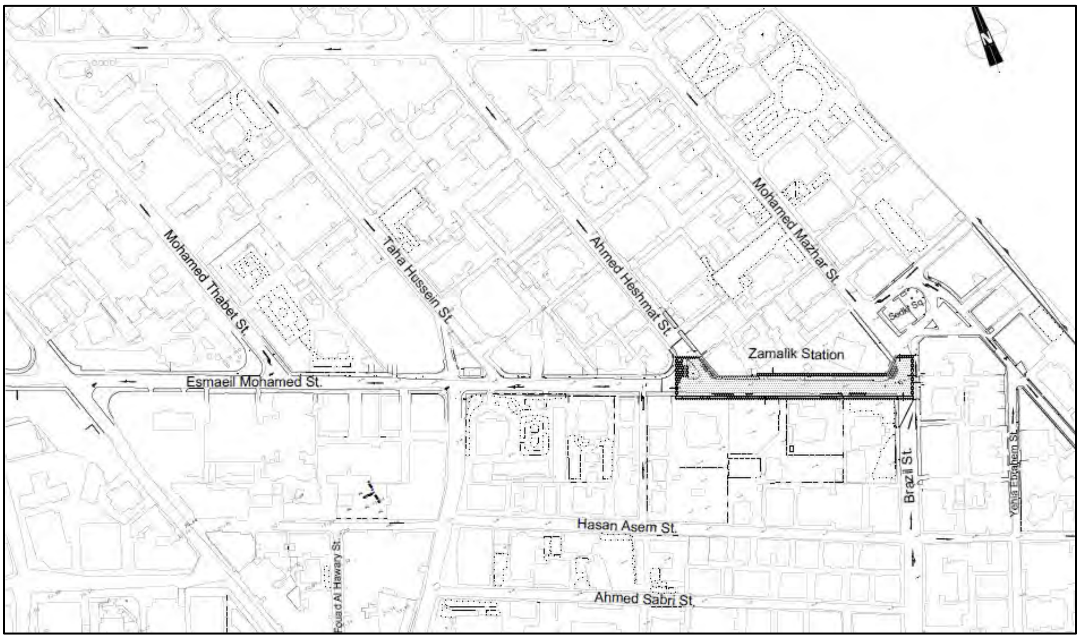

Figure 8-28: Traffic Diversion at Zamalek Station Location
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

The diversion includes the following

- Intersections between Ismail Mohamed street Ahmed Heshmat Street will be closed during construction

- Intersection between Ismael Mohammed >Street and Brasil Street will have a one way lane of about 3 m for cars coming from the Brasil Street to Mohammed Mazhar Street. Traffic from Ismail Mohamed street will be still a one way street

Kitkat Station

The Kitkat station and the diversion shaft are located at Sudan street at its entrance from Kitkat square. The station and diversion shaft are going to utilize Sudan street carriageway for about 550 meters length. The station will be constructed in two phases ,each phase will utilize two thirds of the carriage way.

Phase (1):

The diversion plan demonstrates, that the traffic from Nile Cornish –Embaba side and coming from Sudan street will utilize the north side of Sudan street in two lanes at about 7.0 meters width. The remaining traffic coming south side of the area between Sudan street and Ahmed Orabi street is going to use Mohamed Roshdy street-Omar Toson street-Ibn Khaldon street-Hassan Amin street-Abdel Aziz Tallat Harb street up to Galal El Din El Hamamsy street. While the traffic from Sudan street and coming from Nile Cornish will follow Galal El Din El Hamamsy street-Al Alamin street up to the two roads between El Awkaf Residential Buildings and Ministry of Culture, OR Mohamed Roshdy street up to the Cornish. The Al Alamin street carriageway width is about 14.0 meters at that section. The parking and informal workshops (on-street workshops for maintenance of vehicles) should be prohibited.

The two roads between Al Awkaf Residential Buiildings and The Cornish have carriageways of 12.0 & 14.0 meters width. Parking should be prohibited at both streets. The traffic diversions in this phase 1 are presented in the following drawing.

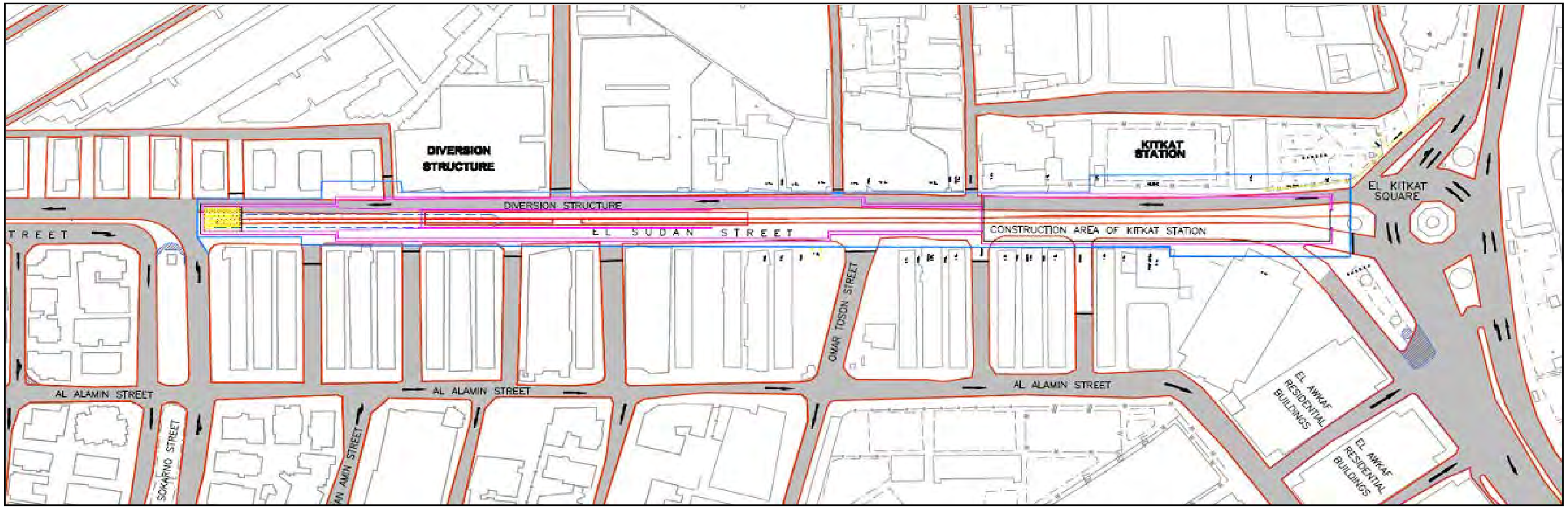

Figure 8-29: Traffic Diversion at Kitkat Station Location (Phase 1)
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

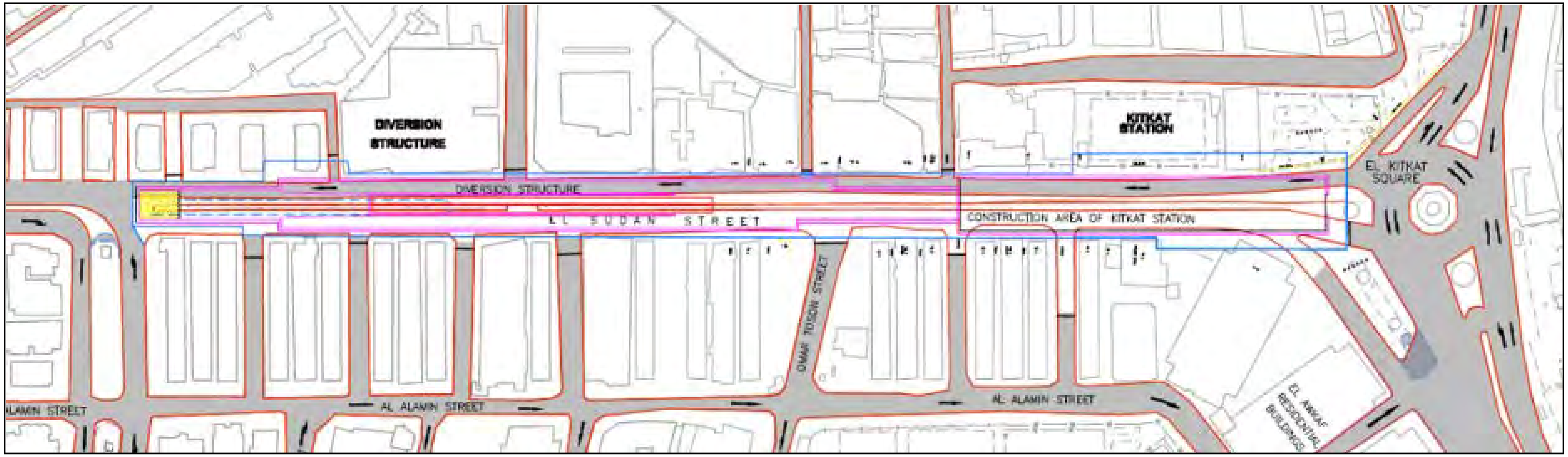

Figure 8-30: Traffic Diversion at Kitkat Station Location and Diversion Shaft Phase (Phase 1)
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Phase (2):
In this phase, the traffic from Nile Cornish –Embaba side and coming from Sudan street will utilize the south side of Sudan street in two lanes at about 7.0 meters width. The remaining traffic coming from south side of the area between Sudan street and Ahmed Orabi street is going to use Mohamed Roshdy street-Omar Toson street-Ibn Khaldon street-Hassan Amin street-Abdel Aziz Tallat Harb street up to Galal El Din El Hamamsy street.

Whilst the traffic from Sudan street and willing Nile Cornish will follow Galal El Din El Hamamsy street/Abdel Aziz Tallat Hrab street-Al Alamin street up to the two roads between El Awkaf Residential Buildings and Ministry of Culture, OR Mohamed Roshdy street up to the Cornish.

Traffic diversions in this phase 2 are presented in the following drawings.

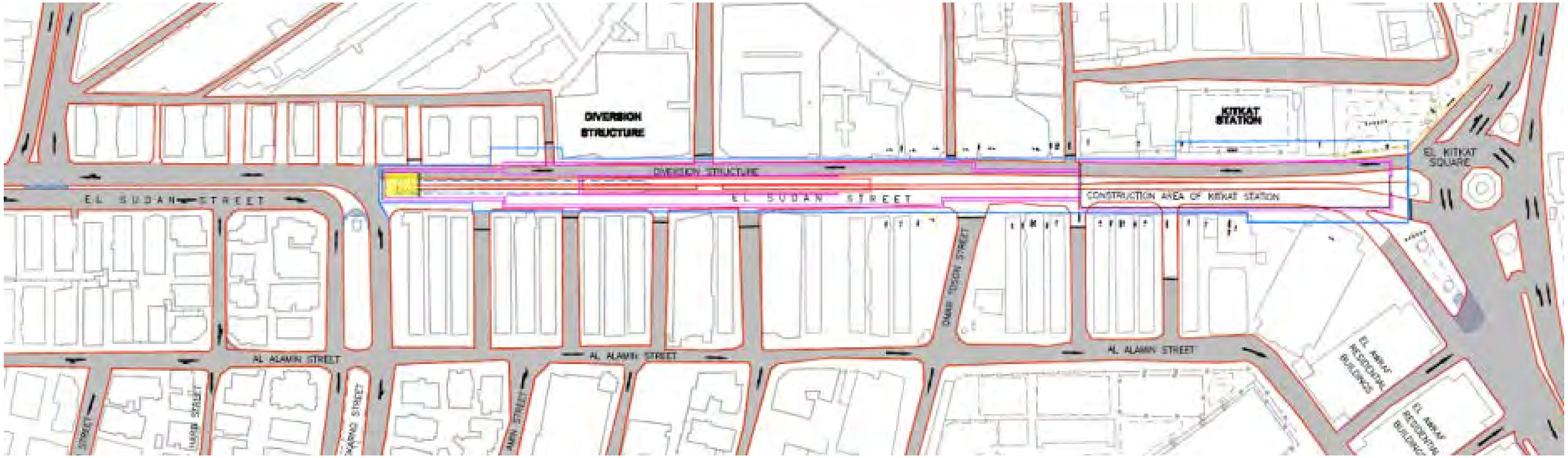

Figure 8-31: Traffic Diversion at Kitkat Station Location (Phase 2)
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Diversion Plans for Phase 3B

Diversion plans for Phase 3b, line.3 from Sudan station to Rod El Farag station comprises six stations. These stations are as follows:

1. Sudan station
2. Imbaba station
3. El Bohi station
4. El Kawmia station
5. Ring Road station
6. Rod El Farag station

From those, not all diversion plans will be outlined in this study. Only for those which are creating some major traffic diversion activities, traffic diversion plans are added. In case of more detailed information for all stations, the reports can be obtained by SYSTRA.

Sudan Station

Sudan station is located at sudan St. in front of the industrial school.

The station is going to utilize most of Sudan St., and will be constructed in two phases. Phase (1)

Traffic diversion in this phase is presented in the following drawing.

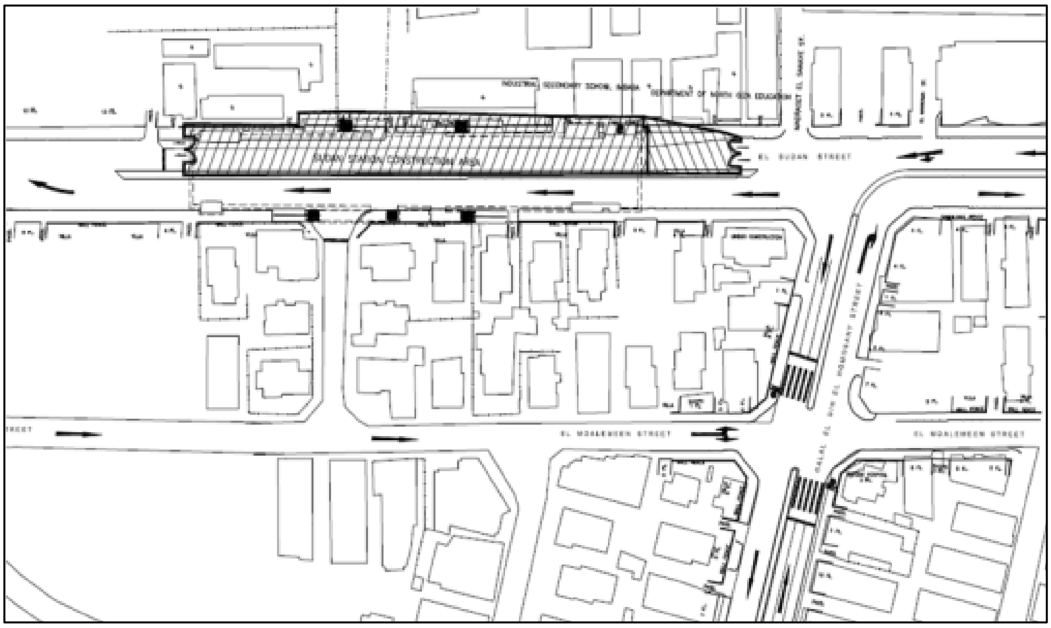

Figure 8-32: Traffic Diversion at Sudan Station Location (Phase 1)

Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Where the traffic from Kitkat Square side and coming from Al Matar St. side will be diverted to the other side of Sudan St. and then back to its original path after the public transport authority garage entrance. Whilst the traffic from Al Matar St. side and coming from Kitkat Square side will be diverted to Moalmeen St. up to its intersection with Galal El Din El Homosany St. , where traffic signal will be integrated to regulate the traffic at the intersection, then the traffic will follow Galal El Din El Homosany St. and back to Sudan St.

Phase (2)

Traffic diversion in this phase is presented in the following drawing.

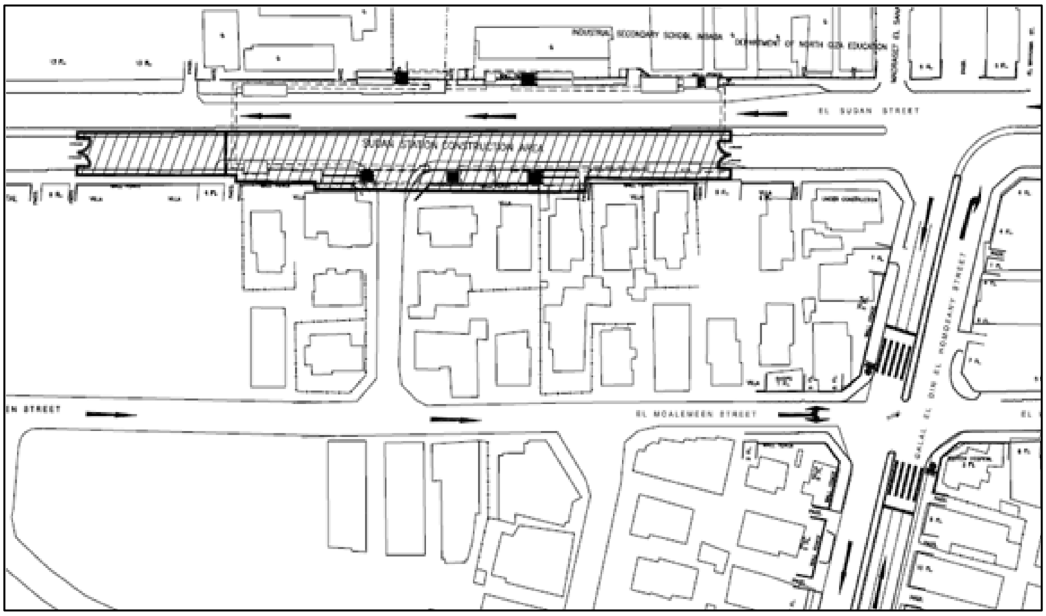

Figure 8-33: Traffic Diversion at Sudan Station Location (Phase 2)
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3

Phase 3 Design Study, 2010
The traffic from Kitkat Square side and willing Al Matar St. side will be back at its original side of Sudan St.. While the traffic from Al Matar St. side and willing Kitkat Square side will be diverted to El Moalemen St. up to its intersection with Galal El Din El Homosany St. and then back to its original path at Sudan St. .

Imbaba Station
Imbaba station is located in the Imbaba District beside the ENR railway line. No traffic diversion is needed for the station.

El-Bohi Station
El Bohi station is located in the Imbaba District, along El Bohi Street.

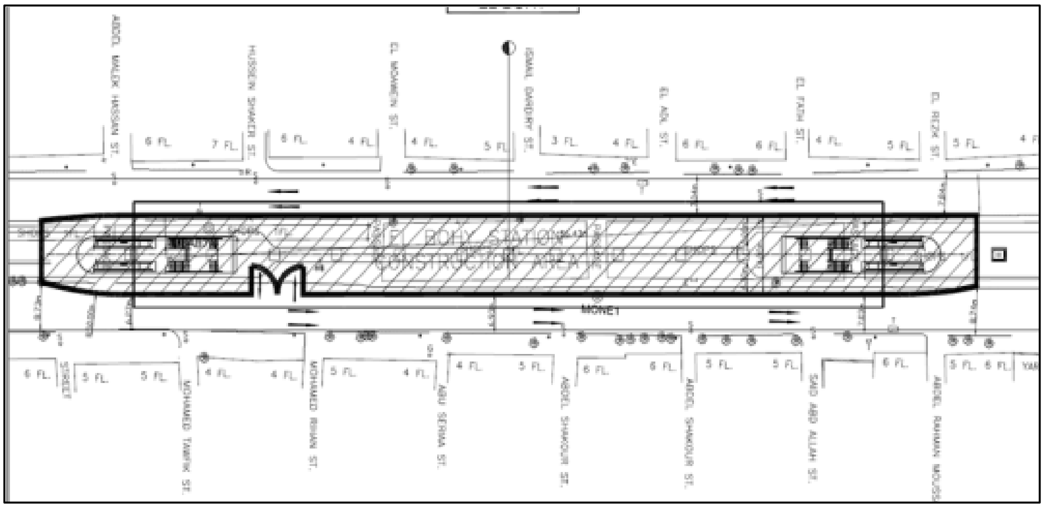

Figure 8-34: Traffic Diversion at El Bohi Location
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

The station is going to utilize only extra 3 meter out of the intermediate median width both sides of the street during construction of the elevated structure footings, columns and superstructure. This means the traffic will keep the same direction as it is at the current time as indicated in the attached drawing.
The station is going to utilize the distance of 150 meters length of the intermediate median, added to this 3 meters both sides to put the outer working area boundaries during the construction period. Due to the reduction in the carriage way width of El Bohi Street through the construction area, parking must be prohibited throughout the mentioned area.

El Kawmia Station
El Kawmia station is located in the Imbaba District, in el Kawmia El Arabia Street. The construction of the station is going to utilize 14.00 meters from the street including the intermediate median. The remaining width of the carriage way ranges between 7.14 & 9.94 meters both sides which suit the existing traffic, parking will be prohibited within the station construction site.
The drawing below represents el Qawmia station implementation on site.

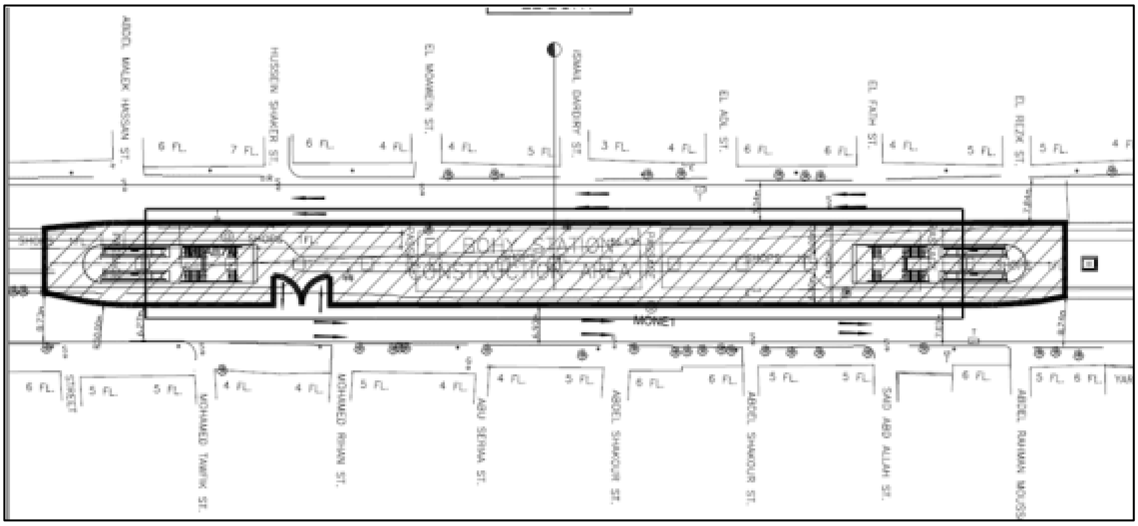

Figure 8-35: Traffic Diversion at El Kawmia Location
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Ring Road Station
The Ring Road station is located at the intersection between metro line 3 and the Greater Cairo Ring Road. The following drawing represents the proposed ring road station general layout plan.

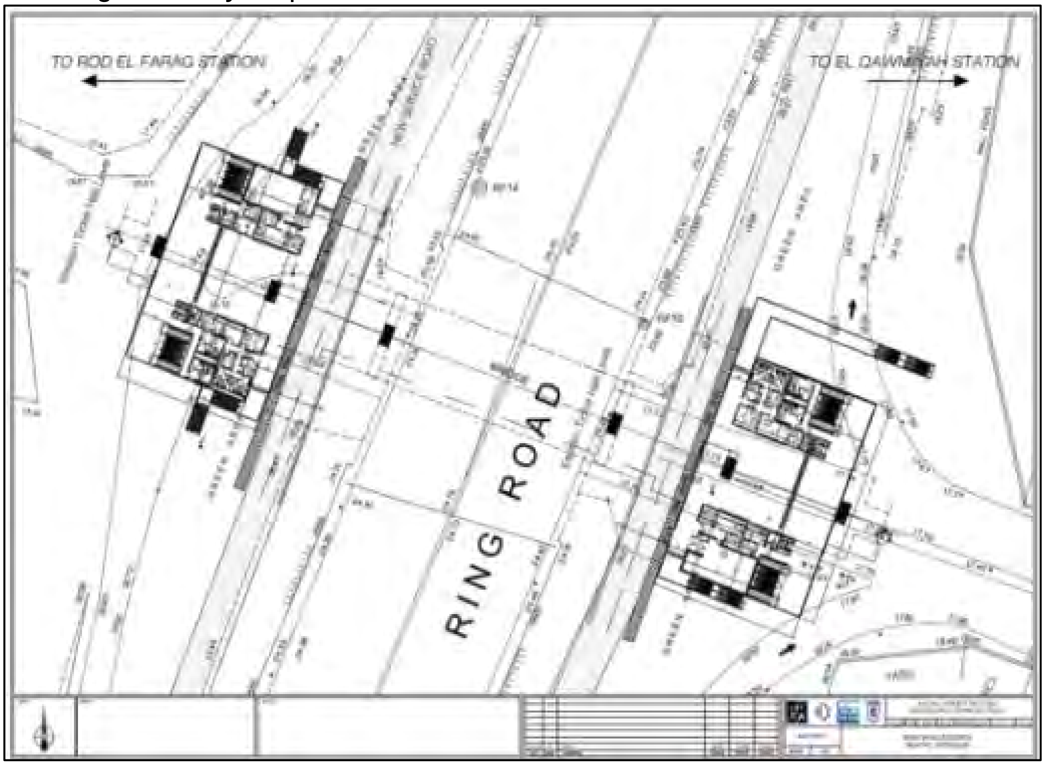

Figure 8-36: General Lay Out Plan of the Ring Road Station
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

The station is still subject to further investigation from the general authority for roads and bridges as well as method of construction of the station. A diversion plan therefore is not yet available.

Rod El Farag Station
The Rod El Farag station is located in agricultural land. It will be connected to a future highway. No traffic diversion is required for the station at the moment. The following drawing represents the station general layout plan.

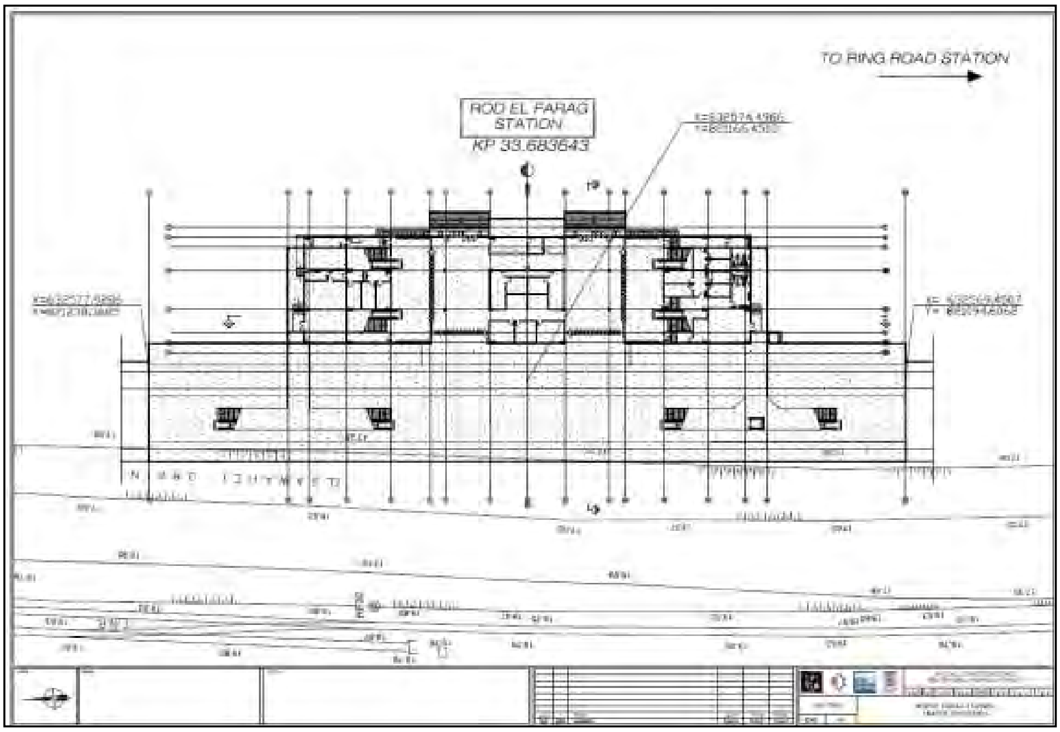

Figure 8-37: Traffic Diversion at El Kawmia Location
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Traffic Diversion Plans for Phase 3C
Diversion plans for Phase 3c, line.3 from Tafikeya station to Cairo University station comprises 5 stations and. These stations are as follows:

1. Tafikia station
2. Wadi El Nil station
3. Gamet El Dowal station
4. Boulaq El Dakrour station
5. Cairo University station

From those, not all diversion plans will be outlined in this study. Only for those which are creating some major traffic diversion activities, traffic diversion plans are added. In case of more detailed information for all stations, the reports can be obtained by SYSTRA.

Tawfikia Station
Tawfikia station is located in Al Rashed St. in front of Terssana sporting club, crossing Ahmed Orabi St. (direction of traffic from Sudan St. into Sphinx Square) and ends at the edge of the intermediate median of the other side of Ahmed Orabi St. The station will be constructed in three phases:

Phase (1):
Phase 1 will be mainly inside Ahmed Orabi St´s median and will not affect the existing traffic. The traffic diversion in this phase is presented in the following drawing.

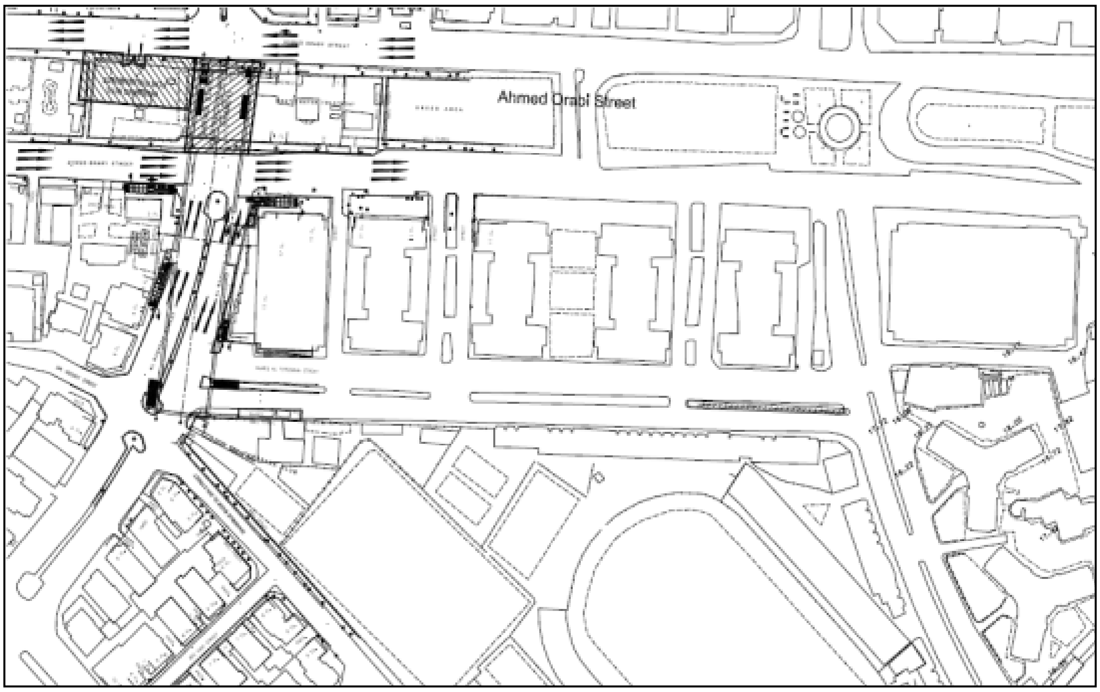

Figure 8-38: Traffic Diversion at Tawfica Location (Phase 1)
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Phase (2)
During this phase construction of the station will utilize most of El Rashed St. between Sharq Al Terssana St. and Ahmed Orabi St. The traffic of Ahmed Orabi St. from Sudan St. side and coming from Ahmed Orabi St. side will be diverted into the intermediate median.

There will be a 13 meter carriage way width available at the narrowest section of Ahmed Orabi St. Parking must be prohibited within the diversion stretch of Ahmed Orabi St. The traffic at El Rashed St. from Wadi El Nile St. side and coming Ahmed Orabi St. will be diverted into Sharq El Tressana St. up to it's intersection with Al Fanan Salah Jahen St. then to Ahmed Orabi St. Parking must be prohibited at Sharq El Terssana St . The traffic diversion from Ahmed Orabi St. and coming from Wadi El Nile St. will use the same route in the other direction.
Traffic diversion in this phase is presented in the following drawing.

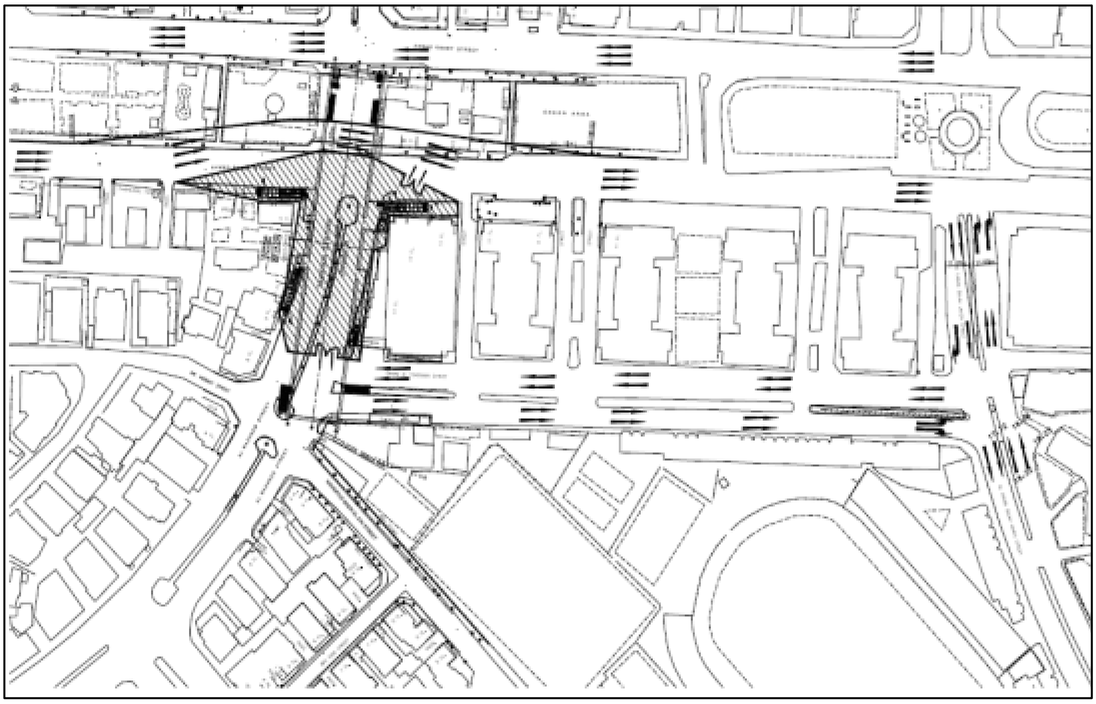

Figure 8-39: Traffic Diversion at Tawfica Location (Phase 2)
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Phase (3)
During this phase most of El Rashed St. in front of El Terssana Sporting Club and Sharq El Terssana St. will be closed. The traffic from Ahmed Orabi St. side and coming from Wadi El Nile St. will use 7.00 m carriage way at the narrowest section in El Rashed St. where parking will be prohibited at that section
The traffic from Wadi El Nile St. side and coming from Ahmed Orabi St. will be completely closed during construction of this phase. Traffic diversion in this phase is presented in the following drawing.

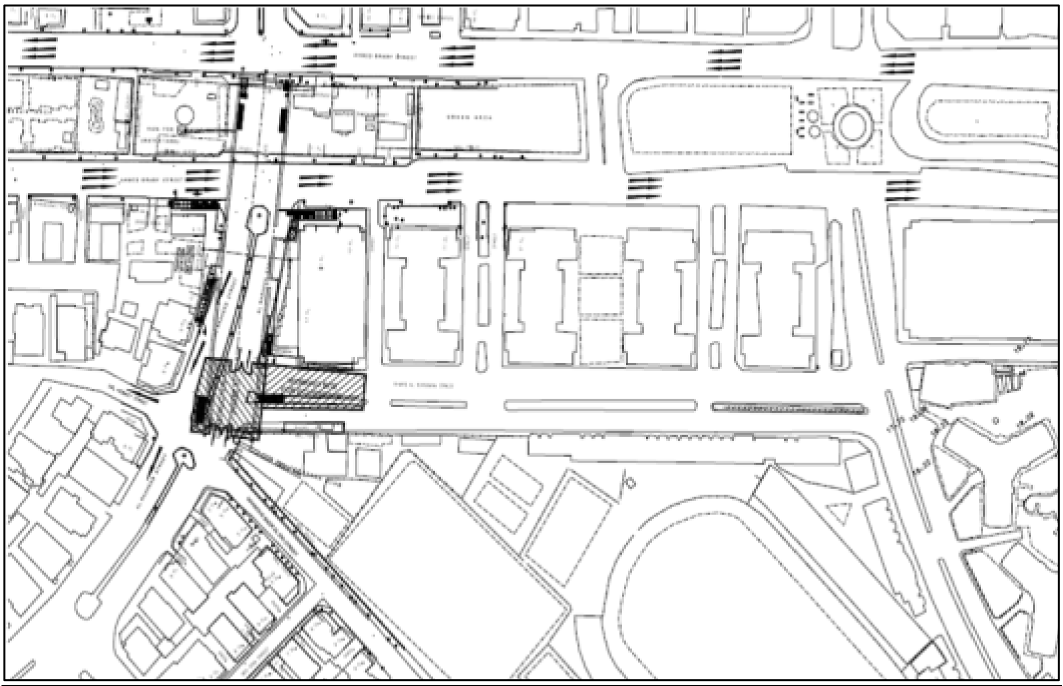

Figure 8-40: Traffic Diversion at Tawfica Location (Phase 3)
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Wadi El Nil Station
Wadi el Nile station is located at Wadi El Nile street between Ezz El Arab st. and Shehab St. The station is going to utilize most of the street during construction.

The following drawing represents the traffic diversion, where the traffic from 26 July Street tunnel and coming from Gamet El Dewal El Arabia St. will be diverted into Shehab St., Lebanon St. then to Ezz El Arab St. and back to Wadi El Nile St. up to Gamet El Dewal El Arabia St. .
The traffic from Gamet El Dewal El Arabia St. and coming from 26 July st. tunnel will follow the existing U turn between El Batal Ahmed Abdel Aziz St. and Sphinx Square and then into El Hegaz St. to Mohamed Badr El Din St. up to it's intersection with Ali Abdel Halim St. to Wadi El Nile tunnel. .

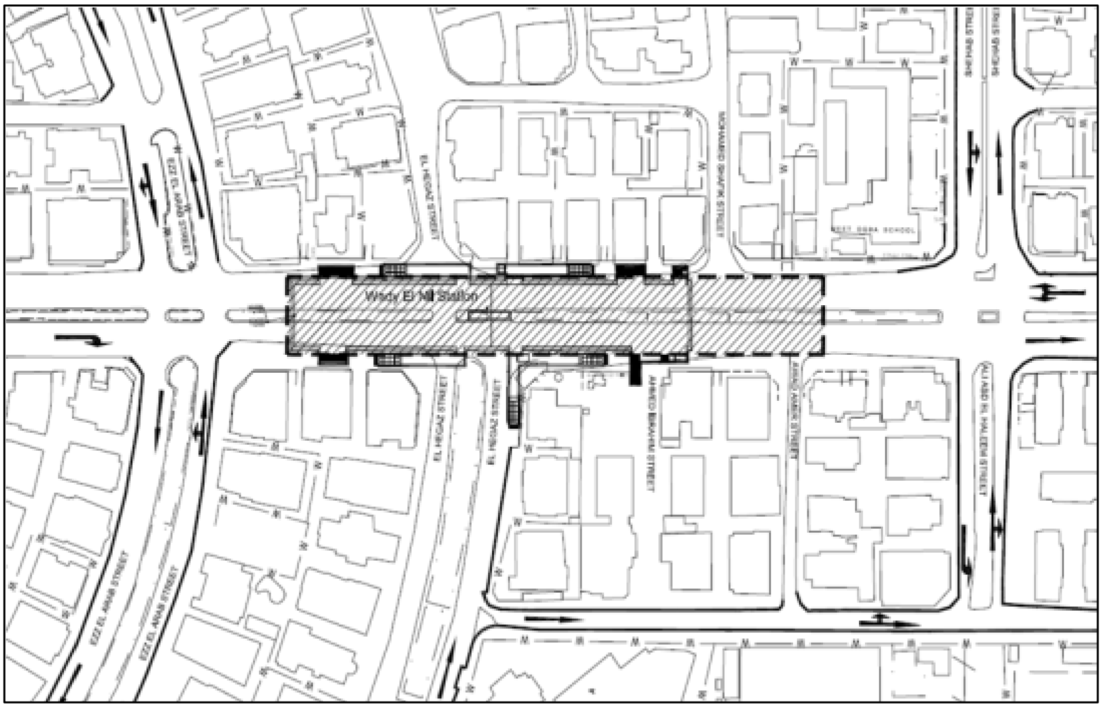

Figure 8-41: Traffic Diversion at Wadi El Nil Location
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Gamat El Dewal Station

Gamat el Dewat el Arabia station is located at Gamat El Dowel El Arabia street between Mohy el Din Abou El Ezz st.and Soliman Abaza St. The station is going to utilize the east side of the street for about 200 meters length and the station and it's access will be constructed in three phases.

Phase (1)

The traffic from Sudan St. side and coming from 15th of May elevated road side will be diverted into the existing median. 12 meters carriage way will be available for the traffic during that phase. The other side of the street serving the traffic from 15th of May elevated road and coming from Sudan St. side will be kept as existing situation. Traffic diversions in this phase is presented in the following drawing.

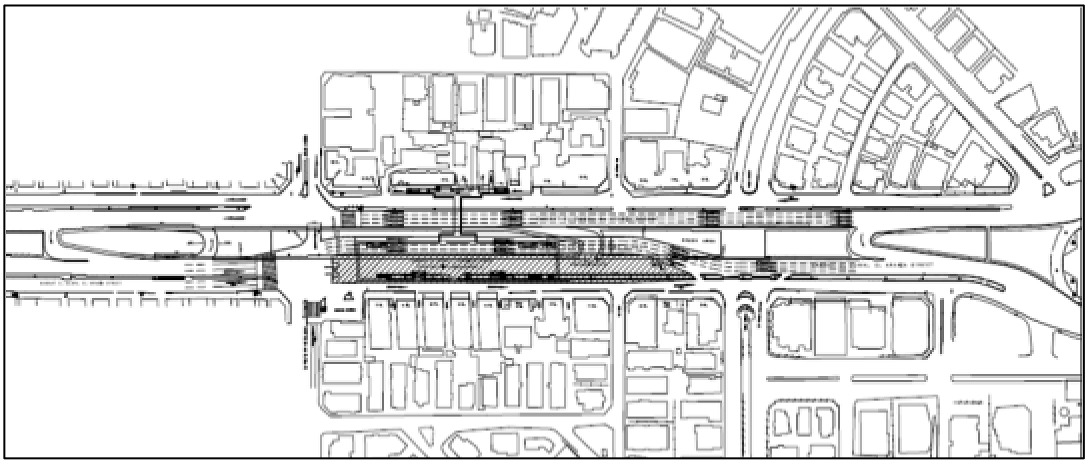

Figure 8-42: Traffic Diversion at Gamat El Dewal Location (Phase 1)
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Phase (2)
During this phase the traffic from Sudan St. side and coming from 15th of May elevated road side will be back at its existing situation, where a 11 m carriage way in Gamat El Dowel El Arabia street will be serving the traffic in this direction. The other side of the street, serving the traffic from 15th of May elevated road side and coming from Sudan St. side will remain according to its existing situation.
Traffic diversions in this phase is presented in in the following drawing

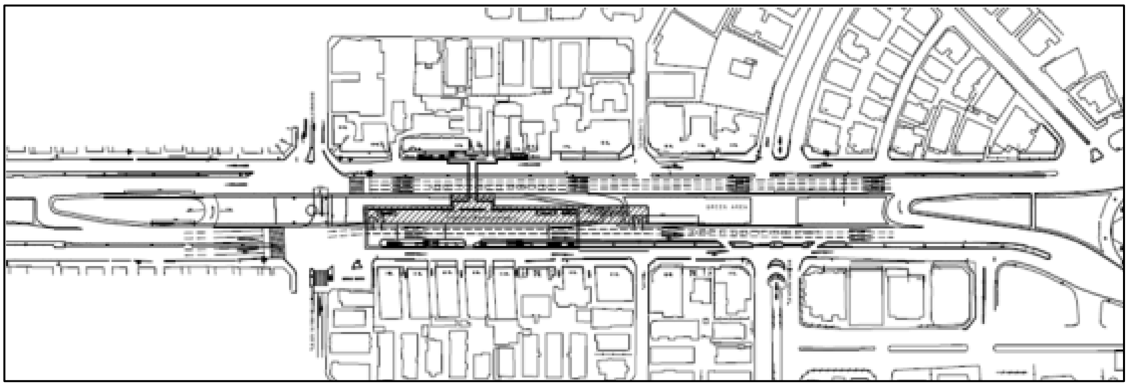

Figure 8-43: Traffic Diversion at Gamat El Dewal Location (Phase 2)
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Phase (3)
During this phase, the traffic from 15th of May elevated road side and coming from Sudan St. side will be diverted into the existing median side. A 14.00 m carriage way will be available, serving this direction of traffic during this phase.
The traffic from Sudan St. side and coming from 15th of May elevated road side will be served by 11 m carriage way in Gamat El Dewal El Arabia St. as in phase (2) .

Traffic diversions in this phase is presented in the following drawing.

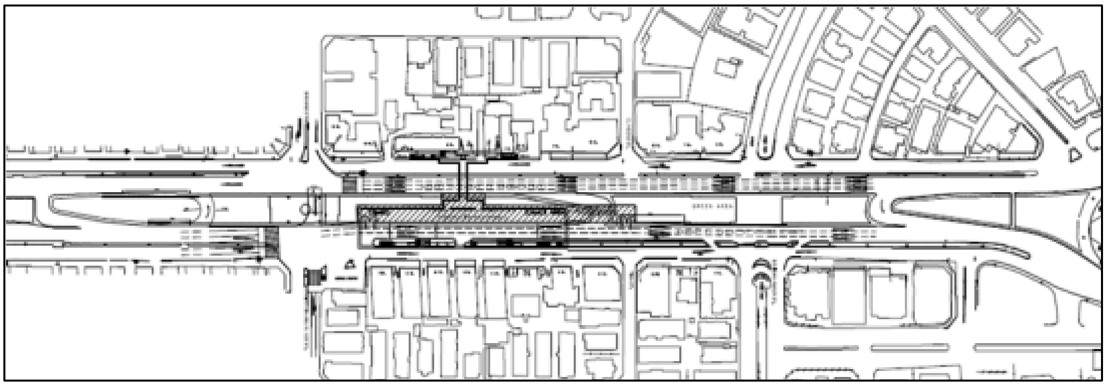

Figure 8-44: Traffic Diversion at Gamat El Dewal Location (Phase 3)
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Boulaq El Dakrour Station
Boulak el Dakrour station is located within the vicinity of al Zomor Canal. Construction of the station will have minimal interfacing with the Zomor canal street.

The following drawing represents the station general layout plan.

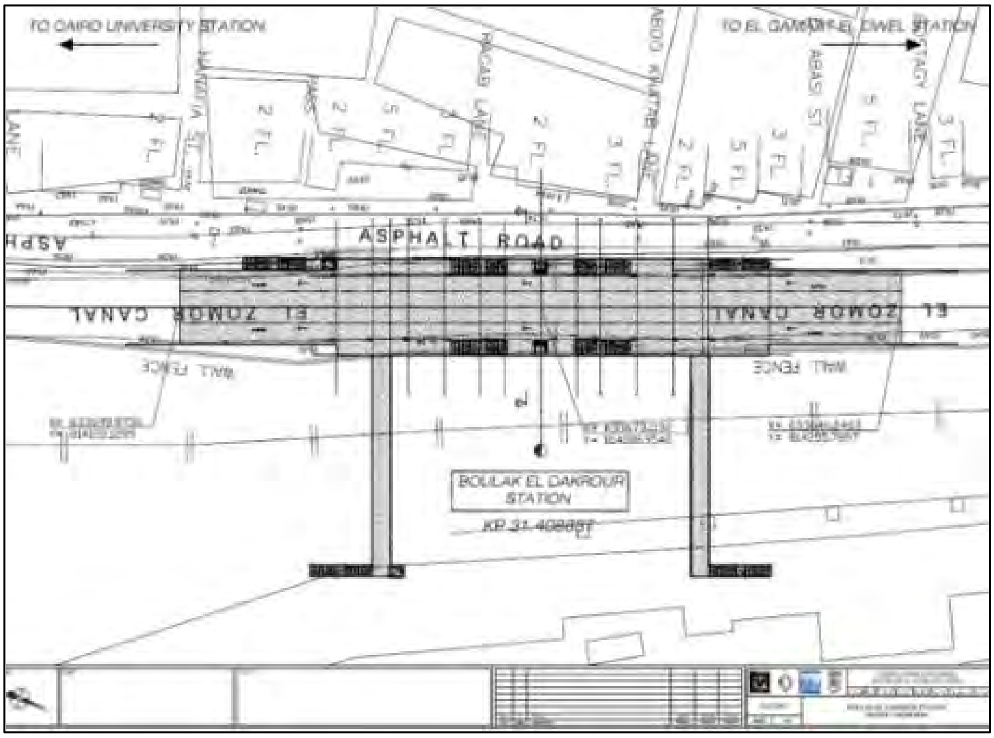

Figure 8-45: General Layout Plan Boulaq El Dakrour Location
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Cairo University Station
The Cairo University station is located in the south direction of existing Cairo University line number 2, along Tereat El-Zomor Street, and beside the E.N.R Railway Line. The station will not affect Tereat El-Zomor street during construction. The street carriage way within the station at construction site will remain according to the existing situation, so no traffic diversion is required during construction of the station.

The traffic diversion in this phase is presented in the following drawing.

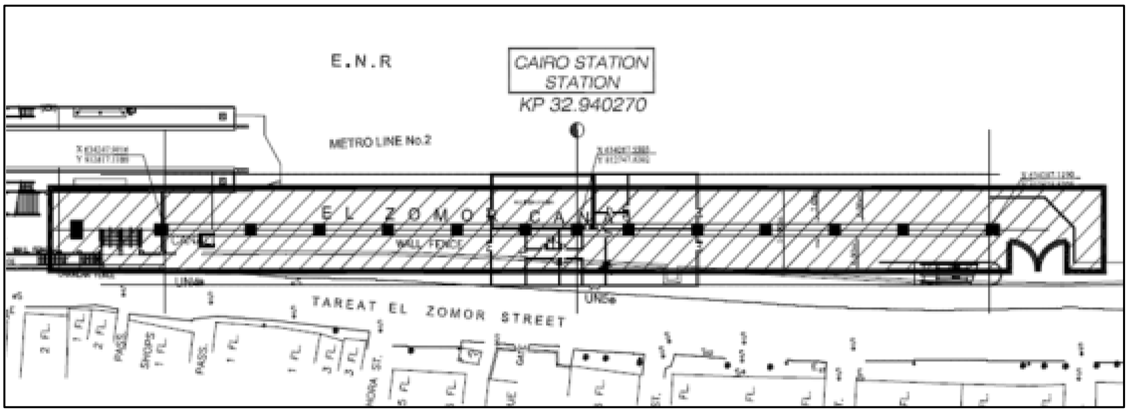

Figure 8-46: General Layout Plan Cairo University Location
Source: SYSTRA, Greater Cairo Public Transport Study Update and Line 3 Phase 3 Design Study, 2010

Traffic Management

An effective traffic management during the traffic diversion period has to established, which covers coordination between the responsible agencies and other involved traffic mode carriers, the development of a route management strategy for each affected station, an information strategy to convey the message of traffic diversion to the affected people, a plan for contingency measures, mitigating problems arising during the first weeks of traffic diversion and a monitoring tool which helps compensating time losses and allows adjustment of frequencies, allocation of resources or managed curtailment of services.

Traffic management strategies
Measures which enable a proper traffic management as coordination needs, route and information strategies, contingency provision and monitoring are discussed in the following.

Coordination
Coordination of the traffic situation in the pre-construction and construction phase will be done with the Traffic Department of the Ministry of Interior to plan for the measures to be taken for construction of each station or viaducts. These Measures include:

- *Temporary lane acquisition should be kept at a minimum to avoid affecting traffic flow.*
- *Traffic diversion planning.*
- *Use temporary steel structures such as levers and cranes to minimise construction equipment movement in the vicinity of construction sites.*
- *Use alternative routes to bypass affected sections of the road where the construction site will be located (EQI:2012: Section 5.2.2)*

In addition to the above measures which need coordination between the involved governmental parties, it is recommended to develop a route management strategy, which allows a smooth guidance of the affected population, private car users and involved private and semi-public transportation agencies during the construction phase.

Route Management Strategy
The development of a route management strategy which considers the public transportation services, private traffic and roads incorporated within the traffic diversion requirements for the station construction and alignments. The following tasks, which have to be coordinated between the traffic authority, NAT and the contractor should be agreed:

- Outline and explain the diversion routes and contingency measures in the event of prolonged congestion or delays being experienced.
- Outline and explain the diversion route and contingency measures in the event of emergency situations or scheduled events.
- Provide details of the enforcement measures agreed with the respective transport authority.
- Set out the monitoring strategy for the diversion routes.
- Provide a summary of key contacts to facilitate a fast and coordinated approach to route management.

It is intended that this strategy be used as a key reference document during the diversion period. To implement this strategy, close communication with the affected parties has to be installed. This will be achieved through a common agreed information strategy.

Information Strategy
On-going communications with stakeholders, especially members of the public, residents and businesses is required in order to reduce the amount of public/passenger confusion before and during the diversion, including (but not exclusive to):

- Email campaign in advance of the closure
- A5 flyer to be handed out by the bus drivers to the passengers
- Information in the media
- On bus announcements
- Notices placed at bus stops along the effected routes.

The responsible institution shall be the respective transport authorities in the Governorates. Furthermore have problems to be mitigated, resulting from first week introduction of the traffic diversion.

Contingency Measures and Monitoring
It can be expected that the first two to three weeks after the start of the diversion route is challenging regardless of the amount of advanced publicity and signing provided. Traffic requires time to settle into new network patterns, giving drivers time to work out alternative routes where possible.
After this time, if issues persist, then contingency measures may be required to mitigate these problems. Contingency measures in the event of a number of issues arising have to be identified and adequate mitigation measures have to be taken to solve problems have to be implemented accordingly. Although these measures may affect any transport mode, they are of particular concern to public transport lines due to the large potential impact on bus services and passengers.

Monitoring
Public and private bus services and operations are expected to be monitored through various means, such as Ministry of Transport, Transport Authority and Police in Giza and Cairo Governorate as well as with the private bus operators. Immediate reports about traffic line congestions and delays should be analyzed and necessary actions (e.g. change the frequency of busses, further deviation of traffic etc.) have to be taken. In the short term, operational staff will seek to ensure that bus services are maintained in the best possible way, where necessary avoiding the problem locations.
Once the cause of the congestion or delay has been identified, an agreed internal procedure between the involved parties is followed. This would review the reliability of each route, how much lost mileage is being generated (buses that do not reach the end of the scheduled route), how long the delays are and the affect on the wider network of making changes to bus services (for example, if required, running times will be reviewed and measures taken with the operators to restore reliability). This could include adjustment of frequencies, allocation of resources or managed curtailment of services.
This work should be carried out by the Traffic Authority, in close cooperation with the Ministry of Transport. All changes would need to be approved though the usual director-led sign off processes. However, it is expected that no alternations would be made to bus services during the first three or four weeks of operation of the diversion routes.

Residual Impacts and Costs of applying mitigation measure

Utilities Diversion
It can be expected that associated costs of applying mitigation measures for utility diversion are covered by the respective public and private companies responsible for the maintenance and operation of utilities. No residual impacts will emerge.

Traffic Diversion
Cost of applying mitigation measures depend on the actual implementation of the mitigation measures, which involve mainly the public authorities.

It can be expected that even a proper applying of the proposed mitigation measures for handling traffic diversion by the local authorities will left problems in form of traffic congestions, which are not all monitored and mitigated. This can be expected, as long as the control mechanisms from the governorate for traffic handling are not seriously improved. Furthermore is there no guarantee that the proposed diversion measures are respected in a proper way by the traffic causers.

8.10.4 Operations

Assessment, Description and Evaluation of Impacts

The operation of the stations will increase the flow of pedestrians at their respective locations. They will also likely serve as unofficial rallying, transmittal points for microbuses, taxis, or private vehicles, which will aggravate the traffic situation locally. On the other hand, part of the microbus, taxi or rickshaw drivers may lose some of their clientele, if the Metro satisfies transport demand in the areas trans-sected by Line 3 – Phase 3.

The affluence of pedestrians themselves may cause nuisances such as noise, crowding, waste generation and littering, and increased risks of accidents. Their presence and activities may also change the nature around some areas, such as Ismaïl Mohammed St. in Zamalek, which is a relatively quiet and residential street compared to most other areas along Phase 3. The case of that street is particular, because it is the only location selected for a station that is strictly residential.

Finally, it should be mentioned that the operation of the stations, and to a lesser extent, the Metro coaches, will add pressure on services such as sewage, power/energy and water supply.
These negative impacts are summarized as follows

- *Increased pedestrian traffic around metro stations may contribute to existing severe vehicular traffic problems and increase risk of accidents.*
- *Pressure on utilities.*
- *Microbuses, taxis or rickshaws will lose part of their clientele.*

Most of the above impacts can be mitigated to a certain extent, so they should be considered minor, with a few exceptions.
More on a positive side, the project will provide an efficient, safe, and comfortable mode of transportation for travellers between Downtown Cairo, and various areas of the Giza agglomeration close to its periphery (western Imbaba). It will extend into densely populated areas of the GCR that are not served or underserved by public modes of transportation. This may attract more commuters to using the Metro, which will contribute to reducing road traffic congestion, noise, and air pollution. The objective of constructing an efficient public transport system will be met.

These positive impacts of the Cairo Metro 3 Line 3 project can be summarized thus:

- *Improved public transportation service, reduced transfer time, more comfort and fewer accidents. Transfer of 60,000 travellers per hour instead of existing 5,000 travellers using buses and microbuses. The metro service will be cheaper, safer and better organized than the microbuses and pick up-trucks.*
- *Improvement of traffic flow within the metro corridor, since more people will use the metro instead of their cars in their trips.*
- *Reduction of vehicular/road traffic related noise levels; but increased noise levels for residents along the viaducts.*
- *Reduction in air pollution levels due to reduced vehicular exhaust emissions (EQI 2012: Section 5.2.2)*
- Behaviour change of the citizens which leads to a positive change of the character and image of the area.

<u>Mitigation of Impacts</u>

Mitigation measures will have to be implemented to reduce these aforementioned negative impacts. Such measures are of general nature and can be summarized as follows:

- Consequent follow up of citizen´s complaints to improve the service for the Metro line and keeping it an attractive alternative to other traffic modes;
- Regular and sustained dialogue between all public transport enterprises;
- Regular analysis of the citizens Metro user behaviour;
- Regular coordination meetings between all public authorities, concerned with the operation and maintenance of the Metro line.

Residual Impacts and Costs of applying mitigation measure

Cost of applying mitigation measures are mainly of administrative nature and incorporated in the annual household cost of the operator. Major external cost can emerge from the surveys, which should be implemented by a private consultant regularly every year and paid by the operator of the Metro line.

8.11 Urban Development

8.11.1 Identification of Impacts

Through applying different site visits and reviewing the EQI ESIA report, it was notable that the land use in the project areas is diverse according to the different urban character of the areas. The stations and alignments are located in high-density urban mixed use residential areas, industrial areas, commercial areas, suburban residential areas and rural and open spaces and therefore will have a different impact on the community.

The discussion of land use impacts is linked to the discussion of socioeconomic impacts which indicates that there is a high potential for the development of agricultural lands located near the Ring Road into residential areas. Not only this area of virgin urban development but also the development plans for the former Imbaba Airport and the connection of El Farag Station to the future express way might be affected due to the implementation of the project.

Analyzing the different urban situations, the ESIA team relied upon the description of land use and urban situation described in chapter 7.4. In additional, further information was added based on the consultants site visit and the land use maps of SYSTRA and GOPP. This information was analyzed and described in chapter 7.4, trying to provide a comprehensive picture of the actual and planned land use pattern in the project area. Based on this information, this chapter describes the impacts of the provision of the Metro Line 3, Phase 3 regarding:

1. Change of Land use activities and real estate conditions
2. Change of community character
3. Recreational improvements

As identified in chapter 7.4, the provision of a new Metro line will influence the land use pattern, the community character, have an influence on the development of the areas with residential areas and facilities and influence the real estate market.

Main impact on land use can be expected in the semi-urban area on the Ring Road and El Farag station. The impacts inflicted by these stations on the land use development might be addressed as rapid changes from agricultural land into residential area.

8.11.2 Operations

<u>Assessment, Description and Evaluation of Impacts</u>

Community Change
The described types of rapid urbanization might have impacts which are mixed in nature as is also discussed in the socioeconomic impact analysis. This is due to the rapid change in the livelihood of community. The discussion regarding mixed nature impacts is further detailed in the following:

- On the one hand this can be seen as a positive effect, providing new markets and gaining of profit for farmers, selling their land. Owner of the agricultural lands will benefit due to the amazingly raise in the prices from 600 EGP- 3000 EGP per m^2. Owners of one floor mud houses will also benefit from selling their property and can expect a high price

- On the other hand the loss of most fertile arable agriculture land will reduce the possibilities for local food production and will increase the unemployment for farmers. Negative impacts Can be expected especially for the families and most vulnerable groups who will be deprived from their source of income

- In addition, the selling of land could create a huge squatter which might suffer inappropriate facilities as has happened before in Dar El Salam area in Line 1. The mentioned area here changed rapidly from agricultural to modernized area. At the beginning small buildings were constructed on the agricultural lands, following this small buildings rapidly became 10-14 floor buildings and the lands deteriorated. In addition, the quality of services and facilities is poor.

- The planned new urban structures of the Imbaba Airport project and the inter-connection of the Metro line with the existing Ring Road and the planned Express Highway will accelerate land use change especially in the Phase 3B area.

It can be expected that the change of the community behaviour is important in sub-urban and rural areas, where the Metro line will stimulate the development of new settlements, commercial activity and new traffic routes. The community will change their life style and can communicate easier by improved traffic possibilities.

As a negative impact, there is a fear from the “indigenous” residents in Zamalek that the community character of Zamalek with its noble traditional restaurants, villas and high class apartments might be changed by the increase of social variety stimulated by this public transport system. The concern here is with the community's ability to deal with change in a way that maintains or enhances its social and cultural characteristics.

Another reaction might be expected from the Boulac El Dacrour area, with its informal settlements. Here the acceptance of the Metro line is expected to be high, because its provides a cheap and comfortable transport means, the increase in business and the improvement of the accessibility between the Boulac and the Giza area.

Generally the impact on community change behaviour stimulated by this new traffic mode is a long term impact and can be seen positive, because it widens the communities livelihood. It can be expected that the increase of other social levels into closed societies as Zamalek will not disturb the exclusive character of Zamalek, but will increase business activities in the area and decrease the parking problem, created by the students.

Recreation facilities
Another impact, stimulated by the new Metro line is the improvement of recreational facilities as e.g. new greening and tree planting and – in direct connection with this – improved security of traffic (see also chapter 8.10) in the area. In connection with the project, the population can benefit from the recreation and urban landscaping facilities, provided with the construction of the Metro stations and their alignments (see chapter 8.7).

This impact is heavily influenced by the magnitude of physical loss of community components (e.g., removal of homes/residents, institutions), or changes in the community environment (e.g., visual intrusion, noise, air quality levels; demographic change etc.), the community will suffer from.

This impact is positive, because in most areas, where the planned Metro line will pass through, recreational facilities are poor or even missing.

Mitigation of Impacts

Mitigation measures proposed for impacts on land use are multi facetted, because it is not only the metro line who will have an influence on this phenomena, which is of major concern for the planning institutions in Cairo.

A proper land use plan is recommended, especially for the northern part of the Metro Line 3 Phase 3B and the negative impacts from the change of land uses from agriculture land into residential use.It is also recommended to combine this with an improved control of construction activities in this area.

Regarding the community change behavior, information campaigns for the population, especially in Zamalek is essential to increase the acceptance of the Metro station in this area. The proposed public consultations – as outlined in the Stakeholder Engagement Plan, ESIA Vol. 3 Appendix 1– are part of the first step in this direction.

Regarding the mitigation measures on recreation facilities, it can be expected thatnew and improved greenery and urban landscaping will be available for the affected population in the area with the construction of the metro station.

Residual Impacts and Costs of applying mitigation measure

It should be considered that impacts mentioned for the change in land use are difficult to be mitigated as they are not only a result of the project alone but resulted from the uncontrolled construction process which took place after the Revolution. This process can be observed all around Egypt.

8.12 Involuntary Resettlements - Including Vulnerable Groups

8.12.1 Identification of Impacts

Potential Impacts due to expropriation and resettlement activities:

- Community disturbance might result due to the expropriation activities
- Changing the environment of children, particularly, schooling and other recreational places allocated for them.

- Transferring the affected people to remote alternative might affect their business (owners of shops) or affect their living conditions.
- Applying the resettlement activities by force might cause problems with the community people, especially, after the revolution
- Lose of arable lands in the Ring Road might affect the community people as well, the land there is moving rapidly into construction lands. The compensation will not be addressed based on its new nature but it will be based on being an arable land
- Compensation might be of a low market price or the units provided as alternative units might be of a different social, standards.

Potential Impacts Resulted due to the Involuntary Resettlement
Resettlement and expropriation is one of the permanent impacts resulted due to the implementation of the project. The project will result limited impacts that might be summarized as follow:

- El Bohy street would induce the higher probability of causing the land acquisition and resettlement due to the station construction. The potential expropriated lands are located in the middle of street (market and a mosque). The market contains 166 shops rented from the governorate under Right to Benefit
- Potential loss of income during the construction phase in El Bohy street
- Maspero will result land acquisition for some shops and a cinema
- 28 Feddan in the Ring Road will be expropriated
- A parking area close to Dar El Qadaa will be also expropriated
- (Detailed expropriation maps and information will be added)

NAT has, with the assistance of consultants, developed a Resettlement Policy Framework (RPF) for the Metro Line 3 Phase 3 project. The RPF has been developed in accordance with World Bank Operational Policy 4.12 on involuntary resettlement, as well as Egyptian Law. This document is made available in ESIA Vol. 3 Appendix 4. A Resettlement Action Plan will be developed to put in place the necessary measures prior to construction start.

8.12.2 Pre-Construction

It is not anticipated that the pre-construction phase of the project will result in significant involuntary resettlement. Any resettlement that does take place should follow the provisions given below.

8.12.3 Construction

<u>Assessment, Description and Evaluation of Impacts</u>

Construction activities may lead to disruption of livelihoods, commercial activities and social services for some Project Affected People (PAPs) on different sections of the metro route. Any livelihood activity taking place within pre-construction/ construction area, or any roadside shops, regardless of their legal status, may need to be temporary interrupted or permanently relocated, resulting in temporary or permanently loss of income generation opportunities, need special attention. More details on PAPs is discussed in relevance to resettlement in the Resettlement Policy Framework (RPF) document (Vol. 3 Appendix 3) .

<u>Mitigation of Impacts</u>

The mitigation of impacts will be described in detail in the Resettlement Action Plan which is currently under development. This should be finalised and implemented prior to resettlement taking place.

Figure 8-47: El Bohy Market

Figure 8-48: El Bohy Market

Figure 8-49: Cinema in Maspero

Figure 8-50: Parking area close to Dar El Qadaa

Based on the entitlement characteristics, any one that might be affected due to expropriation should be compensated. Those who might be compensated can be summarized as follow:

1. Owners (lands- houses- movable assets…)
2. Commercial owners a who lose their source of income temporarily during the construction. For example a shop that is closed by the fence of the construction area.
3. The tenants of the lands, shops or houses

NAT does not provide any assistance to the affected people in terms of training or rehabilitation for the affected groups (which is not necessary for this project). That is mainly due to the provision of fair compensation that reduces any impacts result due to the implementation of the project. However for the compensation assistance the following procedures are adopted by NAT compensation committee:

- Seeking for appropriate alternative for routes in order to reach the maximum limitation for the affected areas
  - The route in Ismail Mohamed in Zamalek district
  - The route in El Bohy Street – Imbaba district
- Redesigning any parts of the route that might face any potential dense expropriation
  - Redesigning the route at the end of El Matar street in Imbaba

- Thinking about different strategies for compensation
  - For example, the market in El Bohy the compensation committee thought about rebuild it in a different place, or under the metro line in the same place as the metro will be viaduct and pay a daily compensation for the affected people during the construction for the loss of their business.

Residual Impacts and Costs of applying mitigation measure

Major if mitigation measures and site management practices are applied.

This discussion will cover the whole potential impacts resulted due to land acquisition and expropriation during the preparation of the project, during the construction and during

The estimated cost for applying the different activities related to the potential expropriation and land acquisition will be mainly based on:
1. Finding alternative units with the governorates
2. Negotiation with the land owners
3. Negotiation with Maspero Development company
4. Cost estimation for the shops located in down town in Maspero
5. Therefore, any estimations of the budget for such activities will not be based on a solid rationale

8.13 Socio-economic Effect

8.13.1 Identification of Impacts

The analysis of social impacts for any developmental project is the core process to address the points which might work for the benefit or against the project. The discussion of impacts will revolve about the following issues:

Type of impact according to its positive or negative nature

1. The potential **positive** impacts that might result due to the implementation of the project. If the potential impacts are of more value than the negative ones, then the probability of implementing the project is high. In order to identify the positive impacts all community stakeholders should be incorporated during the assessment, as well, the consultant design his analysis not only on the field results level but also on the level of the validity and the credibility of the data collected. This process if not well prepared, designed and applied, the risks of the project rejection by community might be high.
2. The potential social **risks** associated with a project and explores how to address them so as to achieve the project's development objectives. It is generally characterized by being of subjective nature.
3. The third type of impact that might be met in the project is the **mixed** in nature impacts. That type sometimes is positive while other time is negative. In the Metro line 3, this type will be tailored to cover the project area as it will be presented later.

Type of impact according to hosting communities

Communities that host the project in most of cases is affected either positively or negatively. Regardless of the benefit of any developmental projects, it was notable that waves of impacts might hit the communities, sometimes severely or gently. Thus, it is meaningless to describe the impact without the discussion of the hosting communities. During the description of the project areas, the nature of each area was illustrated densely. However, based on such description we ended to the following distribution of the areas that might be classified according to their socioeconomic characteristics, which might be affected due to the project, to the following:

- Class A: That is mainly Zamalek, Mohandseen and Gameat El Dewal El Arabia in Agouza and Dokki, 26 of July street. However, Zamalek has its own characteristics that made it a unique area that should be presented
  - Good dwelling and street conditioned
  - Excluding Zamalek, street are wide
  - Clear utilities mapping
  - Limited expropriation activities
- Class B: Kit Kat square of Sudan st, El Qawmia st, El Matar st. and El Bohy in Imbaba
  - Semi-urban areas
  - Densely occupied by microbus and Tuk Tuk
- Class C: the Ring road
  - Slum agricultural area with high potential for rapid unorganized urbanization
  - Agricultural land expropriation
- Class D: Boulak Abu El Ela and Boulak El Dakrour
  - Popular markets
  - Highly populated and congested areas
  - Olad bad conditioned dwellings

In order to discuss the impact in each area of the project that might be a long tiring process, so the study team tried to present some commercial areas versus residential area, high socioeconomic areas against low, intermediate and squatters. Only in case of finding any special or unique impact in one of the areas that should be highlighted densely. The following photos might reflect the social standard and characteristics of each areas. For further information, please see the chapter regarding project areas for more detailed information.


Figure 8-51: Zamalek old highly esteemed palace


Figure 8-52: Mostafa Mahmoud Square in Gameat El Dewal El Arabia


Figure 8-53: Gamaet El Dowal, looking northeast


Figure 8-54: 26th of July Street, looking west towards Zamalek


Figure 8-55: Sudan Street, off Kit-Kat Square, looking west


Figure 8-56: Matar St., northeast

Figure 8-57: Opening of the wstern ENR wall with Matar St

Figure 8-58: Location of El Bohy Station, above market in central reservation

Figure 8-59: Bolak Abu El Ela Commercial area

Figure 8-60: Boulak El Dakrour popular market

Type of impact according to its main theme

Socioeconomic impacts are not categorized as one type of impacts. But the following items are covered by this huge umbrella. Potential social impacts may range from the following issues:

1. The potential change in source of income
2. Job availability
3. Access to basic services and utilities
4. Reduction in income of microbus and Tuk Tuk drivers due to construction waste accumulation and traffic problems
5. Impact on health status and health seeking behaviors
6. Impacts on houses and dwellings due to the vibration
7. Potential subsidence for old dwellings
8. One of the main impacts result due to the current political status is the potential political tensions which affect directly the economic status

Due to this subjectivity that associates with the social impacts, the level of significance of the impacts was not done on numerical basis and was determined based on the Consultant technical judgment. The analysis of the impacts gave special attention to the area sensitivity and type of hosting community.

In assessing the significance of the impact distinction was made based on the impacts that are of most concern (need to be avoided, mitigated or compensated) and those that are considered to be less important because they are of temporary nature or because the affected groups will be able to cope with them. The following will be a detailed discussion for the socio-economic impacts and how to mitigate them in case of negative ones.

8.13.2 Pre-Construction

Some of the socio-economic impacts identified in relation to the project are of relevance in all stages of pre-construction, construction and operation. However, as they constitute the largest impact with long-term effect in the constructions and operations phases, these impacts are described in there.

8.13.3 Construction

Assessment, Description and Evaluation of Impacts

Table 8-10: Potential socioeconomic impact during the Construction phase based on their nature, duration and area

Type of impact	Class A Zamalek	Class A Gameat El Dowel	Class B Imabab	Class C Ring road	Class D Boulak El Dakrour	Class D Boulak Abu El Ela
During the construction						
The potential change in source of income	negative	negative	negative	**positive**	negative	negative
Job availability			**positive**	**positive**	**positive**	negative
Access to basic services and utilities	negative	negative	negative	negative	negative	negative
Reduction in income of microbus and Tuk Tuk drivers due to construction waste accumulation and traffic flow		negative	negative	negative	negative	negative
Impact on health status and health seeking behaviors	negative	negative	negative	negative	negative	negative
Impacts on houses and dwellings due	negative	negative	negative	negative	negative	negative

to the vibration						
Potential subsidence for old dwellings	negative				negative	negative
Impact on the political tensions	negative				negative	negative

The discussion of impacts results in two main potential impacts which are positive and negative in addition to the mixed in nature impacts. Moreover, the impacts might change due to the phase, construction or operation. The discussion of impacts will be directed to present positive impacts first as they will result no mitigation measures.

Potential Positive Socio-Economic impacts

The potential positive socioeconomic impacts are as follows:

- Enhancement of the source of income in those living in the Ring Road due to having some information about the construction of Metro line 3. Some of them started to develop small business in this area (small restaurants, cafes) to serve the potential workers. Yet, now they started gain profit out of their small business.
- Regarding job creation, this is mainly due to the nature of such projects that needs so many unskilled workers who might be emigrants from different governorates and settle in squatter areas i.e Ring Road, some of Imbaba areas close to the Ring Road and Boulak El Dakrour. In addition to the unskilled workers, highly skilled workers and administrative staff might work with the contractor. No exact figure was available but it is estimated to exceed 2000 workers of different types, skilled, unskilled, technical and high possession engineers.

Potential Negative Socio-economis impacts

It is predicted that the majority of developmental projects might result in minor negative impacts during the construction as it might be of a big disturbance to the community. In order to have a clear discussion of the negative impacts, they will be presented under the following titles:

1. Assessment and description of the impacts
2. Proposed mitigation measures
3. Cost of applying mitigation measure
4. Residual impact after applying the proposed mitigation measures

<u>Mitigation of Impacts</u>

In this section mitigation measures are proposed for the construction phase, accounting for the negative socio-economic impacts of the construction activities. The following potential socio-economic impacts were identified for the construction phase:

Potential change in source of income

- It was predicted that the source of income might be reduced on a temporary basis due to the construction activities. Some of the categories that might be affected are as follow:
  - Shops in Boulak Abu el Ela, Imbaba and Gameat El Dewal and Zamalek
  - Vendors in Boulak El Dakrour and Bolak Abu El Ela
  - Other economic activities i.e. clinics , medical centers that might be closed temporary by construction work
- The following mitigation measures are proposed:
  - A clear plan should be set in order to facilitate moving in different areas. That plan should contain some routes or access to the different economical activities
  - In case of affecting the access to different activities, fair market price based compensation should be paid prior to the implementation of the project
  - Alternative areas should be given to vendors to work in, especially instead of Bolak Abu El Ela street vendors
- The mitigation measures proposed are covered by the Resettlement Action Plan (RAP)

Job Availability

- The main unfavorable impact reported was the one mentioned in Bolak Abu el Ela in case of not having alternative market instead of the active area there. As well some of the expropriated shops hire old people who might not have alternative place to work in
- The following mitigation measures are proposed:
  - Another market should be prepared there for the vendors, especially if it is in the surrounding area,
  - For the old people, there should be some type of arrangement with the Social Insurance Department to provide them with a monthly financial support (especially because, they are not more than 5-10 people)
  - Encourage contractors and other service providers to use local employment during the construction phase
- The majority of these mitigation measures proposed are covered by the RAP

Access to Basic Services and Utilities

- Access to basic services (water supply, electricity, health services, etc) might be affected in the whole areas during the construction phase.
- The potential utilities diversity might also work against community people causing community disruption
- The following mitigation measures are proposed:
  - Minimize the areas occupied by the construction sites to a practical minimum and make sure that access to services is minimally disrupted, especially for local residents.
  - Proper and sufficient pedestrian crossing points, as well as entries and exists shall be designed carefully during construction phases.

  - The construction plan will also arrange to conduct the construction away from the seasonal activities e.g. utilize summer vacations to complete most of the air and noise generating activities when working next to schools.
- The mitigation measures proposed should be considered within the overall construction management process, and in particular included within the traffic management plan to be developed by the contractor.

Reduction in income of microbus and Tuk Tuk drivers

- This potential impact is due to construction waste accumulation and traffic flow, hence limiting the usual activites of microbuses and Tuk Tuks in the relevant construction areas.
- If waste is not managed appropriately and hence allowed to affecting the flow of traffic, there will be a possibility of lost income among small vehicles drivers.
- The following mitigation measures are proposed:
  - Clear traffic alteration mapping should be prepared and published in visible area
  - Reduction of waste after developing a plan to dispose it according to the procedures mentioned in waste mitigation measures
- The mitigation measures proposed are covered by the RAP

Impact on quality of life

- Impacts on quality of life might result from: Noise and dust; potential accidents in the site for the workers or for community people; lack for health facilities, and/or no access to health facilities
- The following mitigation measures are proposed:
  - All environmental procedures should be applied to reduce dust and noise
  - The site should be surrounded by fence in order to keep community people out
  - Health and safety procedures should be followed
  - Access to health facilities should be put into consideration
- The mitigation measures proposed are covered by overall Environmental Management System to be developed for the project

Impacts on houses and dwellings due to the vibration

- This is one of the most severe impacts that might result due to the project, especially, because the project contains too many activities of digging. The sever of the disturbance is relatively high in Zamalek as it is quiet area
- Vibration will be monitored during construction and operations.

Potential subsidence for old dwellings

- Old fragile houses are mainly in the old areas Zamalek is of the highest value of these buildings. In Boulak Abu El Ela and Boulak El Dakrour the houses are of extremely bad condition which might result in a collapse to them
- Vibration will be monitored during construction and operations.

Impact on the political tensions

- Political tension is one of the main problems resulted after the 25th of January Revolution. Thus, it was recommended to investigate the perception towards the project which is high. Except for among Zamalek residents and the vendors of Boulak Abu El Ela and Bolak El Dakrour
- As a mitigation measure it is recommended to apply the stakeholder engagement plan (SEP) activities in order to integrate the community to be supportive to the project

Residual Impacts after applying Mitigation Measures

The residual impacts after applying the mitigation measures are regarded as **minor** for all but one of the potential socio-economic impacts if the described mitigation measures are applied for the different impacts. This is not the case for the potential impact of job availability, where it has been evaluated that elderly people might be the unmitigated groups due to some administration complications.

Cost of applying Mitigation Measures

The majority of the mitigation measures identified above are covered by the mitigation measures applied for other environmental and social impacts.

8.13.4 Operations

Assessment, Description and Evaluation of Impacts

The discussion of impacts ended to having two main potential impacts which are positive and negative in addition to the mixed in nature impacts. Moreover, the impacts might change due to the phase, construction or operation. The discussion of impacts will be directed to present positive impacts first as they will result no mitigation measures.

Table 8-11: Potential socioeconomic impact during the Operation phase based on their nature, duration and area

Type of impact	Class A Zamalek	Class A Gameat El Dowel	Class B Imabab	Class C Ring road	Class D Boulak El Dakrour	Class D Boulak Abu El Ela
During the Operation						
Enhancement of transportation with low cost	**positive**	**positive**	**positive**	**positive**	**positive**	**positive**
The potential change in source of income (that might include also any change of the land and assets		**positive**	**positive**	Mixed of nature	**positive**	**positive**

price)						
Job availability	Mixed in nature	**positive**	**positive**	**positive**	**positive**	**positive**
Access to basic services and utilities	**positive**	**positive**	**positive**	**positive**	**positive**	**positive**
Change in microbus and Tuk Tuk drivers' income due to the operation of the metro	**positive**	**positive**	**positive**	**positive**	**positive**	**positive**
Impact on health status and health seeking behaviors	Mixed in nature	**positive**	**positive**	**positive**	**positive**	**positive**
Reduction of accidents and traffic congestion	**positive**	**positive**	**positive**	**positive**	**positive**	**positive**

Potential Positive Socio-Economic impacts

- The potential positive socioeconomic impacts are as follow:The first main benefit that might result and change the living conditions completely is the accessibility to quick, cheap, accessible and safe means of transportation that might reduce the congestion in these highly populated areas.
- All areas reported an expected ammeiloration of the quality of transportation: *"It is great … better to save ourselves from those reckless minibus drivers*" reported an old female vendor in Boulak El Dakrour.

The other positive socioeconomic impact that might result during the operation might be summarized as follow:

- Provision of source of income for those who will operate the metro and work on permanent basis in the Metro 3. Based on rough calculation for the direct jobs to be provided, it will exceed 1500 job. In addition, having such type of transportation might encourage people to have markets close by the stations as it happened in Faysal Station and Giza station phase 2.
- Reduce road traffic congestions that might also result amazingly indirect positive impact on different sectors i.e. tourism, trade and other sectors. Not only that but the expected modal shift will improve mobility (access to jobs, education, commerce, etc) to the local community especially in the poor and densely populated areas. Saving time will also will be one of the benefits in addition to the reduction of number of accidents.

- Access to basic services and utilities is one of the main important benefits that might work for the enhancement of those living in poor areas in particular. Residents in Boulak El Dakrour and Imbaba reported that having a metro will enable them to take their children to hospitals downtown easily. *"If we have a sick child it took us with a taxi 2 hours to reach the hospital in El Qasr El Einy due to the congestion.. the child might die of fever but in vain roads are congested… but if we have a metro it will take 25 minutes maximum"* reported a mid-age women in El Matar street- Imababa.
- Potential change in the microbus and tuk tuk drivers' income was one of the main unpredictable positive impacts as it was anticipated that they might lose their source of income. But based on interviews conducted with them in different areas they reported that they suffer due to the congestion. In case of having a metro, that might accelerate moving in the road, consequently made them able to have more round (the microbus name one trip to and from a place is a round). Moreover, in Sudan street close to Boulk El Dakrour station, there is another metro station "El Behos" phase 2. Many microbus drivers are parking there to take people to Boulak El Dakrour or other areas in Mohandseen. This type of business will increase due to the expansion of the line.
- The impact on health status will be useful due to the reduction of congestion and facilitating access to different health utilities.
- Reduction of traffic congestion is one of the main benefits that might result due to the expansion of the project coverage.

Potential mixed in nature socio-economic impacts
What is meant by the potential mixed in nature impacts is that the impacts that might be a positive or negative effect in the same area. One of the areas that might have this type of mixed impact is the Ring Road, as the benefits start showing through the increase in the price of lands in one of the squatter areas. During the site visit to the Ring Road the majority of people interviewed reported that the land price now reached 3000 EGP per square metre. Before knowledge of the project the land price did not exceed 600 EGP. This resulted in the owners of lands gaining a fortune before the project had started. They predict another increase in the prices of lands and dwellings in the area during the operation phase. This is considered a positive impact for the land and dwelling owners. However, for the young couples seeking an apartment in this area to get married will be very expensive. AS a consequence, they will not be able to afford it .

The second mixed in nature impact reported in Zamalek was related to job creation. Many people might find it easy to have jobs in Zamalek after the construction of the new Metro. This will attract more job seeker to the area. However, the residents might find it difficult to accept the congestion, and *"nappropriate social groups might step into the area", as* reported by a shop owner in the area.

Despite the impacts enhancing health conditions due to the reduction of congestion and upgrading the health seeking behaviors, Zamalek residents reported that they might experience psychological disturbance and nerveousness due to the noise result from the potential people who will use the metro. Especially in the station area close to the Spainish and Algerian embassies.

Mitigation of Impacts

In this section mitigation measures are proposed for the operations phase, accounting for the negative socio-economic impacts of the construction activities. The following potential socio-economic impacts were identified for the operations phase:

Impact on Health Status and Health Seeking Behavior

- There might be a possibility to affect the health status of people in Zamalek due to the noise and congestion in the station
- The following mitigation measures are proposed: All environmental procedures should be applied to reduce the impact

Residual Impacts after applying Mitigation Measures

Minor if mitigation measures and site management practices are applied.

Cost of applying Mitigation Measures

No further cost as it is part of the contractor activities.

8.14 Labour Standards and Occupational health and safety

8.14.1 Identification of Impacts

Tendering process

The tendering for construction of Metro Line 3, Phase 3 will be the responsibility of NAT. SYSTRA is currently preparing the tender documents for the construction work, which will be carried out by contracted constructors. Procurement will be carried out according to FIDIC Standard Conditions of Contract for Construction.

The tendering will be done through six main groups of lots:
1. Civil Works
2. Track Works
3. Power Supply and Workshops
4. Signalling
5. Rolling Stock
6. Fair Collection

NAT's compliance with tendering requirements for Labour and OHS

The potential impacts on labour conditions and occupational health and safety derive from the employment practice and adherence to international labour standards of NAT.

The FIDIC include a number of requirements related to occupational health and safety to be incorporated in the contracts and clauses.

SYSTRA France have undertaken a study on corporate social responsibility and incorporated Environment and Social requirements, including compliance to the ILO core labour standard conventions.

Labour Conditions as implemented by NAT

The hiring policy of NAT is not to get involved in employment issues related to the contractor workforce in order to avoid any legal or operational problems that might rise. However, for the high staff (project leader, co project leaders and their direct assistance) NAT insists on reviewing their CVs in order to avoid any weak or less qualified members.

The employment for the implementation of the project might be done by contractors, subcontractors, joint companies and task based sub-contracting.
The contractor has full right to hire through different channels, as long as the process and contracts abide by Egyptian law including provision of social insurance for the workers in addition to the general contract terms.

The workforce is mentioned in the tender dossier in the particular conditions especially to count health and safety cost and social insurance. The workforce should be informed their right through the contactor as well as, the conditions mentioned in their annual contract as well as how they should address their grievances.

As the workforce is to come from the areas of Greater Cairo, there will be no need for accommodation facilities. The on-site facilities provided for workers will be toilets, small cafeteria and a place for resting.

The contractor provides training on health and safety issues for the workers to be sure of being compliance to H&S regulations. Health and Safety issues are important to raise the ranking of the contractor among international firms. The contractor also applies the highest standards of health and safety even if they are not mentioned in the Egyptian Laws, to guarantee the high level of procedures applied to workers health and safety.

Role of NAT regarding workforce:

- NAT has the following roles regarding employment:
- NAT pay for the contractor additional costs resulting from the implementation of health and safety procedures;
- NAT select the high managerial positions through review of CVs;
- NAT have the right to terminate any employee who does not perform appropriately on-site;
- NAT receive a monthly report about the workers from the contractor identifying workers by name and position;
- NAT monitor health and safety performance on-site;
- NAT monitor workers performance;
- NAT monitor the workers age according to the regulations on minimum age for workers;
- NAT has a permanent full time engineer who stays on-site to monitor the safety and health issues and to monitor the quality of work in addition to a consultancy firm that monitor the performance

8.14.2 Pre-Construction

The pre-construction impacts are considered to be similar to those incurred during the constructions phase and are therefore not assessed independently.

8.14.3 Construction

Assessment, Description and Evaluation of Impacts

Occupational Health and Safety and Labour Standards
The FIDIC does specify that all works shall be carried out strictly in accordance with current European Union health and safety legislation as well as the national legislation, whichever is the most stringent.

The Egyptian Labour Law is aligned to international OHS requirements, and as such no gaps related to the legislation are foreseen. The enforcement of the law however poses risk to the project as the capacity to enforce the Labour law and specifically on the occupational health and safety measures are inadequate.

The FIDIC includes the following requirements:
- Identifying and eliminating sources of hazards to workers
- Training and supervision of all operatives
- Inspection and testing of all equipment
- Appointing of accident prevention officer at the site, to take protective measures to prevent accidents
- Reporting of any accidents, as well as records and reports on health, safety and welfare on workers
- Designation of restricted areas, such as construction sites
- Preparation of an emergency response plan
- Monitoring of all hazardous, and suitable register maintained
- Provision of necessary rescue equipment
- Provision of personal protective equipment and adequate welfare facilities
- Provision of testing of workers against pathogenic agents
- Elaboration and management of a safety guarantee plan
- Provision of first aid equipment and training of workers

Currently NAT are constructing the Metro Line 3, Phase 2 in Cairo. Examples on how OHS is managed on an existing construction site of Line 3, Phase 2 in Heliopolis are given below:

Figure 8-61: Fencing of construction site, Line 3 Phase 2 in Heliopolis.

Figure 8-62: Fencing of construction site, Line 3 Phase 2 in Heliopolis.

Figure 8-63: Locker room, toilet, and shower facilities for workers, Line 3 Phase 2 in Heliopolis.

Figure 8-64: Locker room, toilet, shower and office facilities, Line 3 Phase 2 in Heliopolis.

Figure 8-65: Overview of cut and cover construction site – storage at the far end, Line 3 Phase 2 in Heliopolis.

Figure 8-66: Overview of cut and cover construction site – storage at the far end, Line 3 Phase 2 in Heliopolis.

Figure 8-67: OHS site regulations displayed at construction site entrance, Line 3 Phase 2 in Heliopolis.

SYSTRA France has launched an E&S management systemtender package which will be applied for the tender process for the construction of Metro Line 3, phase 3. The terms and conditions set out the general and specific social governance provisions applicable to the works contracts for the implementation of phase 3 of the Cairo Metro Line 3 and supplement the general conditions and other contractual documentation comprising the contract. They indicate what is expected and specify the contractor's duties in relation to E&S system that must be taken into account when responding to the invitation to tender on the one hand and when planning and implementing their works on the other. The contractor shall include a E&S Management Planplan for the project in his tender, covering all plans and procedures required during project implementation. Specification of the master plan requirements are given in the tender package. Further description is found in the ESMP.

According to contractor's requirements as described in the E&S specifications, contractors are to commit themselves to a number of measures to ensure their social performance. These include:

- To implement a human resources policy in compliance with national legislation, the Egyptian labour code and core ILO labour standards, preventing unacceptable forms of labour, tackling abusive employment practices and all other forms of discrimination;
- To uphold exemplary health and safety standards on site; and
- To ensure that training and dissemination of information to employees.

The requirements on OHS

The SYSTRA E&S management policy and requirements for constructor's contracts and the employee contract include specifications that are crucial to elimination of the high risk areas of labour standards violation in Egypt. These include requirements of specification working hours, remuneration and overtime premium, emphasising the employee's right to a living wage. Furthermore, the issue of trade union membership is also integrated into the requirements of contractors, to respect and not discriminate against union members.

Evaluation
The OHS and labour standard impacts are considered to be a direct impact of likely occurrence on an individual level. The duration is long term and possible to mitigate. The impact is of **major** significance.

However, emphasis has been put on the management of OHS and labour standard issues by the promoter e.g. aligning with FIDIC contract standards and the CSR policies. The adherence to these policies is though dependent on the capacity of the responsible party to monitor and enforce implementation and compliance.

Of utmost importance for decreasing the labour standard risks of the project is the SYSTRA initiative to incorporate adherence to ILO core conventions in constructor contracts, and the individual employee contracts to include working hours, remuneration and overtime premium, emphasising the employees right to a living wage.

Should SYSTRA succeed in the attempt to make the construction of Metro Line 3, Phase 3 a showcase for NAT, by integrating E&S performance criteria and ensuring the approach in effectively implemented throughout the project, this could have a long term indirect positive impact on future infrastructure projects implemented by NAT, probably even with the Egyptian Government or regional in the Middle East.

<u>Mitigation of Impacts</u>

The OHS and international Labour standard requirements will, according to the FIDIC requirements and the SYSTRA E&S management policy, be built into employee contracts, NAT management systems and requirements for contractors in tenders.

At the overall level, NAT should develop:

- A Health and Safety Work Policy to support the development of the health and safety planning for the construction phase activities.
- Health and safety procedures including work place monitoring,monitoring of contractor OHS performance and emergency response arrangements. These should be included in the final construction ESMP as part of the NAT environmental management system. The Emergency Response Plan should be based on a construction site level hazard risk assessment. It should be developed in cooperation with the relevant authorities and communicated broadly to relevant stakeholders.

The contractor is required to develop as part of the tender process, a Staff Training Plan and a Health and Safety Management Plan, which should help to facilitate a safe work place. NAT should monitor their implementation.

The following specific OHS mitigation measures are suggested during the construction phase:

- Contractors to assign a health and safety supervisor to oversee the OHS performance on site;
- Regular on-site inspections of equipment;
- *Use of personal protective equipment and safety harnesses to prevent falling, ladders and scaffolds should be frequently inspected;*
- *Properly store materials, and provide necessary measures against leaks and spills;*
- *Label stockpiled material, provide proper access control measures to prevent accidental exposure, and provide personal protective equipment and first-aid kits;*
- *Store flammable materials in isolated, shaded, and well-ventilated areas;*
- *Install fire extinguishers and access maps in designated places throughout the site;*
- *Train the construction crew for proper conduct at the construction sites;*
- *Strict enforcement of rules and regulations;*
- Provide and maintain all necessary accommodation and welfare facilities outside the construction site;
- Provide sufficient drinking water, temporary sanitary, welfare equipment's and electrical connections;
- *Sanitary facilities shall be closed and located so as to avoid impact to neighbouring communities; (EQI 2012:199).*
- Train HSE inspectors to conduct on-site inspection on OHS performance;
- Where pesticides are used in conjunction with rodent control during pre-construction and construction, their use should be carefully managed in accordance with international standards. This includes provisions for their storage, dosage, method of application and the use of personal protective equipment.

The following labour standard mitigation measures are suggested during the construction phase:

- Incorporate adherence to international labour standards in contractors contracts
- Provide contractors with a "translation" of labour standards and an on-site best practise guide
- Facilitate an awareness raising workshop for contractors and encourage them to apply the Human Rights Compliance Assessment Quick Check[19] on their performance

[19] The HRCA Quick Check is a free, condensed version of the full HRCA, developed by the Danish Institute for Human Rights. The Quick Check includes a selection of the questions contained in the full HRCA, and allows companies to create an overview of the human rights risks and opportunities in their operations.

- Contractors to incorporate specification of working hours, remuneration and overtime premium in employees contracts, respecting employees' right to a living wage; and
- Train HSE inspectors to conduct on-site inspection on labour standards adherence.

Residual Impacts and Costs of applying mitigation measure

The mitigation measures suggested should be sufficient to ensure compliance with international labour standards and OHS requirements.

However, the implementation of mitigation measures is highly dependent on the institutional capacity and the organisation of the implementing agency. This is further described in the E&S management plan.

Furthermore, although a strong commitment to zero-tolerance to workers accidents and a focus on analysing near-miss and improving OHS performance on site, is no guarantee to a working environment without accidents.

8.14.4 Operations

Assessment, Description and Evaluation of Impacts

OHS and labour standard risks during operation, mainly deriving from the lack of implementation of minimum wage among other ILO standards into Egyptian legislation.

Mitigation of Impacts

At the overall level, a Health and Safety Work Policy should be developed to support the health and safety planning for the operations phase activities. The management system for the operations phase should include health and safety procedures for a range of activities including work place monitoring, monitoring of OHS performance and emergency response arrangements. The Emergency Response Plan should be based on hazard risk assessment for Metro Line 3 Phase 3. It should be developed in cooperation with the relevant authorities and communicated broadly to relevant stakeholders

The following specific mitigation measures for OHS and labour standards are suggested during the operation phase:

- Implement a human resource policy in compliance with OHS and ILO labour standards, of ECM, to be followed up by monitoring and inspections.
- Incorporate specification of working hours, remuneration and overtime premium in employees contracts, respecting employees' right to a living wage;
- Train ECM staff in monitoring and inspection of OHS and labour standards adherence
- Regular on-site inspections of equipment;
- Label stockpiled material, provide proper access control measures to prevent accidental exposure, and provide personal protective equipment and first-aid kits;
- Store flammable materials in isolated, shaded, and well-ventilated areas;

- Regular monitoring of in-door air quality, levels of humidity, noise and temperatures;
- Install fire extinguishers and access maps in designated places throughout the site.

<u>Residual Impacts and Costs of applying mitigation measure</u>

Risks of accidents.

8.15 Community Health and Safety

8.15.1 Identification of Impacts

The design, alignment and construction of Line 3 – Phase 3 of the Greater Cairo Metro system will directly and indirectly affect hundreds of thousands of metropolitan households and residents, daily commuters and frequent travellers, local small and medium businesses, farmers and property owners, local government, transportation and other public service providers proximate to the new line. Transportation and traffic flows, recreational areas and markets, schools, medical and religious facilities, access to neighbourhoods and buildings, personal safety and well-being through exposure to increased noise, disruption and pollution will all be significantly affected by the planned design, alignment and construction of the Metro line and stations in the highly-congested urban neighbourhoods of Line 3 – Phase 3.

The benefits of enhanced transportation for residents and commuters, neighbourhoods and businesses, from the operation of Metro Line 3 – Phase 3 are widely appreciated. Greater Cairo's experience with Lines 1 and 2 confirm that. The design, alignment and construction of the Metro project over several years in specific communities can, however, be an enduring hardship, hazard to safety and well-being, or permanent detriment. These negative environmental and social impacts might be considerable.

The alignment will not introduce any new barriers which could divide the communities. On the contrary the Metro Line 3, Phase 3 will improve opportunities for future stations and stations area development in those communities. This development is anticipated to enhance circulation and connectivity of communities with the greater Cairo, which in turn may help to enhance the character and cohesion of these communities. Also, the new and expanded transit services would provide enhanced access directly to those communities, and by improving service throughout the day, they would improve access to and support employment opportunities and job retention, as well as the use of community, institutional, education and recreational facilities in those areas.

8.15.2 Pre-Construction

Community impacts during pre-construction are assessed to be similar to the construction phase and are therefore not dealt with separately.

8.15.3 Construction

<u>Assessment, Description and Evaluation of Impacts</u>

The following areas have been identified as sources for potential impact on community health and safety during constructions:

- Community acceptance
- Noise and vibration
- Hazardous materials and waste
- Air quality
- Traffic disruption
- Visual intrusion
- Expropriation
- Security personnel requirements

The FIDIC requires the contractor to ensure protection of all excavations shall be ensured with the help of temporary barriers, warning signs, cones and signal light in order to prevent accidents. The contractor shall take precautionary measures in order to prevent injuries due to open trenches, excavated materials, equipment and other obstacles. Furthermore, contractors are required to inform the fire and police services before closing up of any street in order to ensure access of emergency services.

The SYSTRA E&S management policy and specification include requirements of cooperating measures for community health and safety in the health and safety management plan. These includes confinement of construction sites, ensuring storage of equipment and machinery, ensuring maintenance of road traffic flow including clear entrances for emergency services, ensuring warning system put in place, properly management of pedestrian traffic, ensuring protection of existing installations and protection of communities against fire.

The potential impact is in direct relation to the acceptance of the Metro Line, as the acceptance of the Metro line may be influenced from the character of communities in/near the area of influence. The Metro Line 3, Phase 3 passes through communities which are mainly urban, and (for the far northern part of 3B) suburban in nature. These communities affected by all stations and alignments of the Metro line 3, Phase 3 have different characteristics. The stations and alignments go through high-density urban mixed use residential areas, industrial areas, commercial areas, suburban residential areas and rural and open spaces. The provision of a new Metro line will influence the community character and have an influence on the development of the areas, where the Metro line passes through.
Community along the alignment are already exposed to traffic, noise, and poor air quality and the impacts related to this. However, these exposures will be further increased as a consequence of the project.

The community impacts of dust and air quality will be highest during the construction phase. The critical distance between construction sites and residences have been assessed to be 100 meters, with respect to dust emissions. Given the densely populated areas that the alignment run through the communities located along the alignment and neighbouring constructions sites will be impacted by dust. For the community impacts of noise the situation is similar. These impacts will be felt by communities around all construction sites; especially in the community along El Bohy Street, where there is limited space around the alignment and construction of the elevated sections and stations is going to take place along the entire street of El Bohy. Furthermore, the impacts during operation will also be highest in communities with at grade or elevated alignments, as along El Bohy Street.
It can be expected that in areas, where the Metro line is elevated, the main driver on community disruption from the Metro line will be visual effects and noise resulting from the construction and operation and the structural support systems as the utility and traffic diversions that will be required.

The extent to which communities will feel disruption are not only determined by the actual impact on the community environment (noise, air quality and traffic diversions), but at large also an effect of how communities are being involved and informed about new developments in their area. Therefor the process of public consultation, stakeholder engagement and community involvement throughout the implementation of the project will impact the community health and safety.

Evaluation
The impact on community health and safety is considered to be an indirect impact of likely occurrence on a local level. The duration is long term and possible to mitigate. The impact is of major significance.

Mitigation of Impacts

The guiding principle to mitigate impacts to communities during construction is to establish and sustain an open and transparent dialogue between NAT and the affected communities.

The mitigation measures identified under the sections on noise, air quality, waste management and traffic deviation, will all minimize the potential negative impacts for communities. Additionally the following mitigation measures addressing community health and safety are suggested during the construction phase:

- Timely and appropriate dissemination of information on the planned design, alignment and construction in affected communities along the alignment;
- To invite, listen and respond properly to community concerns;
- Timely and appropriate information on traffic deviation plans to affected communities;
- Timely and appropriate information on the grievance mechanism established in NAT for this project to affected communities;
- Satisfactory resolutions for each legitimate complaint and grievance;
- Timely and appropriate information disclosure, including stakeholder information on the NAT website;
- All resettlement issues are properly addressed and the RAP is enforced, including communication to affected communities

<u>Residual Impacts and Costs of applying mitigation measure</u>

Large infrastructure construction in urban environments as densely populated as Greater Cairo, is indefinitely going to be disruptive to communities. The implementation of the mitigation measures will lessen this disruption, but will not erect them all together.

Cost described to the mitigation of each impact aspect e.g. noise, air quality, traffic deviation will cover the mitigation respectively. The additional cost are related to the setup of a HSE unit in NAT responsible for handling of community liaison, grievances, information dissemination etc. is further described under the institutional capacity in the management plan, which also describes the cost related to establishing and running the HSE unit.

8.15.4 Operations

<u>Assessment, Description and Evaluation of Impacts</u>
There is a potential risk of emergency events occurring during metro operations.

<u>Mitigation of Impacts</u>
The Emergency Response Plan developed for the construction phase should be carried forward into the operations phase. This should be done in dialogue with relevant stakeholders.

<u>Residual Impacts and Costs of applying mitigation measure</u>
The successful implementation of the Emergency Response Plan will help minimise the negative impacts of an emergency event on the community.

8.16 Cumulative Impacts

8.16.1 Identification of Impacts

According to Annex IV of the EU EIA Directive, an EIA should include a description of the project that also covers its “cumulative” effects[20]. Here the term cumulative effect is used to cover the impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project, as portrayed in the schematic below.

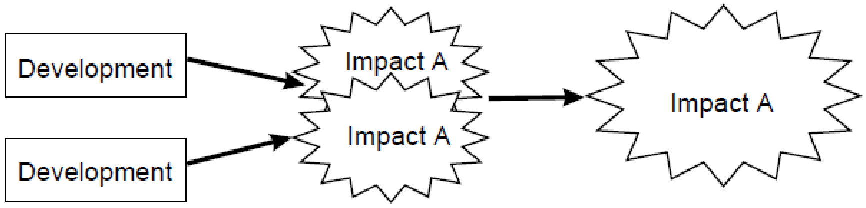

Figure 8-68: Cumulative Impacts
Source: EC, Guidelines for the Assessment of Indirect and Cumulative Impacts and Impact Interactions, May 1999

A cumulative effects assessment has been conducted for the physical, biological and social aspects of the Cairo Metro Line 3-Phase 3 project. The project is part of the Greater Cairo Metro Line, and when completed will provide a significant boost to Cairo’s collective transport capacity. The cumulative effects assessment therefore investigated the effects of the current proposed project with the effects of the following past, present and foreseeable metro lines:

1. Metro line 1, started operations in 1987 and line fully completed in 2000
2. Metro line 2, started operations in 1996 with full line completed in 2005
3. Metro line 3 phase 1, inaugurated in February 2012
4. Metro line 3 phase 2, under construction, scheduled for operations end 2013
5. Metro line 4, planning and design phase

Plans have also been mooted for a 5th circular metro line, linking the others but this has not been made more concrete and is thus not considered further in the section on cumulative effects.

[20] Directive 2011/92/EU of the European Parliament and of the Council of December 2011 on the assessment of the effects of certain public and private projects on the environment

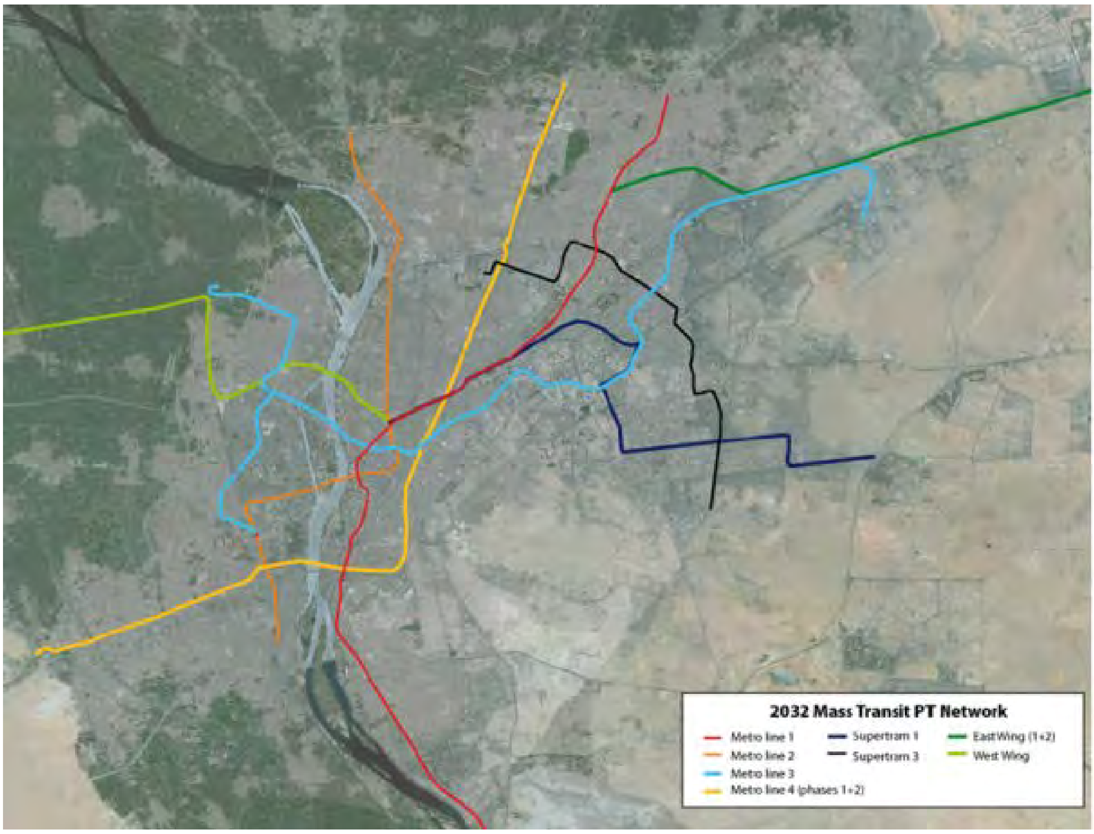

Figure 8-69: 3032 Mass Transit PT Network
Source: Systra, GREATER CAIRO METRO – LINE 3 PHASE 4, Feasibility Study Report, November 2010

8.16.2 Construction

<u>Assessment, Description and Evaluation of Impacts</u>

Biological Effects
The Greater Cairo area is heavily urbanised with very little green space remaining. The metro line sections within the inner city are therefore not deemed to have a cumulative biological effect. The main risk being the need to fell old and iconic trees that may have come to represent the areas where they are established, and have almost become part of the community. Efforts will be made to replant these trees, and seedlings could even be cultivated from seed taken from them in order to ensure a direct descendency.

Social and Cultural Effects
In general, the metro lines are expected to generate a positive cumulative economic effect on the local and regional economies the operations phases, through continued and increased employment, the acquisition of skills, and taxation.

Several large infrastructure projects are scheduled to take place in Cairo in addition to the metro developments. These are the planned development of the Imbaba Airport area and the construction of the Express High Way, connected to El Farag Station, as described in section 7.6. It is likely, however, that the Cairo Metro Line 3 Phase 3 project will be completed before construction begins on these projects (indeed Metro Line 3 is seen as a necessary catalyst for these developments), thus avoiding any cumulative impacts.

Land is required for the metro developments - both temporary and permanently – resulting in the resettlement of both businesses and housing. In general, experience shows that the metro lines have been designed to minimise resettlement to the extent possible, in fact in line with the provisions of World Bank OP 4.12. Thus Line 4 will lead to the resettlement of relatively few businesses and houses for an infrastructure project of this scale[21]. The actual resettlement process to date has largely been based on national legislation but with the increased involvement of international finance such as EIB and JICA, subsequent resettlement is planned according to international standards, and this trend is likely to continue in the future through continued international finance and via the exchange of know-how.

Another negative social impact resulting from the metro lines has been the loss of recreation and open space, which is in high demand in Cairo. However, since the majority of the metro line constructed so far is underground, the loss of recreational space has been relatively minor. It is likely that any recreational areas temporarily included in the construction areas will be reinstated upon completion of the metro line, for example underneath the elevated sections.

Cairo has a rich and unique cultural heritage that is of global importance. The Feasibility Study prepared for Line 4 includes an archaeological study that has used borehole drilling to investigate the presence of historic artefacts along the planned route. The results show that there is a wide variety of fragments such as shards of pots that can be expected to be found wherever excavation work takes place in the city area. The promoter is well aware of the opportunity for chance finds, and will have the necessary management systems to react to cultural heritage finds. Many important recent archaeological discoveries across the world have been made in connection with infrastructure projects, and the metro developments in Cairo may even contribute to furthering understanding of Egypt's past.

<u>Mitigation of Impacts</u>

- There will be significant replanting in the Cairo Metro Line 3 Phase 3 project as part of the measures to mitigate visual impacts.
- Resettlement within Cairo Metro Line 3 Phase 3 will be managed via the Resettlement Framework Policy and Action Plan.
- There will be appropriate management of cultural heritage risks during construction through the chance find procedure and additional study.

<u>Residual Impacts and Costs of applying mitigation measure</u>
Information is provided in the relevant sections on visual impacts, resettlement and archaeology.

8.16.3 Operations

<u>Assessment, Description and Evaluation of Impacts</u>

Physical Effects
Some of the most significant cumulative effects of the Metro lines are based on the fact that they offer a clean and efficient solution to transporting over 800 million passengers per year. This has many positive physical effects, for example it makes a significant contribution to reducing air emissions from personal vehicles because it meets 22% of Cairo's motorised transport demand through collective transport.

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[21] JICA Preparatory Survey on Greater Cairo Metro Line No. 4 Supplementary Survey, Edition 2, November 2010

If these passengers were forced to use vehicular traffic then the resultant air emissions would be highly damaging to both the environment and public health, as well as contributing to the greenhouse effect and resultant global warming. Although there are air emissions related to the construction phase, for example dust, and particulate matter emissions from the heavy machinery used, these air emissions will be offset many times over by the metro lines during their operations phase.

For certain sections of Line 3 Phase 3, the metro line travels at both at-grade and elevated sections. In addition there will be above ground stations at the street level as well as at elevated levels. It is assessed that these will add very little to the cumulative visual impact of the metro lines because the greatest majority of the metro lines so far constructed are underground. The visual impacts of the at-grade and elevated sections of phase 3 are therefore deemed to be relatively localised to the specific areas. For example, when standing at El Bohy Street and viewing the elevated section of phase 3, it will not be possible to see other elevated metro lines in the vicinity causing a high cumulative visual effect. The construction of the elevated metro line sections does though offer the relevant authorities the opportunity to improve the local urban environment, for example by planting trees and removing piles of garbage, and giving the neighbourhoods a general boost.

Biological Effects
The metro lines that will run through the city outskirts will transect green spaces, but most of this is farmed intensively, and therefore likely to be of limited biological value. Indeed, experiences from other countries have shown that linear infrastructure such as motorways and railways provide corridors of green space, allowing narrow strips of ecosystems to establish themselves and facilitating the movement of animals, birds and plant species that would otherwise be impossible.

Social and Cultural Effects
In general, the metro lines are expected to generate a positive cumulative economic effect on the local and regional economies the operations phases, through continued and increased employment, the acquisition of skills, and taxation.

The metro projects are a significant part of Cairo's stategic development plans, and will aid the sustainable development of the city. In general the metro has a positive effect on health through the provision of an alternative to vehicular traffic thus reducing the levels of dangerous air pollutants such as fine particulates. Furthermore, the metro is based on modern and safe technology, and will help to improve the road safety by taking cars off the road, making a likely contribution to reducing the number of traffic and pedestrian accidents. Further developing the metro will improve the quality of life of its users, since the demand on the service is already exceeded by 20% during the peak hours.

One effect related to metro projects is the process of gentrification whereby real estate prices and also rental prices increase in the neighbourhoods closest to the metro stations. This effect has not been documented in Cairo. It is not likely that there will be a cumulative increase in house prices in Cairo as a result of the metro. It is more likely to be concentrated in certain areas, for example around the metro stations of certain districts.

<u>Mitigation of Impacts</u>
None foreseen.

Residual Impacts and Costs of applying mitigation measure
None foreseen.

8.17 Summary of impacts before and after mitigations

The summary of impacts before and after mitigation are presented in Table 8-12 below. This summary table is also included in the Non-technical summary.

Table 8-12: Summary of impacts before and after mitigation

Environmental or Social Aspects	Project phase	Description and evaluation of the potential impacts	Proposed mitigation	Description of the residual impact after applying the mitigation measures
Soil	**Pre-Construction**	Contamination of soil from spills and soil storage and disposal	Development of soil handling management plan, including suitable storage, transport, and disposal of waste at approved disposal sites. Spill management measures. Monitor vibrations from civil works. Conduct building surveys on rights of way.	With proper soil handling plan and storage the impacts are expected to be negligible
		Minor Impact		Negligible Impact
	Construction	Compaction due to the load of heavy construction equipment and machinery. Disturbance of soil layers from construction activities. Contamination of soil from spills and soil storage and disposal.	Development of waste management plan, including suitable storage, transport, and disposal of waste at approved disposal sites. Spill management measures. Monitor vibrations from civil works. Monitor building conditions on rights of way.	With proper soil handling plan and storage the impacts are expected to be negligible
		Minor Impact		Negligible Impact
	Operation	Disturbance due to induced vibration and leakage of wastewater effluents.	Proper management of wastewater effluents. Monitor vibrations during operations. Monitor building conditions on alignments.	
		Minor Impact		Negligible Impact
Waste and hazardous waste	**Pre-Construction**	Lack of adequate landfill sites and long transport roiutes	Agreement with relevant authotities on usage of landfill sites and soil dumping areas. Contractors to develop Waste Management Plan during tendering process.	

Environmental or Social Aspects	Project phase	Description and evaluation of the potential impacts	Proposed mitigation	Description of the residual impact after applying the mitigation measures
		Negligible Impact		Negligible Impact
	Construction	Lack of capacity in handling the waste generated through the construction of the Metro line, including earthwork waste, excavated soil and waste water, and fuel and oil used for machinery may cause impacts to soil, water environment, and communities.	Provide waste management instructions for the contractor and contractors to develop Waste Management Plan during tendering process.. Ensure registration of waste quantities and final disposal is controlled in Waste Records, incl. Environmental Register and Hazardous Register Propose arrangements for waste storage, transport, recycling and treatment Proper management of waste. Proper storage of earthwork waste, excavated soil and waste water, and fuel and oil used for machinery.	With proper management of waste and arrangements for waste storage, transport, recycling and treatment in place impacts are expected to be of minor magnitude.
		Major Impact		Minor Impact
	Operation	Impacts from waste generated in the operation of the metro.	Proper management of waste management in the surroundings of the Metro stations and arrangements for waste storage, transport, recycling and treatment.	Operator responsible for cleanliness of the Metro stations and alignments
		Minor Impact		Negligible Impact
Water environment	Pre-Construction	Contamination of groundwater due to unintentional spill or discharge of hazards chemicals including oil and fuel from construction equipment	Develop proper maintains plans for construction equipment	With proper maintains plan in place the impacts are expected to be negligible
		Minor Impact		Negligible Impact

Environmental or Social Aspects	**Project phase**	**Description and evaluation of the potential impacts**	**Proposed mitigation**	**Description of the residual impact after applying the mitigation measures**
	Construction	Physical and chemical changes in surface water characteristics. Changes in groundwater geometry and chemistry. Contamination of groundwater due to unintentional spill or discharge of hazards chemicals including oil and fuel from construction equipment	Applying competent measures to prevent accidental spills and process discharges. Monitor groundwater depth and substitute damaged wells. Develop proper maintains plans for construction equipment	With proper maintains plan in place the impacts are expected to be negligible
		Minor Impact		Negligible Impact
	Operation	Contamination of groundwater due to uncontrolled discharge of wastewaster and oil from workshop.	Applying competent measures to prevent accidental spills and process discharges. Monitor groundwater depth and substitute damaged wells.	With proper maintains and operation plan in place the impacts are expected to be negligible
		Minor Impact		Negligible Impact
Air quality and dust	**Pre-Construction**	<u>Utility diversion:</u> Dust emissions from construction and transportation to and from construction site. Air emissions from construction machinery and vehicles.	Dust management plan and dust management measures to reduce dust emission during construction activities, storage, and transportation. Consideration of adoption of stricter emission requirements with respect to emissions of particulate matter and NOx. Use of particle filters and DeNOx technology Inspection and maintenance of vehicles and machinery. Monitoring of ambient air quality.	Reduction in dust emissions
		Major impact		Minor impact

Environmental or Social Aspects	Project phase	Description and evaluation of the potential impacts	Proposed mitigation	Description of the residual impact after applying the mitigation measures
	Construction	Dust emissions from construction and transportation to and from construction site. Air emissions from construction machinery and vehicles.	Dust management plan and dust management measures to reduce dust emission during construction activities, storage, and transportation. Consideration of adoption of stricter emission requirements with respect to emissions of particulate matter and NOx. Use of particle filters and DeNOx technology Inspection and maintenance of vehicles and machinery. Monitoring of ambient air quality.	Considerable reduction in dust emissions Reduction in specific emission of PM >80% by applying diesel particulate filters Reduction in NOx emissions by 75% (g/kWh) by applying DeNOx technology
		Major Impact		Minor Impact
	Operation	Indirect emission to air through electric energy consumption. Shift in means of transportation to the Metro will lead to a reduction in emissions.	No mitigation necessary	
		Positive Impact		Negligible Impact
Noise	**Pre-Construction**	<u>Utility diversion:</u> Noise emitted from the construction activities results from machinery, equipment and transportation.	Noise control measures, including: Scheduling of noisy activities in consideration of daytime and night time noise limits Provide for and use of temporary noise-insulating barriers Use equipment modified to reduce noise Monitoring of noise impact	Noticeable noise increase in the range of 3 dB(A)
		Major Impact		Minor Impact

Environmental or Social Aspects	Project phase	Description and evaluation of the potential impacts	Proposed mitigation	Description of the residual impact after applying the mitigation measures
	Construction	Noise emitted from the construction activities results from machinery, equipment and transportation.	Noise control measures, including: Scheduling of noisy activities in consideration of daytime and night time noise limits Site layout to keep noisier equipment and activities as far as possible from noise sensitive locations Provide for and use of temporary noise-insulating barriers Use equipment modified to reduce noise Monitoring of noise impact	Noticeable noise increase in the range of 3 dB(A)
		Major Impact		Minor Impact
	Operation	Noise stemming from the operation of the Metro along at-grade and elevated alignments.	Additional study on Noise impacts along at-grade and elevated alignments to be carried out. Implementation of noise barriers along sections which will cause impact above established limits. Monitoring of noise impact.	With the application of noise barriers it is estimated that the project can reduce noise impacts to a level that comply with noise standards.
		Major Impact		Minor Impact
Vibration	**Pre-Construction**	<u>Utility diversion:</u> Vibration emitted from the construction activities results from machinery, equipment and transportation.	Mapping of sensitive buildings/constructions along the alignment. Scheduling of activities in consideration of surrounding communities Use equipment modified to reduce vibration. Monitoring of vibration impact and complaints of vibration nuisance. Conduct building survey on right-of-way.	Reduced vibration emitted from the construction activities
		Minor Impact		Minor Impact
	Construction	Vibration emitted from the construction activities results	Mapping of sensitive buildings/constructions along the	Reduced vibrations emitted from the construction

Environmental or Social Aspects	Project phase	Description and evaluation of the potential impacts	Proposed mitigation	Description of the residual impact after applying the mitigation measures
		from machinery, equipment and transportation.	alignment. Scheduling of activities in consideration of surrounding communities. Use equipment modified to reduce vibration. Monitoring of vibration impact and complaints of vibration nuisance. Monitor building conditions along right-of-way.	activities
		Minor Impact		Minor Impact
	Operation	Vibration stemming from operation of the Metro along the alignment.	Monitor vibration impact and complaints over vibration nuisance. Application of mitigation measures as needed. Monitor building conditions along alignments.	Vibration resulting from operation
		Minor Impact		Minor Impact
Visual and functional intrusion	**Pre-Construction**	Unclear commitment on implementation of re-vegetation and urban landscaping Elevated Metro line design creates major visual intrusion to the residents	Agreement on Re-Vegetaion Plans and Urban Facility Plans before consztruction starts Selection of design improvements to minimize visual intrusion	
		Major Impact		Minor Impact
	Construction	Removal of public green recreational areas at construction sites. Disturbance for urban facilities. Construction site as visual disturbance factor.	Implementation of re-establishing green, recreational areas and urban facilities immediately after construction. Minimizing visual barriers and improve public information.	
		Major Impact		Minor Impact

Environmental or Social Aspects	Project phase	Description and evaluation of the potential impacts	Proposed mitigation	Description of the residual impact after applying the mitigation measures
	Operation	Maintain re-greening and re-organisation of the urban environment.	Maintenance of newly established green, recreational areas and urban facilities.	
		Major Impact		Minor Impact
Biodiversity and nature conservation	**Pre-Construction**	Utility diversion: Vegetation clearance and habitat destruction.	Replanting of trees and re-establishing green areas.	None
		Minor Impact		Negligible Impact
	Construction	Vegetation clearance and habitat destruction.	Replanting of trees and re-establishing green areas.	None
		Minor Impact		Negligible Impact
	Operation	None	None	None
		Negligible		Negligible Impact
Archaeological and cultural heritage	**Pre-Construction**	Utility diversion: Risk of damaging historical buildings. Risk of damaging chance-find buried artifacts.	Additional study required to perform a thorough investigation of the potential impact on historical buildings and chance-find. Develop a chance find procedure and ensure its implementation prior to construction start	
		Major Impact		Minor Impact
	Construction	Risk of damaging historical buildings. Risk of damaging chance-find buried artefacts.	Use equipment modified to reduce vibration. Develop a chance find procedure and ensure its implementation prior to	

Environmental or Social Aspects	Project phase	Description and evaluation of the potential impacts	Proposed mitigation	Description of the residual impact after applying the mitigation measures
			construction start	
		Major Impact		Minor Impact
	Operation	None	None	None
		Negligible		Negligible
Public utilities and Traffic	**Pre-Construction**	Utility diversion: Unclear committment on implementation of traffic diversion plans	Completion and agreement on traffic diversion plans before public consultations and construction start.	
		Major Impact		Minor Impact
	Construction	Traffic congestion around construction sites as main routes closes or decrease capacity and further impacted by the need for utility diversion.	Development of detailed plans for utility and traffic deviation. Improved Traffic Management, Route Management Strategy, Information Strategy and monitoring	Traffic congestion, as alternative routes have limited capacity.
		Major Impact		Minor Impact
	Operation	Pressure on utilities. Microbuses, taxis or rickshaws will lose part of their clientele. Provision of an efficient, safe and affordable mean of transportation.	No mitigation	
		Minor Impact		Negligible
Urban Development	**Operations**	Changing agricultural land into urban development	Establish a planned process for urbanization of the area.	Risk of creating new squatter areas with poor

Environmental or Social Aspects	Project phase	Description and evaluation of the potential impacts	Proposed mitigation	Description of the residual impact after applying the mitigation measures
		around the Ring Road. Change in community character (sub-urban and rural areas). Recreational Improvements	Development and implementation of a proper land-use plan is recommended (especially for northern part, phase 3B) to mitigate the negative impacts from the cnange of land-use. Community Character: Information campaigns, public consultation (outlined in SEP) Recreational: none	services and facilities. None Mentionned. None Mentionned.
		Minor Impact		Negligible
Involuntary resettlement and vulnerable groups	Construction	Resettlement, disruption of livelihood, commercial activities and social services for people along the alignment.	Implementation of the Resettlement Action Plan in accordance with the provisions of the Resettlement Policy Framework.	Resettlement, disruption of livelihood, commercial activities and social services for people along the alignment.
		Major Impact		Major Impact
Socio-economic effects	Pre-Construction	Enhancement of income opportunities along the alignment and job opportunities of unskilled workers during construction. Negative impacts are covered and mitigated in other relevant sections.	No mitigation – NAT should consider encouraging contractors to use local labour during the pre-construction phase.	
		Positive Impact		

Environmental or Social Aspects	**Project phase**	**Description and evaluation of the potential impacts**	**Proposed mitigation**	**Description of the residual impact after applying the mitigation measures**
	Construction	Enhancement of income opportunities along the alignment and job opportunities of unskilled workers during construction. Negative impacts are covered and mitigated in other relevant sections.	No mitigation - NAT should consider encouraging contractors to use local labour during the construction phase.	
		Positive Impact		None
	Operation	Enhancement of income opportunities as a consequence of higher mobility of workers.	No mitigation - NAT should consider encouraging contractors to use local labour during the operations phase.	
		Positive Impact		None
Labour standards and occupational health and safety	Pre-Construction	OHS and labour standard risks on construction sites.	Incorporation of OHS and ILO labour standard compliance into contractor's contracts and ensuring enforcement through comprehensive inspections. Develop NAT H&S Work Policy, OHS procedures and Emergency Response Plan based on activity level risk assessment. Contractor to develop Staff Training Plan and H&S Management Plan.	Risks of accidents
		Major Impact		Minor Impact
	Construction	OHS and labour standard risks on construction sites.	Incorporation of OHS and ILO labour standard compliance into contractor's contracts and ensuring enforcement through comprehensive inspections.	

Environmental or Social Aspects	**Project phase**	**Description and evaluation of the potential impacts**	**Proposed mitigation**	**Description of the residual impact after applying the mitigation measures**
			Develop NAT H&S Work Policy, OHS procedures and Emergency Response Plan based on activity level risk assessment. Contractor to develop Staff Training Plan and H&S Management Plan.	
		Major Impact		Minor Impact
	Operation	OHS and labour standard risks during operation, mainly deriving from the lack of implementation of minimum wage among other ILO standards into Egyptian legislation.	Implement a human resource policy in compliance with OHS and ILO labour standards, of ECM, to be followed up by monitoring and inspections. Develop Emergency Response Plan based on activity level risk assessment.	Risks of accidents
		Major Impact		Minor Impact
Community health and safety	Operation	Impacts mainly deriving from noise for communities along the alignment.	Noise, air quality and dust measures. Timely and appropriate community liaison. Develop Emergency Response Plan based on activity level risk assessment.	Noise
		Major Impact		Minor Impact

Source: Consultant's assessment of impacts.

9 FRAMEWORK ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

9.1 Introduction

This chapter presents the Framework Environmental and Social Management Plan (ESMP) developed for Cairo Metro Line 3 Phase 3 and the background for its implementation. It consists of the following sections:

- Objectives of the framework ESMP
- The Cairo Metro Line 3 Phase 3 Framework ESMP
- Guidance on Emergency Response Plans
- Waste Management instructions
- Design change procedure
- Roles and responsibilities in the implementation of the framework ESMP

A further assessment of NAT's organisational capacity necessary to implement the ESMP is provided in chapter 10.

9.2 Objectives of the Framework ESMP

The framework Environmental and Social Management Plan (ESMP) consists of a set of mitigation, management and monitoring measures to be taken during implementation of the project to avoid, reduce, mitigate, or compensate or offset any adverse social and environmental impacts. In addition, the framework ESMP defines procedures to ensure that the management of environmental and social issues during the different project phases are undertaken in accordance with national legislation and IFI regulations and best practice procedures.

The ESMP should be implemented in conjunction with the relevant documents developed in conjunction with the ESIA process, including but not limited to the traffic management plan, waste management plan, chance find procedure, design change management plan and HR policies. Moreover, particular attention should be given to the integration of the RAP and the embedded grievance mechanisms, as explained in the Resettlement Policy Framework (ESIA Vol. 3 Appendix 3).

The successful implementation of the ESMP will depend on a range of different elements. To ensure a management plan that incorporates and successfully integrates with interface documents, the following elements must be considered and acted upon:

- The E&S Performance Management Unit should be adequately staffed to ensure the proper implementation and monitoring of the ESMP. The organizational structure of the E&S PMU should also reflect the range of complete competencies to perform the tasks detailed in the E&S Management plan and the RAP.
- The development and management of registers for the proper documentation and tracking of environmental and social training, E&S incidents and E&S related complaints.

9.3 Framework Environmental and Social Management Plan Framework

The framework ESMP is presented in Table 9-1below. In addition to detailing the proposed mitigation actions according to pre-construction, construction and operations phases, the framework ESMP also indicates the organisation responsible for implementing the action, the timeframe of implementation, as well as the monitoring needs connected to the implementation.

Table 9-1: Framework Environmental and Social Management Plan

Description of the potential impacts (and risks) (Structured based on the identified Environmental/ Social Aspect)	**Proposed Mitigation** (based on the proposed mitigation from chapter 8 based on the identified, assessed and evaluated impacts)	**Responsible** (who is responsible for implementing of the mitigation)	**Estimation of implementing cost of mitigation measure / EUR**	**Monitoring of implementation** (how to monitor the mitigation)
Environmental and Social Management System				
Cross-cutting environmental and social impacts	Development of an overall environmental and social management system (ESMS) prior to construction start, i.e. prior to pre-construction phase. The ESMS should be updated on a regular basis and be carried forward from pre-construction, to construction, to operations. The ESMS should include a social and environmental assessment, the finalised management programmes for the mitigation measures to be implemented in the three project phases as detailed in the ESIA, organisational capacity, training plans, community engagement, monitoring and reporting. The ESMS should also contain procedures for monitoring the contractors' implementation of the management plans developed as part of the tendering process. An important part of the ESMS is the Emergency Response Plans to cover all three phases of the project.	NAT in cooperation with Project Implementation Unit	Management cost	Environmental and Social Management System manual developed prior to construction start.
Framework ESMP for Pre-Construction Phase				
Soil	Develop soil handling management plan, including suitable storage, transport and disposal of waste at approved disposal sites. Implement spill management measures. Monitor vibrations from civil works. Conduct building survey on right-of-ways.	Contractor	Management cost	Inclusion in ESMS Manual prior to construction start.

Description of the potential impacts (and risks) (Structured based on the identified Environmental/ Social Aspect)	**Proposed Mitigation** (based on the proposed mitigation from chapter 8 based on the identified, assessed and evaluated impacts)	**Responsible** (who is responsible for implementing of the mitigation)	**Estimation of implementing cost of mitigation measure / EUR**	**Monitoring of implementation** (how to monitor the mitigation)
Waste and Hazardous Waste	Agree with relevant authorities on usage of landfill sites and soil dumping areas Contractors to develop Waste Management Plan as part of tender process requirements	NAT Contractor	Management cost	Agreement in place Monitoring plan presented
Water Environment	Develop maintenance plans for construction equipment	Contractor, supervised by NAT	Management cost	Monitoring plan presented
Air Quality and Dust	Implement ambient air quality monitoring programme Contractor to develop dust management plan as part of tender process requirements	Contractor, supervised by NAT Contractor	250-300 per location/per 8 hour shift	Monitoring plan and results presented
Noise and Vibration	Implement noise and vibration monitoring	Contractor, supervised by NAT	1250 per location, 420 per location	Monitoring plan and results presented
	Implement building survey along right-of-ways	NAT in cooperation with Project Implementation Unit	Management cost	Survey plan and results presented
Public Utilities and Traffic	Develop and operationalize detailed plans for utility and traffic deviation.	NAT and public authorities	Management cost	Detailed plans developed
Visual and Functional Intrusion	Agree on re-vegetation and urban facility plans prior to construction start. Select designs to minimise visual intrusion.	NAT in cooperation with Project Implementation Unit	Management cost	Re-vegetation and urban plans approved by local authorities
Biodiversity and Nature Conservation	Replant trees and re-establish green areas after completion of utility diversions.	NAT and public authorities	Management cost	Detailed plans developed
Archaeological and Cultural Heritage	Perform additional study to determine level of risk Develop chance find procedure	NAT in cooperation with Project Implementation Unit	Management cost	Study performed and assessed Procedure in place

Description of the potential impacts (and risks) (Structured based on the identified Environmental/ Social Aspect)	**Proposed Mitigation** (based on the proposed mitigation from chapter 8 based on the identified, assessed and evaluated impacts)	**Responsible** (who is responsible for implementing of the mitigation)	**Estimation of implementing cost of mitigation measure / EUR**	**Monitoring of implementation** (how to monitor the mitigation)
Public Utilities and Traffic	Completion and agreement on traffic diversion plans before public consultations and construction start	NAT and relevant authorities	Management cost	Traffic diversion plans finalised and communicated to affected communities
Socio-Economic Effects	Encourage contractors to make use of local labour opportunities	NAT	No cost	
Labour Standards and Occupational Health and Safety	Development of a Health and Safety at Work Policy with complementary procedures, hazardous risk assessment for development of Emergency Response Plan Contractor to develop Staff Training and Health and Safety Management Plans as part of tender process requirements	NAT in cooperation with Project Implementation Unit Contractor	Management cost	OHS components of overall ESMS developed and implemented prior to construction start
Framework ESMP for Construction Phase				
Soil	Develop and operationalize waste management plan (WMP), including suitable procedures for storage, transport, and disposal of waste at approved disposal sites. Develop procedures for spill management measures Monitor vibrations from civil works. Monitor building condition on right-of-ways	Contractor	Management cost	WMP developed Spill management procedures developed
Waste and Hazardous Waste	Provide waste management instructions for the contractor and require waste management plan Ensure registration of waste quantities and final disposal is controlled in Waste Records – Environmental Register and Hazardous Register Propose arrangements for waste storage, transport, recycling and treatment in close	NAT Contractor supervised by NAT	Management cost	Instructions provided and requirements made Waste records developed Arrangements proposed

Description of the potential impacts (and risks) (Structured based on the identified Environmental/ Social Aspect)	**Proposed Mitigation** (based on the proposed mitigation from chapter 8 based on the identified, assessed and evaluated impacts)	**Responsible** (who is responsible for implementing of the mitigation)	**Estimation of implementing cost of mitigation measure / EUR**	**Monitoring of implementation** (how to monitor the mitigation)
	cooperation between the responsible Cleansing and Beautification Authorities of the respective Districts, the contractor and NAT Establish Environment Assessment Program Contractors to develop Waste Management Plan as part of tender process requirements			
Water Environment	Apply competent measures to prevent accidental spills and process discharges Apply strict measures to protect water courses from any expected pollution due to illegal dumping of waste. Monitor groundwater depth and substitute damaged wells if any.	Contractor supervised by NAT	Management cost Under investigation	Spill management procedures developed Measures applied Monitoring plan and results
Air Quality	Prepare Dust Management Plan (DMP) for each specific site including site map indicating location of physical barriers such as fencing, location of stockpiles and storage areas, traffic routes and stabilised site access/exit points, presentation of dust control measures to be used on site, and dust management checklist Apply dust management measures	Contractor supervised by NAT	Management cost	DMP developed Management measures applied
	Adopt stricter emission requirements with respect to emissions of particulate matter and NOx such as EURO V for heavy vehicles and EU requirements to mobile construction machinery and equipment (subject to monitoring results)	NAT	Management cost (resulting in costs for contractors)	Emission requirements adopted
	Use diesel particulate filters Use NOx Control Technologies Inspect and adjust fuel systems	Contractor supervised by NAT	5-10,000 Varies	PM filters and NOx control tech applied Inspection and maintenance

Description of the potential impacts (and risks) (Structured based on the identified Environmental/ Social Aspect)	**Proposed Mitigation** (based on the proposed mitigation from chapter 8 based on the identified, assessed and evaluated impacts)	**Responsible** (who is responsible for implementing of the mitigation)	**Estimation of implementing cost of mitigation measure / EUR**	**Monitoring of implementation** (how to monitor the mitigation)
	Visual inspection of exhaust gases from construction machinery and vehicles Establish documented maintenance programme			programme developed
	Implement air quality monitoring programme	Contractor, supervised by NAT	250-300 per location/per 8 hour shift	Monitoring plan and results presented
Noise and Vibration	Implement noise control measures, including: Scheduling of noisy activities in consideration of daytime and night time noise limits Configure the construction site in a manner that keeps noisier equipment and activities as far as possible from noise sensitive locations Use equipment modified to reduce noise Provide for and use of temporary noise-insulating barriers	Contractor supervised by NAT	Management cost	Noise control measures planned for and implemented
	Implement noise and vibration monitoring Conduct assessments of building condition along right-of-ways	Contractor, supervised by NAT	1,250 per location, 420 per location	Monitoring plan and results presented
	Conduct noise impact study to adequately assess the impact of the operation of the metro in areas along the at-grade and elevated sections of the metro line	NAT	Estimated at 10,000 by local consultant	Study implemented and results controlled
	Install noise barriers, subject to result of noise impact study	NAT	Estimated at 200 per meter by local consultant	Noise barriers installed
Visual and Functional Intrusion	Apply the combined design guidelines Implement the detailed context planning scheme and beautification measures Develop plans for re-establishing green recreational areas immediately after construction. Prepare Management Plan for the surface	NAT	1-2 % of construction costs	Design guidelines applied and context planning implemented Plans developed

Description of the potential impacts (and risks) (Structured based on the identified Environmental/ Social Aspect)	**Proposed Mitigation** (based on the proposed mitigation from chapter 8 based on the identified, assessed and evaluated impacts)	**Responsible** (who is responsible for implementing of the mitigation)	**Estimation of implementing cost of mitigation measure / EUR**	**Monitoring of implementation** (how to monitor the mitigation)
	facility sites of the stations			
Biodiversity and nature conservation	Replant trees and re-establish green areas.	Contractor supervised by NAT	Cost included in visual intrusion costs	Green areas re-established
Archaeological and Cultural Heritage	Carry out additional study required to perform a thorough investigation of the potential impact on historical buildings. Develop chance-find procedure.	NAT	Consultancy fee being investigated	Study implemented Procedure developed
Public Utilities and Traffic	Develop detailed plans for traffic management	Contractor supervised by NAT	Management cost	Plan developed
Urban Development	Establish a planned process for urbanization of the area.	NAT	Management cost	Plan developed
Socio-economic Effect	Encourage contractors to make use of local labour opportunities	NAT	No cost	
Labour Standards and Occupational Health and Safety	Incorporate OHS and ILO labour standard compliance into contractor's contracts and ensuring enforcement through comprehensive inspections. Development of a Health and Safety at Work Policy with complementary procedures, hazardous risk assessment for development of Emergency Response Plan. Contractor to develop Staff Training and Health and Safety Management Plans as part of tender process requirements.	NAT Contractor	Management cost	OHS components of overall ESMS developed and implemented prior to construction start
Community health and Safety	Carry out noise, air quality and dust monitoring. Carry out timely and appropriate community liaison.	Contractor supervised by NAT	Management cost. Monitoring cost est. under aspect	Monitoring planned and implemented

Description of the potential impacts (and risks) (Structured based on the identified Environmental/ Social Aspect)	**Proposed Mitigation** (based on the proposed mitigation from chapter 8 based on the identified, assessed and evaluated impacts)	**Responsible** (who is responsible for implementing of the mitigation)	**Estimation of implementing cost of mitigation measure / EUR**	**Monitoring of implementation** (how to monitor the mitigation)
Involuntary resettlements (incl. vulnerable groups)	Implement Resettlement Action Plan prior to expropriation and relocation activities including dialogue with PAP, appropriate and adequate compensation and provision of alternative locations for resettlement.	NAT in cooperation with PIU	Management cost	Compensation scheme implemented
Framework ESMP for Operations Phase				
Soil	Develop procedures for spill management measures Monitor vibrations from operations Monitor building condition on alignments	Contractor	Management cost	Spill management procedures developed
Waste and Hazardous Waste	Waste management plans to cover Metro stations and surroundings	ECM	Management cost	Waste management procedures developed as part of overall ESMS for operations phase
Water Environment	Apply appropriate measures to prevent accidental spills and process discharges Monitor groundwater depth and substitute damaged wells	ECM	Management cost	Management procedures developed as part of overall ESMS for operations phase
Noise and Vibration	Carry out regular maintenance of rail tracks, metro trains, and facilities	ECM	O&M cost	Maintenance implemented
	Implement noise and vibration monitoring during operation Monitor building condition on alignments	ECM	Management cost	Monitoring plan and results presented
Visual and Functional Intrusion	Maintain re-greening and re-organisation of the urban environment	ECM and relevant authorities	Management cost	Planted areas maintained
Urban Development	Encourage a planning process considering how the areas around the stations and alignments will be developed	ECM and relevant authorities	Management cost	Formal plan or vision developed
Labour Standards and Occupational Health and Safety	Development of a Health and Safety at Work Policy with complementary procedures to cover operations phase. Should be in line with international and Egyptian labour	ECM	Management cost	Management procedures developed as part of overall ESMS for operations phase

Description of the potential impacts (and risks) (Structured based on the identified Environmental/ Social Aspect)	**Proposed Mitigation** (based on the proposed mitigation from chapter 8 based on the identified, assessed and evaluated impacts)	**Responsible** (who is responsible for implementing of the mitigation)	**Estimation of implementing cost of mitigation measure / EUR**	**Monitoring of implementation** (how to monitor the mitigation)
	standards. Develop Emergency Response Plan to cover operations phase based on comprehensive metro line 3-level hazardous risk assessment. Ensure that it is communicated to relevant stakeholders.			
Community Health and Safety	Develop Emergency Response Plan to cover operations phase based on comprehensive metro line 3-level hazardous risk assessment. Ensure that it is communicated to relevant stakeholders.			Management procedures developed as part of overall ESMS for operations phase

Source: Consultant's assessment

9.4 Emergency Response Plan

The HSE Unit will also be responsible for the implementation of emergency measures related to lighting, fire fighting, emergency exits, ventilation shafts failure, in the Cairo Metro Line 3 Phase 3 project, during the construction and operation phase. The Emergency Response Plan identifies areas, population and structures likely to be affected. It shall also include preventive action, notification, warning procedures and co-ordination among various authorities.

Furthermore, according to FIDIC requirements the contractors Emergency Response Plan should provide suitable arrangements to cater for emergencies, including:

- *First aid equipment (dressing etc.);*
- *Person(s) trained to administer first aid;*
- *Communication with, and transport to, nearest hospital with an accident emergency department;*
- *Monitoring equipment;*
- *Rescue equipment;*
- *Fire fighting equipment; and*
- *Communication with the nearest fire brigade station.*

Emergency Lighting

The emergency lights operated on battery power shall be provided at each station. The battery system shall supply power to at least 25% of the lights at the station, platforms, and tunnels or viaducts. The underground stations shall have transformers at each end of the platforms. Both the transformers need to be kept energized and shall feed independently alternate rows of lights to avoid complete darkness in the event of one of the transformers' failure. The tunnels need to be provided with fluorescent lamps at a reasonable spacing (EQI 2012:209).

Fire Fighting Measures

The building materials shall be fire-resistant. Wood shall not be used for any purpose, excluding artificial wood products, which are flame resistant. The electrical systems shall be provided with automatic circuit breakers activated by the rise of current as well as activated by over current. The design of the stations shall include:

- *Fire prevention measures*
- *Fire control measures*
- *Fire detection systems*
- *Means of escape*
- *Access for fire fighting squad*
- *Means of fire fighting*

Accumulation of solid waste including flammable materials like paper and plastic constitute a major fire hazards and should be controlled. All aspects of fire prevention and control shall be dealt in close collaboration with the city fire fighting authority. Smoke control shall be achieved by the following means:

- *Down stand bulkheads shall be provided around openings for escalators, lifts and stairs in underground stations;*
- *In underground stations the ventilation system shall be designed to extract smoke in the event of fire; and*

- *In enclosed public areas of above ground stations arrangement for smoke extraction shall be provided.*

A minimum of 30 minutes supply of water must be assured in the case of fire. The pumps/overhead tanks shall have the capacity to discharge the water at the rate of 1,100 litres per minute at a head of 21 m at the nozzle mouth.
The storage capacity in an underground or overhead tank may be divided into two parts, i.e. dead storage and running storage. Fire fighting pumps shall be provided with a diesel pump as a standby arrangement, in case of power failure (EQI 2012:209).

For fire of electrical origin, water cannot be used until the electric system has been made dead and earthed. For electrical fires, non-aqueous agents like ABC Power Chloro-Bromo Methane or CO2 gas should be utilized. Fire extinguishers with these agents shall be liberally provided at static installations and on the rolling stock. Smoke needs to be transported away from the site of the fire. In order to achieve this, both fresh air has to be introduced into the underground section and exhaust gases shall be sucked out from other section.

Openings, including ducts and passages, shall be protected by fireproof doors, fire shutters, fire dampers etc. as appropriate. Fire detection and alarm systems shall also be provided.

Preparing the fire fighting plan, the HSE Unit will:

- *Identify the human, administrative and organizational elements as well as the equipment and locations necessary to fight hazards;*
- *Identify human resources for the management of emergency incidents;*
- *Identify the required types of training for participants in the plan, with specific execution timelines;*
- *Draw maps of available resources for fire emergencies locating the emergency management centres, fire fighting and medical aid equipment, as well as evacuation points specifying the time-line for escape;*
- *Identify the concerned parties bound to provide support and services in emergency incidents, specifying the kind of help requested for rescue missions and fire fighting, ambulance and medical care. The mechanism for making emergency calls shall also be specified; and*
- *Check the maintenance programmes for the all fire-fighting.*

(EQI 2012:210)

The emergency response plan shall specify which workers will be responsible for communicating the hazard to all workers on-site and ensuring their awareness on the nature of the hazard. A provision for an ambulance or a field clinic on–site shall be guaranteed to provide the injured with medical care and transport them to hospital.

There will be a mechanism to report incidents involving injuries, property damage, environmental damage, and near-accidents. Such information and records will be used to improve response procedures, and minimise potential hazards. General information to be recorded includes:

- *Date, time, and location of the incident or emergency;*
- *Person or people involved or affected;*

- *Description of the situation and site conditions;*
- *Identification and estimated extent of injury, loss, damage, or contamination;*
- *Actions used to control the extent and severity of the situation; and*
- *Documentation of remediation measures or clean-up actions taken to restore or mitigate the situation.*
- *(EQI 2012:210)*

Post Emergency Actions

After overcoming an emergency, a comprehensive survey of the incident site shall be performed to make sure the hazard is totally removed and to restore the situation to the pre-accident status. Post emergency activities are designed to:

- *Define the causes of the emergency;*
- *Assess efficiency of procedures carried out for emergency response;*
- *Propose corrective measures required for implementation to prevent the occurrence of new accidents of this type;*
- *Determine the need for implementing remediation and/or monitoring measures for the recovery of the affected area; and*
- *Monitor health recovery for those who may have been affected.*

Revising and Updating the Emergency Response Plan

Prior to the construction phase, procedures will be established for consolidating the plan with specific information required for its implementation. This will include specific site information, responsibilities of personnel, contractor information, contact information, etc. The plan will be updated on a frequent basis due to changes in relevant information (EQI 2012:211).

9.5 Waste Management Instructions

The following instructions are recommended to be integrated into the ESMP as part of the contractors obligations. They cover recyclable solid waste and non – recyclable solid waste management, domestic and other solid wastes management, hazardous waste management and medical waste management. In addition, instructions for earthwork waste management, including construction / road cover wastes, excavation soil wastes and wet excavation soil

Instructions for Solid Waste Management

Recyclable Solid Waste Management Instruction

The recyclable solid wastes collected in the worksite facilities will be sorted according to the following classification:

- Metal
- Glass
- Paper and Cardboard
- Plastics

The contractor has to take care about waste separation on site. For this, separate containers for waste types have to be provided with clearly named labels (even better in different colours) according to the following Groups:

- Metal, which can be filled with e.g. used
  - Oil cans,
  - Other cans

  - Preserve cans
  - Cans and aluminium drinks boxes
- Glass**.** which can be filled with e.g. used
  - Glass bottle
  - Glass jars
- Paper and Cardboards, which can be filled with e.g. used
  - Newspapers
  - Used other papers
  - Package cardboards
  - Other Cardboards
  - Drink and milk boxes (Laminated cardboard)
- Plastics, which can be filled with e.g. used
  - Polyethylene (PE) containers,
  - Cleaning, Shampoo and detergent bottles,
  - Motor oil bottles,
  - Trash bags
  - Polyvinylchloride (PVC) Packages of water and liquid detergents,
  - Polyethylenetetrafthalate (PET) for water, soft drink and oil bottles (light)
  - Containers for some chemical substances,
  - health and cosmetics products
  - Polypropylene (PP) Lids of detergent boxes,
  - Polystrene (PS) for food containers as e.g. Yoghurt and margarine containers

Specific collecting container of each waste group should be delivered to the worksite by the Governorate or its subcontractor. In case these can't be provided, solid waste containers of proper qualities will be provided from the market.
In regular intervals should the waste be collected and disposed to the respective dumping and recycling sites by the respective subcontractor or private organisation. The waste amounts collected and delivered shall be recorded by the relevant responsible person on the construction site and the final disposal site The record details covering the collection and the delivery date will be entered in the forms of *"Waste Record"* and will be sent to the respective management unit on the construction site.

Non – Recyclable Solid Waste Management Instruction
Non-Recyclable Solid Wastes will be kept in the Non-Recyclable Solid Waste container. Similar to the recyclable solid waste management instruction, The record details covering the collection and the delivery date will be entered in the forms of "Waste Record" and will be sent to the respective management unit on the construction site.

Domestic Solid Waste Management Instruction
The proper trash containers for solid waste will be placed in the worksite field and will be collected periodically by the waste collecting vehicles of the related Government authority or its subcontractor. Wastes from the dining hall as organic food wastes shall be stored separately at a cool place (preferable in cool containers) where they will be collected regularly by private companies which might use the waste for animal feeding. Other domestic wastes with origin from the offices will be collected in the trash containers

Instruction for the Other Solid Wastes

It is recommended to collect solid waste substances which are bulky and could be harmful for the other construction material such as, wood debris, scrap iron, nails and similar items remaining from the construction process, at locations on the worksite where they are not disturbing the on-going construction process.. The accumulated waste materials will be transported to the disposal site to be indicated by the responsible governorate. It is recommended also to keep data in the "Waste Record" form.

Instruction for Hazardous Waste Management
Hazardous wastes like printer cartridges, toners from the offices, expired batteries, fluorescent bulbs, welding electrodes, empty cans, boxes of chemicals similar to dye and thinner, dangerous wastes like gloves, fabrics and similar, contaminated by hazardous wastes shall all be collected on the hazardous waste sites inside the construction area. This location should be located in a controlled area and should be equipped with relevant warning signs. The containers will be covered in order to protect them against the effects of rain and wind.
The hazardous waste material collected will be transported to the respective designated hazardous landfill site respectively location on the landfill site, specified by the landfill operator. For this type of waste, it is of utmost importance to register the date, the volume of the transporting vehicle and the kind of treatment in the forms of the "Waste Record" by the staff in charge. It is essential to collect the hazardous wastes separately from the other wastes and keep the collected waste separately in special designed location at the temporary hazardous waste storage site inside the fenced construction site. Transport has to be organized in regular intervals and transport has to be done in special designed transport vehicles, which will be provided by private companies.

Instruction for Medical waste Management
Medical Wastes should be collected by the respective medical person on the construction site. It will be stored in special indicated bags. The bags will be delivered to the next hospital which operates an medical waste incineration plant.

Instruction for oil, chemical substances and lubricants from onsite machines
The used oils emerging from the tunnel machines and other construction machinery should be refilled in their original containers. The waste oil containers will be collected in a covered storage site protected against rain and wind.

Oil filters coming from respective machines should be collected in a separate covered container located next to the temporary storage tanks of waste engine oils. Used oil and oil filters are treated different from the other wastes. They should never be thrown in the trash baskets or sent to the trash storage sites. Instead a separate container for used oil filters, with the label "Oil Filter" should be made available.
The ground where the tanks and containers are located should be impermeable, the store should be lockable and measures should be taken against spillage and fire.
It is of utmost importance, not to add to the waste oil any fluid such as, gasoline, fuel oil, detergent, dye, solvent, antifreeze or diesel oil. Never pour it into a medium like soil, water, sewerage system, trash container, etc., never burn it in stoves and boilers. The optimum situation would be if close to the construction site exists a petrol station or workshop with an oil collection point, to where the oil can be delivered.

Instruction for Earthwork Waste Management
Earthwork wastes management has to be discussed by two areas as Construction / Road Cover Wastes and Excavation Soil

- Construction / Road Cover Wastes

- A waste material which emerges during the removal of asphalt and concrete during the construction activities should be checked regarding possible reuse. In cases where this is not possible, the waste has to be transported to a dumpsite, indicated by the CBA. The numbers of truck trips and their respective dates will be entered in the relevant form by the person in charge. An “Acceptance Certificate” has to be obtained by a Sub-contractor, who will transport the construction waste to the designated dumping site. The document will be registered by the Occupational Health and Safety Manager (OHSM) in charge of environment management during the Construction.
- Excavation Soil Wastes
- The material, origin from the tunnel earthwork has to be transported to the final disposal sites. Again a permit application is needed from the relevant Governorate to obtain the right to dispose the soil. Interim storage sites should be located at areas close to the excavation sites specified in advance. In case it is a wet soil, it has to be dewatered. At the interim storage sites, location should be secured in order to prevent soil contamination. The transportation of the soil to a designated landfill needs – as for the construction waste - an “Acceptance Certificate” issued by the respective Governorate. The document will be registered by the Occupational Health and Safety Manager (OHSM) in charge of environment management during the Construction.
- Both types of wastes have to transport by licensed sub-contractor firms authorized by the Ministry of Environment and the CBA´s.
- Wet Excavation Soil
- Contaminated underground waters emerging during activities for the tunnel boring and other large/small engineering works could appear and need to undergo a sedimentation process in sedimentation pools on the work site. The remaining water has to be discharged into the sewage network. Samples collected from the waste waters should be analysed in regular intervals according to their compliance with the water quality analysis parameters as e.g. DO, COD, oil and grease, and pathogenic bacteria.

9.6 Design Change Procedure

In case if serious concerns resulting from public consultations or due to the technical needs might arise, the following design change procedure should be applied, involving the Contractor, NAT and other relevant stakeholders.

- Consideration of design change
  This initial stage is where the need for a proposed design change is considered and developed (if warranted) by ATAS. It will be based on stakeholder consultation submissions.
- Design change development
  The proposed design change is developed to an appropriate level of detail to allow provisional assessment within the design change management system.
- Design change screening
  This is a rapid and desk-based assessment of the proposed design change and the purpose of this stage is to determine if there might be the potential for any significant negative impacts on environmental & social or cost. The concept of significant impacts will be that as contained in the ESIA Report. Generally a significant impact is where a legal or accepted environmental standard is exceeded or where a designated and protected area (e.g. nature conservation area) is being harmed. An affect which may impact on a large population can also be considered significant.

The rapid assessment will cover the following criteria:
1. Programme;
2. Constructability and engineering risks;
3. Strategic cost implications[1];
4. Operational and maintenance (including traffic issues);
5. Environmental and social (including environmental standards);
6. Compliance with relevant health & safety regulations and standards;

Against each of above criteria, a rapid assessment will be undertaken and the results presented in the format as illustrated in Annex A.

4A/B: Screening results

Depending on the results of the screening stage, the two potential outcomes are:

4A: Here there are no significant implications or negative environmental & social impacts but there are changes in the design criteria, such as overall cost, programme and constructability; or

4B: Where there are both significant implications and environmental & social impacts and also changes in the design criteria.

5: New Design / Definition of Impacts
If there is an outcome according to 4A or 4B: Undertake further design work and/or incorporate mitigation measures to remove significant environmental and social effects.

6: *Administration review and approval from NAT*
The proposed design change and the associated screening results (stage 3) will be reviewed and approved by NAT.

7A: Prepare Design Change Report
If there are no E&S implications of the proposed design change, then NAT will prepare a Design Change Report, and inform the Lenders.

7B: Prepare Design Change Report and ESIA Addendum
If there are unmitigated E&S implications and additional impacts, then NAT will prepare the Design Change Report and this report will be part of the ESIA report as an Addendum.
The Report and Addendum will then be issued to Lenders for their information.

8: Disclose results and consult affected stakeholders
The Design Change Report and the ESIA Addendum will be disclosed and a period of public consultation undertaken.
Disclosure and public consultation will be undertaken through the Project website and will also be advertised by a newspaper notices. Affected people, in the affected area will be notified directly. The additional public consultation will be notified within 30-days. Consultation and meetings may also be required with stakeholders. Lenders will be kept informed of such matters at reasonable frequencies.

(1) This is not intended to be a detailed costing of the proposed design change. It is a strategic and preliminary view on the cost implications but it will provide a quantification of the cost which will be subject to change and confirmation where requested by the Lenders. SYSTRA to also indicate the implication for cost contingency budgets and fiscal implications for the various elements in the lending mechanism and structure.

9: Review findings of Disclosure and public consultation
Once the additional disclosure and consultation period has concluded, a review of all submissions received will be undertaken and the proposed change and ESIA Addendum amended if required.
A summary of this consultation (and how it affected the Addendum and the design change) will then be issued to Lenders for their information.

10: Approval of design change
The final stage involves approval of the overall design change by NAT on the basis of the responses to the consultation process.. This decision is made by NAT and the Lenders will be informed of the basis of the decision, and provided with the opportunity to comment should the design change be contentious.
Each separate proposed design change iteration should be separately recorded through an individual design change form (and other reporting documentation, where necessary) and made available when requested.

11: Inform specific stakeholders
In addition to general disclosure of the acceptance and implementation of the design change, NAT will directly inform specific stakeholders in writing of the outcome where the design change process was initiated on their initial suggestion.

The following scheme in the figure below and its related form template summarizes the above mentioned steps:

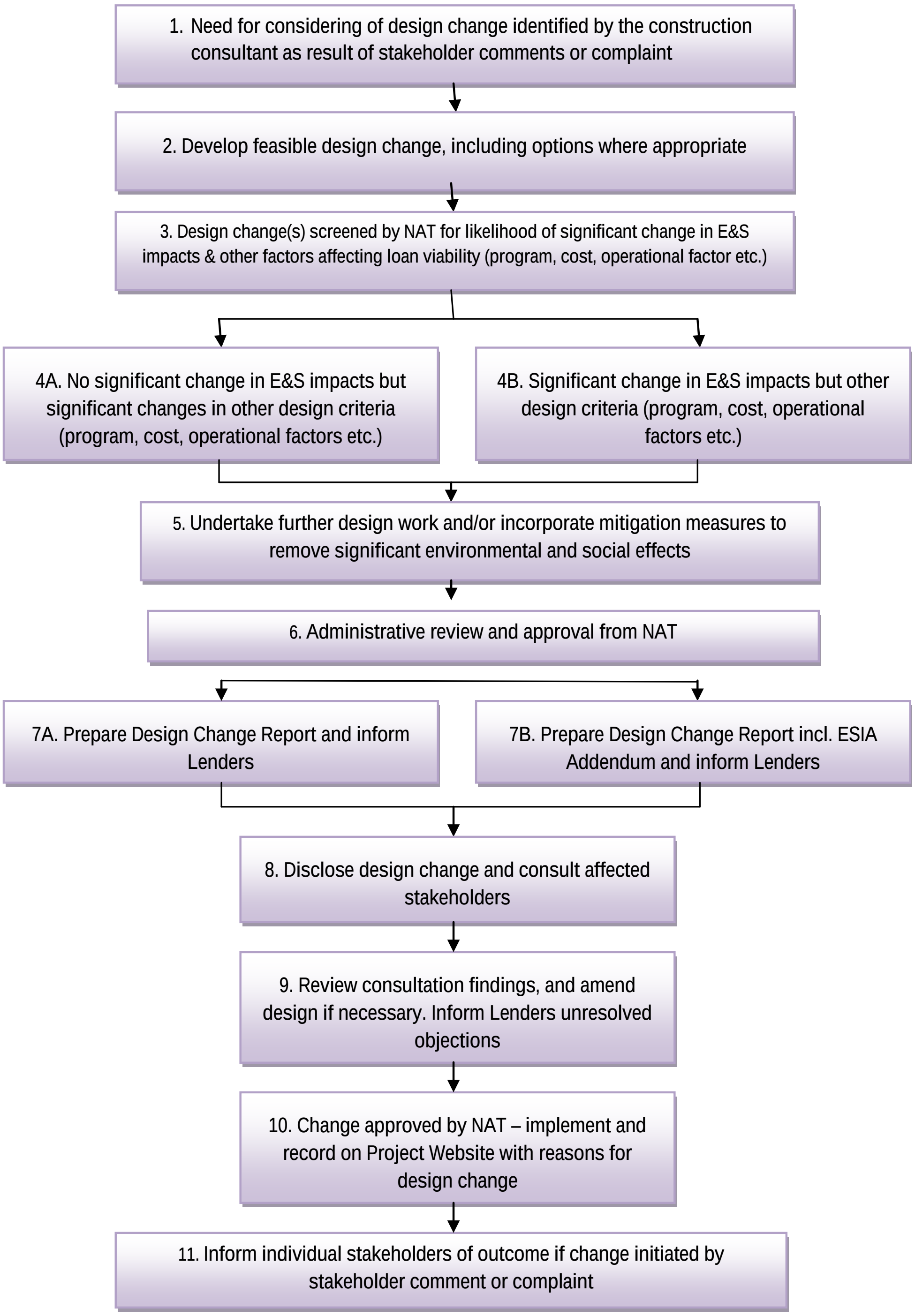

Figure 9-1: EIB Design Change Procedure

Table 9-2: Proposal for Indication of Design Change

<table>
<tr><td colspan="3">METRO LINE 3, PHASE 3: DESIGN CHANGE MANAGEMENT SYSTEM: SCREENING MATRIX</td></tr>
<tr><td colspan="3">Date: XX</td></tr>
<tr><td colspan="3">Reference: XX</td></tr>
<tr><td colspan="3">Summary of Proposed Design Change:
[Example] Change of 200 m radius of alignment between El Bohy and EL Kawmeya Street
A 180 m radius is proposed at the junction of El Bohy and El Kawmeya Street to allow a wider distance of 6.50 m to the houses at El Bohy Street . Originally the distance was about 3m only, which caused an in-adequate visual intrusion to the buildings. See drawing nos. …….. (attached)</td></tr>
<tr><td>Appraisal criterion</td><td>Appraisal of Design Change implication</td><td>Significant change (Y/N)</td></tr>
<tr><td>Change in strategic cost implications</td><td>Quantification of preliminary cost implications for the proposed design change.</td><td></td></tr>
<tr><td>Change in ease and risks of construction</td><td>Construction norm must be checked for exceptions and additional design needs to meet the design standards</td><td></td></tr>
<tr><td>Change in ease and risk of operation</td><td>No change</td><td></td></tr>
<tr><td>Health and safety risks</td><td>• Improved health and safety for the residents through the new designed alignment</td><td></td></tr>
<tr><td>Environmental issues:
• air and noise
• water and soils
• biodiversity
• cultural heritage/landscape</td><td>• Reduced potential visual intrusion, noise and vibration leading to an improvement in livelihood of the affected residents.</td><td></td></tr>
<tr><td>Social issues:
• land use and expropriation
• community disruption
• socio-economic impact</td><td>• The new design will – as already designed for the rest of the elevated alignments - require the construction of absorption shields on both sides of the alignment.</td><td></td></tr>
<tr><td colspan="3">Summary and Conclusions:

[Example] Change results in improved H&S and no significant increase in environmental impact.</td></tr>
<tr><td colspan="3">Lenders informed of design change: Y/N
Date:</td></tr>
</table>

9.6.1 Roles and Responsibilities

SYSTRA France has launched an E&S management system tender package which will be applied for the tender process for the construction of Metro Line 3, phase 3. The terms and conditions set out the general and specific environmental and social governance provisions applicable to the works contracts for the implementation of phase 3 of the Cairo Metro Line 3 and supplement the general conditions and other contractual documentation comprising the contract. They indicate what is expected and specify the contractor's duties in relation to E&S system that must be taken into account when responding to the invitation to tender on the one hand and when planning and implementing their works on the other. The contractor shall include an E&S Management Plan for the project in his tender, covering all plans and procedures required during project implementation. Specification of the master plan requirements are given in the tender package.

E&S roles and responsibilities are defined as follows:

Responsibilities of NAT:

- Establish ownership and responsibility of action in the E&S Unit Director set-up (see chapter 10, figure 10-2)). This should act with the purpose of ensuring their knowledge on various topics related to local and international regulations;
- Ensure proper implementation and monitoring of the process through regular reporting on E&S performance
- Participate as required in the E&S Committee organised by SYSTRA with the contractors' E&S representatives; and
- Carry out or commission audits and inspections of the E&S management system implemented by the contractors; and
- Build on E&S management system indicators provided by the contractors to communicate on E&S system performance.

Responsibility of SYSTRA:

- Appoint an E&S officer within the team, who will interface between NAT and the companies' CSR managers;
- Assist NAT in implementing the communication plan;
- Ensure awareness among the teams on local and international E&S system issues;
- Promote E&S system issues to local stakeholders;
- Lead monitoring from the site preparation phase, including e.g. updating of E&S management system master plan for the implementation phase; validating E&S management system documents issued by contractors; and
- During the construction phase: site visits and audits to verify compliance of the implementation with the CSR specifications, issue of summons to contractors in case of non-compliance, organise meetings and trainings with contractors managers.

Responsibility of the Contractor:

- Undertake to implement the E&S Management Policy of the Cairo Metro line 3, Phase 3;
- Set up the organisation, resources, tools and methods to meet requirements;
- Appoint an E&S officer within the team who will be responsible of implementing and monitoring compliance with the project's E&S management system approach throughout the work, and accompanying SYSTRA/NAT on site visits;
- Provide regular monitoring indicators for E&S management system site reporting;

- Training and awareness of employees, also ensuring the application of these provisions by suppliers and subcontractors; and
- Verifying the implementation of E&S management system requirements and analysing non-compliance and implementing and monitoring corrective actions.

The contractor is required to draft a Preliminary Environmental and Social Management Plan for the project and submit it to NAT for review and comment. From the bid phase onwards, all the requirements and measures agreed to by the contractor will be applicable to its subcontractors and suppliers. The contractor shall be responsible for ensuring these measures are implemented effectively.

Contents of the Contractor's E&S Management Plan as specified by SYSTRA:

- Staff Training Plan
- Health and Safety (HS) Management Plan
- Environmental Management Plan
- Waste Management Plan
- Dust Management Plan
- Traffic Management Plan
- Monitoring of the E&S management system Construction Master Plan

10 STRENGTHENING OF INSTITUTIONAL CAPACITY FOR IMPLEMENTATION OF THE FRAMEWORK ESMP

10.1 Introduction

The following sections in this chapter detail the conditions needed for the implementation of the ESMP framework in terms of strengthening the institutional capacity of NAT and other key stakeholders. The following is recommended as complementary activities to the ESMP framework:

- Establishment of an Environmental and Social (E&S) Unit
- Responsibility of Community Relations and Resettlement Issues
- Responsibility of Health and Safety Issues
- Responsibility of Environment

10.2 Establishment of Institutional Capacity

Implementation of the ESMP will require the establishment of an effective institutional entity to undertake these environmental and social management obligations. The institutional responsibility of implementing the ESMP during the construction phase lies with the National Authority for Tunnels (NAT), when the Metro Line 3, Phase 3 is going into the operation phase this responsibility will be handed over to the Egyptian Company for Metro (ECM) who will be responsible for assuring that operation activities are conducted in a manner which would minimize potential adverse impacts.

As part of the Greater Cairo Metro Line 4, Phase 1, the Japan International Cooperation Agency (JICA) has prepared a feasibility study and an EIA, including Management Requirements for the implementation. As part of this study the existing institutional situation of NAT were analysed and recommendations for improving their capacity included the setup of a PMU. However, so far NAT has not taken steps to embrace the recommendation for capacity improvement, although a committee of NAT technical department engineers with experiences in the environmental affairs and pollution has been formed. NAT has commissioned Dr Magdy Abd El Rahman to perform all the supervision works on the environmental study for Line 3 & Line 4.

A TA to NAT is planned via an EU NIF grant finance programme that will see the establishment of a PIU to build EHS capacity at NAT.

10.2.1 Establishment of an Environment and Social (E&S) Unit

Currently the National Authority for Tunnels (NAT) does not have a specific entity within its structure responsible for environment, health and safety. It is thus proposed to establish a E&S Unit (similar to the HSE department described below) within NAT, and locate it at the same level as the other technical and financial departments as shown in figure 10-1.

A Health, Safety and Environment (HSE) department was already established within the Egyptian Company Metro since 2005. The HSE unit employs several hundred technicians, specialists and engineers in addition to managers. However, additional capacity development would also be needed within ECM to accommodate the implementation of the ESMP, especially with regard to social and community aspects.

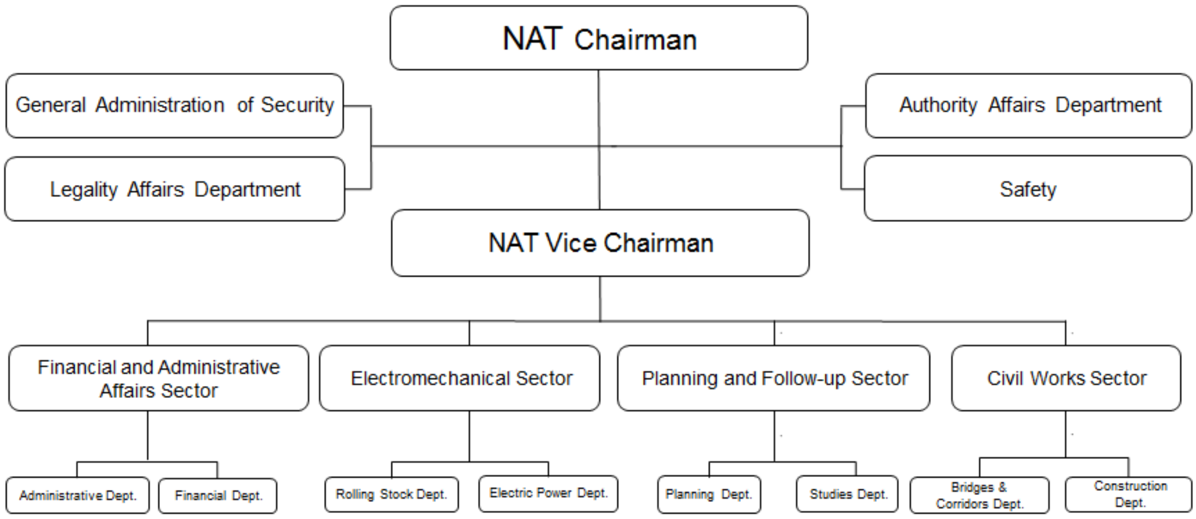

Figure 10-1: Current organisational structure at NAT.

The task of the proposed E&S unit in each of the above entities would be to supervise and coordinate implementation of environmental and social mitigation measures and monitoring schemes. In addition, the department would be concerned with the staff preventive health, environmental protection, ensuring staff safety against injuries and accidents, and the metro line against fire and disasters. Furthermore, the unit should pay due attention to affected communities health and safety, resettlement issues and community liaison, including stakeholder engagement activities and public consultation.

The mandate of the unit would be:

- Ensuring that all three focus areas of the E&S Management Plan are emphasised with the necessary and adequate knowledge and time. As such, the issues of community relations and resettlement, health and safety and environmental issues should have specific resources and staff dedicated to them
- Identification of the national legislation and international standards for social and environmental management relating to the impact of infrastructure development projects;
- Identifying best practice of infrastructure development projects and new solutions to acknowledged challenges impeding the implementation of these;
- *Coordination with the relevant departments within NAT and ECM,* responsible for project implementation to set commitments for safeguarding and preserving the environment;
- *Coordination with other official agencies and local authorities for the reservation of the environment and social aspects as a result of the implementation of the projects in the different Governorates;*
- *Follow-up with EEAA for any amendments to the legislation and decisions relevant to the subject of the environment and social aspects;*
- *Follow-up with EEAA about training or awareness programs that would benefit the HSE department;*
- *Coordination with the regional offices and the competent authorities for the enforcement of surveillance activities, including obligation stipulated in the contracts with contractors or agencies for the implementation of the ESMP;*
- *Request regular reports on ESMP implementation;*
- *Conducting site visits and inspection at the implemented project sites;*

- *Providing reports on compliance with ESMP; and*
- *Ensuring that all resettlement issues are properly addressed and the RAP is enforced. (EQI 2012:193)*
- *The unit would be composed of three areas of expertise, namely community liaison, health and safety, and environment.*

Figure 10-2: Organisational structure of recommended E&S unit to be established in NAT.

<u>Community Relations and Resettlement</u>
The Community Liaison Officer would be responsible for stakeholder engagement, public consultation, management of the grievance and red dress mechanism, and resettlement issues. It is emphasised that the qualifications and competencies of the Community Liaison Officer should ensure that the E&S Unit is able to implement the necessary issues related to the RAP and community relation plans. For this reason, it is recommended that the Community Liaison Officer hold a background within social development and special competencies within resettlement and community relations.

- Supervising the implementation of social mitigation and management measures;
  - Organizing, supervising and/or performing social monitoring activities; and
  - Preparation of monthly reports on the unit's performance.

- Additional specific responsibilities:
  - Establishing a grievance redress mechanism, including procedure for grievance respond;
  - Ensuring that each legitimate complaint and grievance is satisfactory resolved;
  - Ensuring proper administration and records of complaints;
  - Ensuring timely and appropriate information disclosure, including stakeholder information on the NAT website;
  - Ensuring community/media announcements and briefings;
  - Ensuring community relations in affected communities; and
  - Ensuring that all resettlement issues are properly addressed and the RAP is enforced, including cooperation with various government institutions involved in the resettlement/compensations process, as well as PAPs.

The guiding principle to mitigate impacts to communities during construction is to engage in an open and transparent dialogue between NAT and the affected communities. NAT is responsible for the community liaison during the construction phase and should continue consultation in a culturally appropriate manner.

The community liaison officer is responsible to communicate NAT's views and positions to citizens and communities and to maintain effective dialogue and communications with local leaders and organizations. Soliciting community recommendations and cooperation to avoid or lessen disruptions and mitigate risks, monitoring specific situations and generalized disruptions resulting from construction in affected communities, and communicating with local government and public service entities (schools, youth clubs, medical services, etc.) to maintain good community relations is the responsibility of the NAT public liaison office.

All grievances and communications received by the NAT will be registered and the actions taken / responses given will be tracked and recorded for each. Proper administration and internal records of stakeholder complaints and communications are essential for transparency and quality of NAT responsiveness and reporting to stakeholders on the resolution of grievances.

<u>Health and Safety</u>
The Health and Safety Officer would be responsible for preventing and providing protection to the staff against work injuries, preventing diseases, providing first aid treatment for onsite injuries and providing healthcare services for NAT/ECM workforce.

Prevention or at least limiting accidents and providing protection measures should be done in coordination with the related departments of the Ministry of Labour.

- Supervising the implementation of health and safety mitigation and management measures;
- Organizing, supervising and/or performing health and safety monitoring activities; and
- Preparation of monthly reports on the unit's performance.

Additional specific responsibilities:

- Providing adequate protective equipment to personnel, including safety helmets, eye protection, ear (hearing) protection, hand protection, and foot protection as appropriate for the working environment;
- Determining and enforcing guidelines for safe use of dangerous machinery;
- Ensuring adequate warning signs and emergency plans information in all metro user, work and maintenance areas;
- Enforcing maintenance programs for equipment efficiency and injury risk reduction;
- Collaborating with the emergency and fire fighting staff in developing a fire fighting plan
- Ensuring that fire fighting frothy, powder or CO_2 extinguishers are adequately placed in suitable locations;
- Controlling the fire and smoke detection network and conducting periodic fire drills, including periodical drills of staff;
- Ensuring the establishing of equipped first aid units, including health care personnel to provide first aid in case of simple injuries;

- Ensuring that the personnel is adequately trained in using safety equipment, safe industrial practises, safe machinery operation, fire fighting and first aid;
- Ensuring that adequately welfare facilities are provided on site, including drinking water, toilet facilities, and washbasins;
- Taking all necessary measures related to staff health insurance healthcare; and
- Preparing regular reports on the on-site injuries and near-miss[1] including an examination of their causes and methods of prevention.

Environment

The Environmental Officer would be responsible for protecting the environment and communities against pollution. It will also deal with site maintenance and rehabilitation of areas disrupted during the construction phase.

- *Supervising the implementation of environmental mitigation and management measures;*
- *Organizing, supervising and/or performing environmental monitoring activities; and*
- *Preparation of monthly reports on the unit's performance.*

Additional specific responsibilities:

- Ensuring implementation of the noise impact study concerning noise impacts in the operations phase
- Controlling implementation of dust management plan and air emission mitigation measures by construction contractors
- Controlling implementation of contractor's noise mitigation measures
- Controlling implementation of contractor's waste and effluents management measures
- Identification and formulation of additional mitigation and management measures as needed and based on monitoring results and complaints
- *Supervising valuable tree removal and replantation activities during and after the construction phase;*
- *Maintenance and creation of new green areas in and around the above-ground Metro railways and stations; and*
- *Carrying out the tasks related to quality control and the preparation of the Environmental Register required for inspection and follow-up.*
- *(EQI 2012:194)*

Staffing and Training

In order to ensure the competence of the department personnel in undertaking the social and environmental management procedures and implementing the ESMP, training will be administered to the HSE department personnel according to their particular responsibilities as described in Table 10-2.

Constructors' and vendors training and awareness

[1] A near-miss is an accident that nearly happened. Reporting of these are important because it helps to understand which situation could potential lead to accidents and prevent these from happing again.

Contractors' and vendors that perform work on site will be required to show evidence of appropriate health, safety and emergency response training. An orientation program will be developed to advise contractors and site visitors on basic health, safety and emergency procedures such as emergency signals and evacuation routes. Contractors and vendors on short-term assignments who do not have safety and emergency response training will work under supervision of the company staff. (EQI 2012:19)

10.2.2 Establishment of Environmental Register

According to the Executive Regulations of Law 4/1994 concerning Environmental Protection, an Environmental Register shall be kept to be presented to inspecting agencies, whenever requested, to demonstrate the proper functioning of the project and related utilities. The Register will be kept throughout the lifetime of the project. The Register shall include, but will not be limited to, the information listed in Annex XX of the Executive Regulations, whenever relevant. In particular:

- *List of raw materials;*
- *List of products;*
- *List of hazardous materials and wastes;*
- *Waste water analysis results;*
- *Gaseous emissions analysis results;*
- *Workplace noise, dust and heat; and*
- *Solid waste description (quality and quantity).*

(EQI 2012:195)

Table 10-1: Institutional Strengthening Activity

Institutional Strengthening Activity	Position(s)	Need for Training and Technical Assistance	Responsibilities		Cost Estimates (EUR)
			Implementation	Supervision	
Establishing of the E&S unit in NAT and ECM	Director Social/Community and Resettlement Officer H&S Officer Environmental Officer	Establish office Prepare work-plans Prepare job/office descriptions of responsibilities and task manuals Prepare and support staff to effectively implement their functions and responsibilities	Institutional capacity building consultant	NAT/ECM Management	
Training of E&S staff	Director Community Liaison Officer H&S Officer Environmental Officer	Stakeholder engagement Information dissemination Grievance handling Community health and safety Expropriation, compensation and resettlement Occupational Health and safety Emergency Preparedness Reporting of accidents and near-miss Preparation of Environmental Register Supervision Training of trainers Implementation of E&S mitigation and management measures Monitoring	Training and E&S consultant	NAT/ECM Management	
E&S awareness	NAT/ECM general staff, HSE site inspectors	Prepare awareness materials including cases on social and environmental aspects, and good practise of community relations and grievance handling	Public awareness and E&S consultant	NAT/ECM Management	
Training of inspectors	Staff of different NAT/ECM department and operation regions	Inspections on implementation of occupational and community health and safety and environmental measures and E&S management system systems	Training and E&S consultant	NAT/ECM Management	
Training of vendors and contractors	Construction Contractors	Prepare training materials on health, safety and emergency preparedness	Public awareness and E&S consultant	NAT Management	

11 SUMMARY OF PUBLIC CONSULTATION

11.1 Background

EIB requires that public consultation is carried out in the ESIA process allowing the promoter to identify and address public concerns and issues, and to provide the public with an opportunity to receive information and make meaningful input into the project assessment and development.

EIB requirements are developed in accordance with the UN ECE Aarhus Convention[1] on access to information and public participation, in particular promoting public availability of the non-technical summary of the impact assessment study and conduct of meaningful, transparent, and culturally appropriate public consultation of affected communities and provide disclosure of appropriate information in a suitable form.

Furthermore the EEAA's national ESIA guideline also contains provisions for the public consultation process. The EEAA guideline corresponds to the EIB requirements and will as such be covered when fulfilling the EIB requirements.

The public consultations for Cairo Metro Line 3 Phase 3 have taken part in two stages:

- Stage 1, organised and implemented by the consultant EQI in cooperation with NAT in the period October -December 2011, was comprised of:
    - Three (3) scoping meetings held in October 2011 in Zamalek, Imbaba and Mohandessin,
    - A public disclosure meeting on the findings of the ESIA held in December 2011 in Zamalek.
- Stage 2, organised and implemented by Grontmij and EcoConServ in cooperation NAT, was comprised of:
    - Development of a Stakeholder Engagement Plan (May 2012), which is included in the ESIA Volume 3, Appendix 1
    - 2 additional public consultation meetings on 7th and 9th of August 2012 held in El Bohy and Zamalek
    - Development of a Public Consultation Report (August 2012), which is included in the ESIA Volume 3, Appendix 2

The outputs and comments given by the stakeholders involved in the Stage 1 and Stage 2 public consultations are summarised in the sections below. Detailed descriptions of the inputs received during the Stage 1 consultations are provided in Annex 4 of the Stakeholder Engagement Plan (ESIA Vol. 3, Appendix 1, Annex 4). Detailed descriptions of the inputs received during the Stage 2 consultations are provided in the Public Consultation Report (ESIA Vol. 3, Appendix 2). Furthermore, Appendix 1 and 2 also provide information on how relevant documentation has been disclosed prior to, during, and after the public consultation.

11.2 Stage 1 Public Consultation

1 For more information on the Aarhus Convention see: http://ec.europa.eu/environment/aarhus/

The main focus areas were:

- What levels of compensation will be given for the temporary economic displacement of small business as a result of the construction and traffic diversion activities
- In which areas will expropriation take place, an how will this be managed
- How will the project impact on utilities and public facilities during construction
- How will the traffic diversions be managed
- A need for background information, e.g. a brochure, on the project including final route, station locations and construction timeframe
- Will a grievance redress mechanism be established and how will it work
- Effect of the construction works on older buildings through soil subsidence
- Effect of the metro stations on the surrounding neighbourhood

11.3 Stage 2 Public Consultation

The main focus areas raised during the public consultation at El Bohy were:

- How much expropriation is necessary, and how will it be conducted
- What will happen to the mosque
- Which streets will be affected by the constructions and traffic diversions

The above points were explained with the use of maps. Furthermore, it was explained that the mosque will be demolished and rebuilt in an area close by, and the process will follow NAT's procedures for Religious Buildings. The widows who receive financial support from the mosque will not be affected by the relocation of the mosque.

Figure 11-1: Poster advertising Public Consultation

The main focus areas raised during the public consultation at Zamalek were:

- Traffic diversion plans during construction
- Which areas will be affected by the excavations
- Grievance mechanism

Announcement of Public Meeting
July 31, 2012 – 11:00am to 1:00pm
El-Bohy Street Mosque, El-Bohy Street

This meeting will present for public information and comment:

1. The route and construction timetable of Metro Line 3.
2. The planned route and elevated design of Metro Line 3B through Imbaba and Waraq al-'Arab *aqsaam*.
3. The design and location of the 4 Metro stations of Imbaba, al-Bohy, al-Qawmiya al-Arabiya, and al-Tareeq al-Da`iri.
4. Expected timetable for construction and completion of Metro line 3B.
5. Expropriation and demolition requirements.
6. Plans and responsibilities for traffic diversion.
7. Other social and environmental impacts of subway construction.
8. NAT plans to minimize community disruptions.
9. Public information and citizen complaints management at NAT.

For additional information from NAT:
Public Information Office, Eng. ???
Ramsis Building, Ramses Street, Cairo
www.nat.org.eg Tel: 25742968, 25743024

Figure 11-2: English translation of Poster

11.4 Conclusion

The Environmental and Social Management Plan (ESMP) put forward in this ESIA has been developed taking into account the concerns raised by the community during the stage 1 consultations. The stage 2 public consultation did not result in the identification of critical issues resulting in necessary changes to the ESMP.