AVIC/CREEC

EIA of 10th of Ramadan Light Rail Train (LRT) Phase III New Administrative Capital

(Final Report)

Prepared by:

Environics, SAE
Environment & Development Advisors

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1. Introduction

1.1 Background

Efforts have been done by the Ministry of Transport (MOT) to improve the access and quality of transport in Egypt. The main aim is "transport that works for everyone" through a transport system that balances economic, environmental and social needs. To support this main aim, MOT has set five strategic objectives to:

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

To achieve these objectives, MOT provides leadership across the transport sector working with regional, local and private sector partners who deliver many of these services in Egypt. Six tasks are set by MOT in this regard as follows:

- Improve the current operation and capacity of transport networks and services while providing better information for travellers;
- Shape the future pattern of demand for transport including land use planning and appropriate land pricing;
- Track the environmental impacts of transport including pricing, regulations, cleaner technology, consumer information, and efficient use of resources;
- Plan and manage long term investment programs;
- Regulate and license certain transport services and operators; and
- Manage information and deliver services to support wider Government objectives.

To carry out objectives and tasks effectively and efficiently while innovating public transport services, MOT considers best value for money in managing and delivering its services. In this regard, the vision of MOT is to offer a fully integrated transportation system (Multi-models Transportation Network) that means to provide: 1) advanced economic and social growth; 2) safe moves of goods and people within Egypt and the markets beyond; 3) fair reflection of regional priorities; 4) strong and stable foundation for economic growth; and 5) maintained and improved provincial highway system.

In the context of efforts to meet the challenges of congestion, problems of traffic and promote the establishment of means of transportation environmentally safe and highly efficient, as well as connect the new cities with the Cairo downtown and the New Capital City. The Egyptian government represented by the Ministry of Transport, through the National Authority of

Tunnels (NAT) to build and operate a Light Rail Train (LRT) for passengers. The LRT project comprises three phases, as shown in Figure (1-1).

The first phase (section) of the LRT (10th of Ramadan LRT)obtained its environmental approval by EEAA (**Annex 1**) and is at the final stages of construction while this study is prepared for obtaining the environmental approval for the third section of the project, third phase (New Capital LRT). The project is funded with a loan from the Export-Import Bank of China.

The New Capital LRT starts at the end of 10th of Ramadan LRT at New Capital Station 2 and ends at an interchangeable station with the Sokhna-Alamein High Speed Train (HST) New Capital Station 6, with about 18.5 km total length.

The proposed alignment of the New Capital LRT along with LRT phase 1 will complete the connection of Cairo airport, Abour City, Shrouk City, Badr City and 10th of Ramadan City with the New Capital City. The alignment will serve the central area of the New Capital through interchange with LRT at New Capital 2. Moreover, parking lots and bus stations at each station will allow for interchanges with other means of transport in the future during the operation.

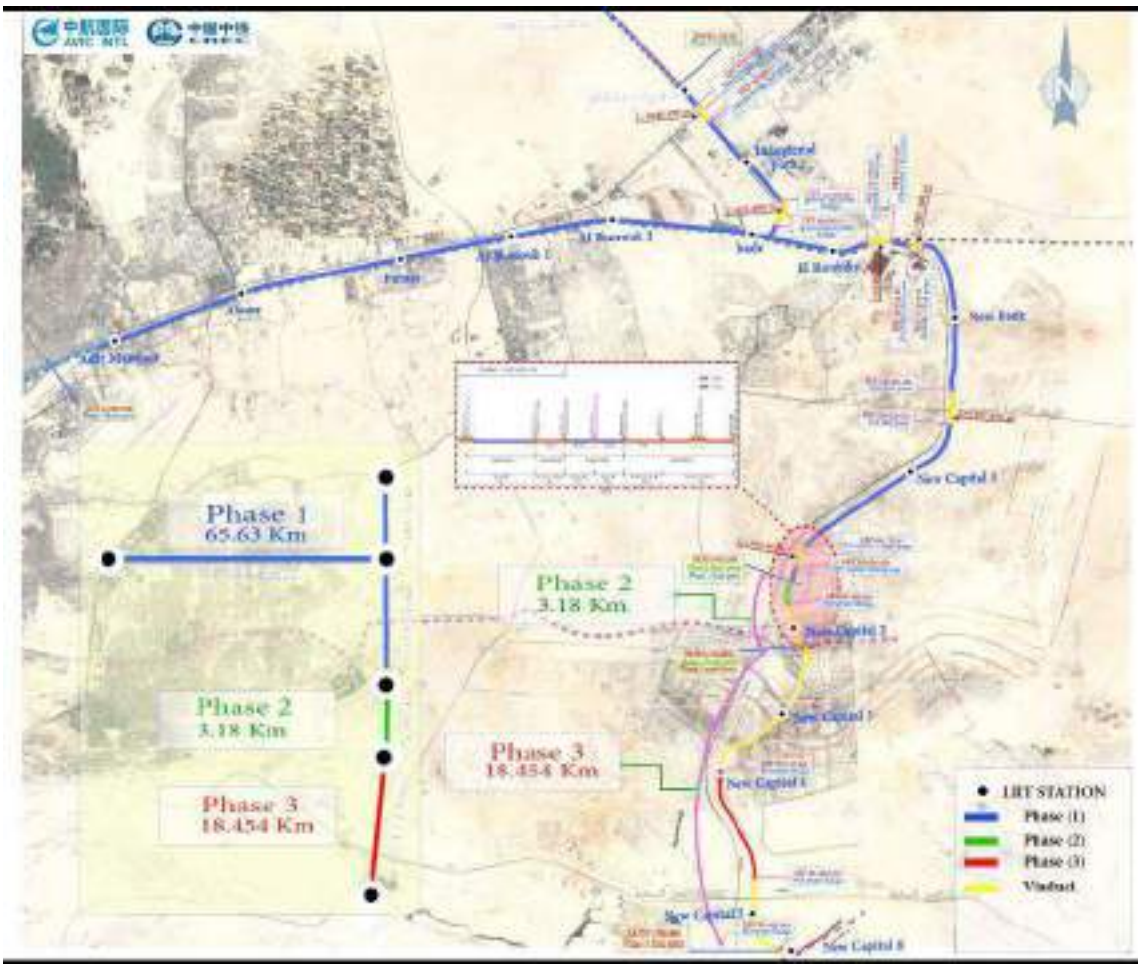

Figure 1-1: The Proposed LRT Project (Three Phases)

1.2 Objective of the Report

The objective of the EIA is to ensure that the project is environmentally sound and sustainable, and that any negative environmental consequences are recognized early in the project cycle and taken into account before project implementation. This is done through:

- Description of the proposed project and associated works together with the requirements for carrying out proposed development.
- Identification and description of the elements of the environment likely to be affected by the proposed development;
- Establishment of the baseline environment of the project area;
- Identification and assessment of the harmful and beneficial environmental impacts of the project.
- Proposal of mitigation measures to lessen the negative impacts of the project.
- Proposal of a monitoring plan during construction and operation of the project to aid impact management and to improve mitigation methods.

The EIA process is subject to local laws and main regulations represented in the Egyptian Environmental Law 4 of 1994 and its executive regulations amended by Decree 9 of 2009), as well as the EIA guidelines issued by Egyptian Environmental Affairs Agency (EEAA) in 2009 and the guideline, which was prepared by the (EEAA) in 2015 specifically for electrified train project.

The National Authority for Tunnels (NAT) on behalf of the National Railway Authority is responsible for development of the project, as well as the National Authority for Tunnels (NAT) is responsible for submitting the EIA study in order to obtain the consent of Egyptian Environmental Affairs Agency (EEAA), which is reviewing the EIA study and approved it.

1.3 Scope of the Report

The scope of the EIA includes the construction and operation of the railway, stations and structures along with the associated utilities. The EIA assesses the impacts resulting from the construction and operation of the project on the following environments:

- Physical Environment.
- Biological Environment.
- Socio-economic Environment.

The impacts of the environment on the project components have been also addressed.

The report does not include activities related to the generation or transfer of energy or electricity to the train as it is outside of the project work scope.

1.4 Structure of the Report

The report consists of the following chapters;

- Chapter 1 (this chapter) comprises the introduction, objective, scope and sets out the context of the report.
- Chapter 2 provides a summary of the Egyptian legislations and guidelines, which are pertinent to the proposed development.
- Chapter 3 includes the methodology used in baseline collection as well as a description of general impacts from the project on environment and vice versa.
- Chapter 4 describes the different project components and infrastructure requirements.
- Chapter 5 includes a comparison of project alternatives.
- Chapter 6 includes the assessment of potential impacts from the construction and operation activities and proposal of mitigation measures.
- Chapter 7 sets the principles of the environmental management and monitoring plan.

2. Legal and Regulatory Framework

This chapter of the report summarizes the environmental and social legislations, regulations and guidelines as well as the international agreements, which are of direct or indirect relevance to the project.

2.1 National Regulations

2.1.1 EIA Context

According to Law 4/1994, law of the environment, and its executive regulations (ERs), which was amended by Law 9/2009, the project proponent, the National Authority for Tunnels – NAT, should prepare an environmental impact assessment (EIA) with the application for license of new projects and/or extension of existing facilities, thus integrating environmental requirements into the existing licensing system. According to the law, the EIA should be submitted to the Competent Administrative Authority (CAA), under which jurisdiction the project falls. The CAA, which is the Ministry of Transport, should send the EIA to the Egyptian Environmental Affairs Agency (EEAA) to issue its opinion within 30 days, beyond which the study would be considered implicitly approved. The proponent is informed of the decision and the conditions to abide by in both construction and operation phases. In case of rejection, the proponent has the right to issue an appeal within 30 days from their receipt of the decision.

The EIA should be prepared according to the EEAA Guidelines of Principles and Procedures for Environmental Impact Assessment (EEAA, 2010). These guidelines describe in detail the procedures for the preparation of an EIA.

According to the EEAA Guidelines of Principles and Procedures for Environmental Impact Assessment, the current project is classified as Category B project, which may result in substantial environmental impacts.

Box (2-1): Categorization System in the Egyptian EIA System

The approach adopted in the guidelines depends on the classification of projects into three categories reflecting increasing levels of environmental impact assessment according to the severity of potential impacts. According to the guidelines, projects are categorized into three categories/lists:

- **Category A:** with minor environmental impacts
- **Category B:** which may have substantial impacts
- **Category C:** which have high potential impacts

Category B projects fulfilling the Form B , issued by EEAA, with its all components and does not require a public consultation

2.1.2 Environmental Aspects

The main environmental aspects that have to be taken into consideration during the project implementation are identified as follows:

- Air quality and emissions
- Noise

- wastewater management
- Waste management
- Hazardous material and hazardous waste management

a. Ambient Air Quality

Article 35 of Law 4/1994 and article 34 of its ERs (amended by Decree 710/2012) and Annex 5 of the ERs provide the maximum allowable limits for ambient air pollutants.

Table (2–1): Maximum Limits of Ambient Air Pollutants

Pollutant	Area	Maximum Allowable limits			
		1 hr	8 hrs	24 hrs	1 year
Sulfur Dioxide SO_2 ($\mu g/m^3$)	Urban Areas	300	-	125	50
Carbon Monoxide CO (mg/m^3)	Urban Areas	30	10	-	-
Nitrogen Dioxide NO_2 ($\mu g/m^3$)	Urban Areas	300	-	150	60
Total Suspended Particles TSP ($\mu g/m^3$)	Urban Areas	-	-	230	125
PM_{10} ($\mu g/m^3$)	Urban Areas	-	-	150	70

b. Gaseous Emissions

Article 36 of Law 4/1994 and article 37 of its ERs (amended by Decree 710/2012) as well as Tables 23 and 24 of Annex 6 of the ERs provide the maximum allowable limits for exhaust gases from gasoline and diesel engines.

Article 40 of Law 4/1994 and article 42 of its ERs (amended by Decree 710/2012) give the maximum allowable limits for the concentrations of pollutants resulting from fuel burning (Tables 1&2, Annex 6).

Table (2–2): Maximum Limits for Exhaust from gasoline and diesel engines (Tables 23 and 24 of Annex 6, respectively)

Gasoline Engines						
	Licensed before 2003		**Licensed from 2003 – 2009**		**Licensed from 2010 till present**	
Pollutants	**HC ppm**	**%CO**	**HC ppm**	**%CO**	**HC ppm**	**%CO**
Maximum limits	600	4	300	1.5	200	1.2
Measured at Idle speed 900 cycle/minute						
Diesel engines						
Year of manufacture (Model)	**Before 2003**		**From 2003 till present**			
Smoke density Coefficient Km^{-1}	**2.8**		**2.65**			
Opacity (%)	**30**		**25**			

Table (2–3): Maximum Limits of Emission from Power Generation by Diesel Engines, table 2 of annex 6[1]

Fuel Type	Maximum Emission Limits (mg/m^3)			
	TSP	CO	SO_2	NO_x
Natural Gas	50	150	100	600
Diesel Oil	100	250	400	600

c. Ambient Noise

Article 42 of Law 4/1994 and article 44 of the ERs (Amended by Decree 710/2012) give the maximum allowable limits for ambient noise intensity (table 3, Annex 7) as shown below:

Table (2–4): Maximum Limit Permissible for Noise Level in the Different

Type of area	Permissible Limit For Noise Intensity [dB (A)]	
	Day (7 am to 10 pm)	Night (10 pm to 7 am)
Residential areas are located on roads less than 12 m and have some workshops or commercial activities or administrative activities or recreational activities, etc.	65	55
Residential areas are located on roads equal or more than 12 m , or industrial zones with light industry and some other activities	70	60

d. Wastewater Discharge

Law 93/1962 and the amendment of its Executive Regulations issued by the Ministerial Decree No. 44/2000 relate to the discharge of wastewater into the sewage system and public network, which is managed by the Ministry of Housing, Utilities & Urban Development.

The specifications for discharging wastewater into public sewer networks are stated in Article 15 of Decree 44 of 2000

e. Solid Waste

Law No. 202 of 2020 is the primary law governing the management of solid waste in Egypt.

Since the executive regulations of the new waste Law is not yet issued until the preparation of this EIA, thus the relevant laws in place should apply.

In this context, Law 38 of 1967 on General Public Cleaning and Law No. 106 of 2012 amending a number of articles of Law 38, and its executive regulations (decree 134/1968), is governing the management of solid waste in Egypt.

Articles 37 of the Environmental Law 9 of 2009 and Annex 11 of its modified Executive Regulations (1095 of 2015) address the collection and transportation of solid wastes.

[1] Reference conditions are stated in Annex 6 of decree 710 of 2012

Article 39 of Law 4 of 1994 and Article 41 of the modified Executive Regulations (1741/ 2005) set the precautions to be taken during digging, construction, demolition or transport of resulting waste and dust.

In addition, Articles 40, 41 of the Decree 211/2003 of Ministry of Manpower and Immigration (MOMI) indicates that the workplace should be tidy, clean and free from wastes and viscous material.

f. Hazardous Substances and Wastes

Article 28 of the Executive Regulations of Law No. 4 of 1994 (amended in decree 1095/2011) sets requirements for hazardous waste identification, minimization, segregation, storage, transportation and on-site treatment.

According to article 31 of the ER of law 4/1994, companies using hazardous chemicals such as acids, alkalis should designate a storage areas for such hazardous chemicals according to proper engineering norms and equipped with needed safety equipment. Related emergency plans should be prepared. It also sets need for employees training and awareness.

Article 33 of Law No. 4 of 1994 (amended by law 9/2009) indicates that all precautions must be taken when handling hazardous material either gaseous, liquid, or solid form to avoid any environmental damage including storage. Articles 34 to 37 address the responsibility of companies in ensuring safety of workers against chemical risks including proper packaging, storage, labeling of hazardous chemicals and maintaining records and hazardous substance register.

Ministerial Decree no. 211 of 2003 of the Labour Law, article 26 and 31 set conditions for the storage of flammable material including fuel. Article 36 of that same decree specifies that the workers should be aware of the hazards related to the chemicals they are handling through written or oral instructions; workers should also be trained on the protection methods and handling procedures.

2.1.3 Workplace Environment

2.1.3.1 Workplace Health and Safety

Facilities operating in Egypt are required to meet the standards for workplace environment. The environmental aspects covered by Egyptian Law include:

- Air quality;
- Noise;
- Health and safety.

Air Quality

Annex 8 of the Executive Regulations of Law 4, 1994 (amended by Decree 1095 of 2011) set the maximum allowable limits of air pollutants inside the workplace.

The applicable limits for workplace emissions are provided in Table 2–5, as regulated by annex 8 of law 4/1994 and law 12/2003.

Table (2–5): Workplace Maximum Allowable Emissions

Pollutant	Maximum Allowable Limits in mg/m^3 (Average 8 hours)
Particulate Matter (PM_{10})	3
Total Suspended Particles (TSP)	10

Articles 208 – 215 of chapter 3 of Book 5 of the labor law 12/2003 address the responsibility of facilities to protect workers against risks resulting from handling of gaseous, liquid and solid chemical substances.

Besides, Ministerial Decree no. 211/2003 of the Ministry of Manpower also addresses the requirements to prevent adverse physical, chemical, biological and mechanical hazards in the workplace.

Article 7 of Decree 211/2003 includes that the intensity of illumination should be appropriate to the type of work whether using natural or synthetic illumination. In the case of this project, light intensity should be at minimum 215 Lux according to the law since the activities in the facility do not require precision as handling large items.

Noise

Law No. 4 provides the basis for regulating noise levels. The regulations pertain principally to noise limits in the workplace and Table 2–6 present the maximum permissible noise levels inside the workplace.

Table 2–6): Maximum permissible noise levels inside the workplace (dB (LAeq)), Annex 7 Executive Regulations of Law 4, 1994 (as amended by Decree No. 710 of 2012) (Stations and Depot Area)

Type of place and activity	Maximum Permissible Noise [level equivalent to decibel (A)]	Exposure Period (hr)
Work place (workshops and factories) with up to 8 hour shifts (licensed before 2014)	90	8
Work place (workshops and factories) with up to 8 hour shifts (licensed starting from 2014)	85	8
Administrative offices - Work rooms for computers, typewriters or similar equipment	65	---
Work rooms for activities requiring routine mental concentration - banks public squares – industrial activities control rooms - Restaurants	60	---

During working hours, the instantaneous noise level must not exceed 135 dB.

According to Table 2–6, exposure period to noise decreases to half while increasing the noise level by 3 dB (A) in order not to influence the sense of hearing and wearing appropriate ear plugs.

For semi-continuous noise events such as those associated with operation of machinery such as hammers, where the period between noise events is one second or more, the frequency of noise events should not exceed the number of events detailed in Table 2–7. If there is less than one second between noise events, then the noise shall be considered as a continuous noise source and levels shall be as per the criteria specified in Table 2-7.

Table 2–7): Maximum Permissible Semi-Continuous Noise Limits (2 , Annex 7 Executive Regulations of Law 4, 1994 (as amended by Decree No. 710 of 2012))

Noise Intensity (dB (L_{Cpeak}))	Number of permissible impacts during the working day
135	300
130	1,000
125	3,000
120	10,000
115	30,000

Health and safety

Articles 29, 30 and 33 of law 4/1994 amended by law 105/2015; as well as articles 25, 26, 27, 28, 31 and 33 of the modified ERs specify all precautions that must be taken when handling hazardous material in gaseous, liquid, or solid form to avoid any environmental damage and obligate facilities using hazardous substances to obtain a license from the competent authority.

2.1.4 Urban Planning

The Unified Building Law 119/2008 has been issued to regulate urban development.

- Part one of the law, ***'Physical Planning'***, identifies the process of urban development and physical planning as well as the role of the General Organization of Physical Planning in organizing development works in different areas and working with different entities in implementing development plans in these areas.
- Part two, ***'Urban Harmony'***, identifies the mandate of the National Organization for Urban Harmony (NOUH) which was established in the year 2001 and its role in preserving historical and important areas and upgrading the areas of special values, as well as working in parallel with different entities in the development to enhance the urban harmony in the areas of concern.
- Part three, ***'Organizing Construction Work'***, identifies the requirements for construction permits regarding the building regulation in each area.

[2] Annex 7 Executive Regulations of Law 4, 1994.

Traffic Management

According to Traffic Law 66/1973, as amended by the Law 121/2008 and its Ministerial Decree 1613/2008, the following articles deals with the legal background associated with traffic planning during construction of projects:

Article 65 of Law No. 121/2008

Public and private organizations, establishments and companies, as well as the contractors, shall notify the competent traffic department before starting the execution of any installations, digging operations, or road pavement works, and shall put up warning notices and red signs during the day, and lanterns with red light at night to determine, at a distance of not less than hundred meters, the locations of operations and installations on the roads.

Article 3 Ministerial Decree 1613/2008

Public and private organizations, establishments and companies, as well as the contractors, shall obtain the approvals of the competent traffic department before starting the execution of any installations, digging operations, or road pavement works, and putting up warning notices and red signs during the day, and lanterns with red light at night to determine, at a distance of not less than hundred meters, the locations of operations and installations on the roads.

2.2 Environmental Institutional Framework

2.2.1 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 EMP of the EIA.

2.2.2 Ministry of Transport

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.

The Ministry of Transport will establish an authority or a private company to operate the electrified trains.

2.2.3 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, archeological or sensitive. These entities include:

- Traffic Department- Ministry of Interior
- General Organization for Physical Planning (GOPP)
- National Organization for Urban Harmony (NOUH)

3. Baseline Environmental Conditions

3.1 Physical Environment

3.1.1 Methodology

The main objective of study of the physical environment was to develop a comprehensive profile of the study area. Photographic records of prominent features were obtained, whenever possible, and included in the report. Each different component of the physical environment has been described in regional context and supported by observations from field visit at 22/04/2021.

Climatic data were obtained from the annual statistical book, geographic and climate chapter, issued by Central Agency for Public Mobilization and Statistics CAPMAS. Information obtained included temperature, rainfall and humidity. Wind speed and direction obtained from world climate databases weatherbase and windfiner.

The method used for the collection of data on the project study area concerning geology, topography, soil types, hydrology, also included a literature review, geological maps issued by Egyptian General Petroleum Corporation and ASTER Global Digital Elevation Map GDEM to map topographic profiles using geographic information system software. This information was obtained from the National Aeronautics and Space Administration (NASA).

3.1.2 Project Location

The project is located in the eastern side of the Greater Cairo Region and passes on New Capital. It is the third phase of the Light Rail Train (LRT) project from New Capital station 2 to New Capital 6, as shown at Figure (3–1). The total length of the proposed LRT route Phase 3 is 18.5 km including 5 stations as follow:

- New Capital 2
- New Capital 3
- Military entity station (New Capital 4)
- Sport city station (New Capital 5)
- Interchangeable station with high speed train (New Capital 6)

The proposed train trip will start from Capital station 2, near to the Governmental district and Al Masa Hotel, and passes the proposed central park down to Capital station 3, at the south, then the Military entity station, cross-over the Sokhna\ Kattamya road reaching to the Sports city station towards final station, where interconnected with the Sokhna-Alamein High Speed Train (HST) line, as shown in the Figure (3–2) proposed LRT route and main stations.

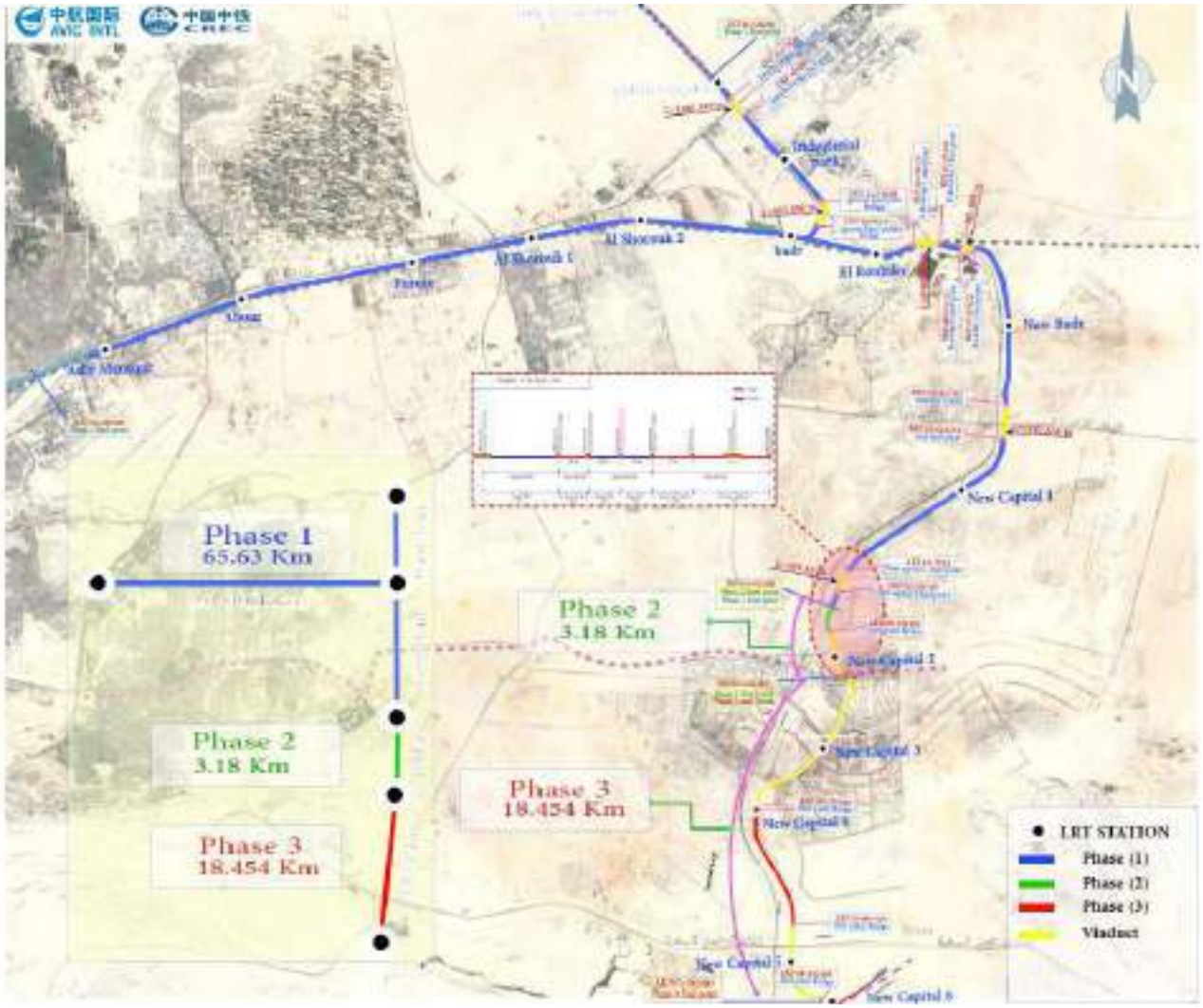

Figure (3–1): Proposed New Capital LRT route, 10th of Ramadan LRT, proposed HST and surrounding communities
Source: CREC-AVIC team

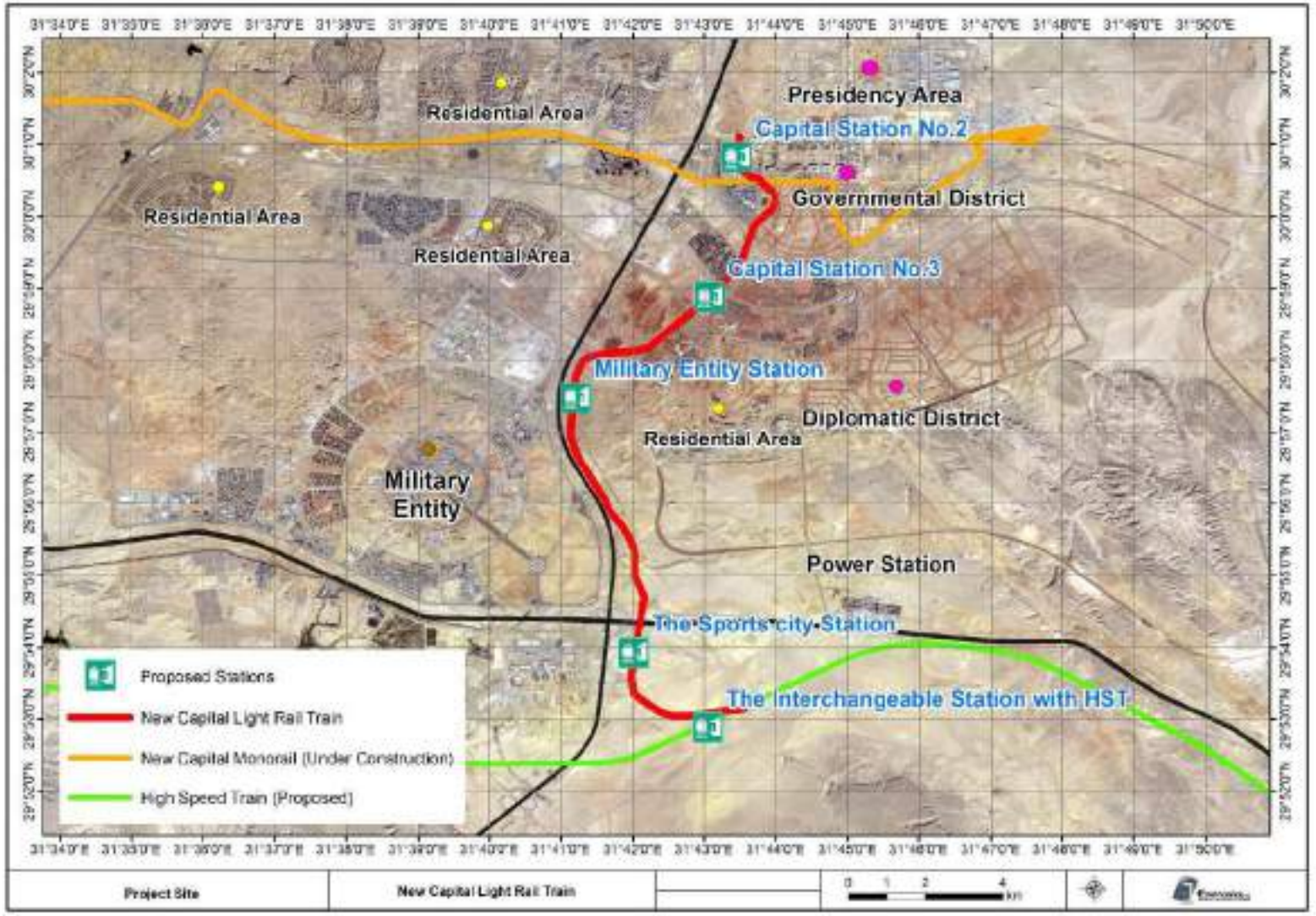

Figure (3–2): Proposed New Capital LRT route and main stations
Source: The satellite image obtained for project area from Sentinal -2 satellite dated 02-02-2020

Surrounding activities

The majority of activities/developments of the New Capital plan are not constructed, except for a few activities that are still under construction or have been constructed and operational, specifically the Al Masa Hotel

Table 3–1 below shows the different surrounding activities as per the provided master plan and its estimated distance for the LRT line. The distances included in the table have been estimated from the centerline of the alignment and the boundaries of land parcel of each development.

The table also shows the construction status of the different developments based on the site observations during the site visit and review of satellite images. The receptors are listed as arranged from the north (New Capital station 2) to south (Interchange station with HST). Also, Section 3.3.3 of this chapter was addressed the main land uses around the proposed stations.

Table (3–1): Surrounding land sues along the alignment

	Right side			Left side		
	Land Use	**Construction Status**	**Distance**	**Land Use**	**Construction Status**	**Distance**
1	Commercial	under construction	within	Conference city	under construction	60 m
2	Governmental complex	under construction	110 m	Al Masa Hotel	operated	50 m
3	Educational service	under construction	35 m	Commercial	under construction	35 m
4	Science and Technology Parks, Mixed Use	under construction	85 m	International Park	under construction	100 m
5	Residential	under construction	85 m	Residential	under construction	100 m
6	Religious service	operated	40 m	Cultural service	Planned	100 m
7	Educational service and Residential	under construction	45 m	Cultural service	Planned	100 m
8	Unknown land use	planned	within	Cultural service and Unknown land use	planned	within
9	Commercial - Mega Mall	planned	60 m	Regional Ring Road	Existing	350 m
10	Commercial	planned	180 m	Regional Ring Road	Existing	220 m
11	Commercial	planned	50 m	Regional Ring Road	Existing	350 m
12	Commercial	planned	within	Regional Ring Road	Existing	520 m
13	Desert land	vacant land	free	Desert land	vacant land	free
14	Desert land	vacant land	free	Desert land	vacant land	free

3.1.3 Climate

Cairo is characterized by arid warm climate with a very hot summer between May and October, and a mild winter from November to April. Cairo is very dry, receiving on average only about a centimeter of rain a year, but it does have high humidity levels in summer. The city occasionally experiences dust storms brought by the sirocco hot winds that are characteristic of Egypt's climate in the month of April (Khamaseen winds).

According to the Meteorological data collected from Cairo Station in 2018 for temperature, relative humidity, and rainfall, 2001-2020 for Wind speed, and 2012-2015 for wind direction, the climatic features of the project area are characterized as follows:

Temperature

The average monthly temperature reaches its maximum value in July (37 °C Max, 25.9°C Min) and its minimum value in January (19.4 °C Max, 12 °C Min), as shown in table 3–1 and figure 3–3. The annual average is 29.6°C Max and 20°C Min.

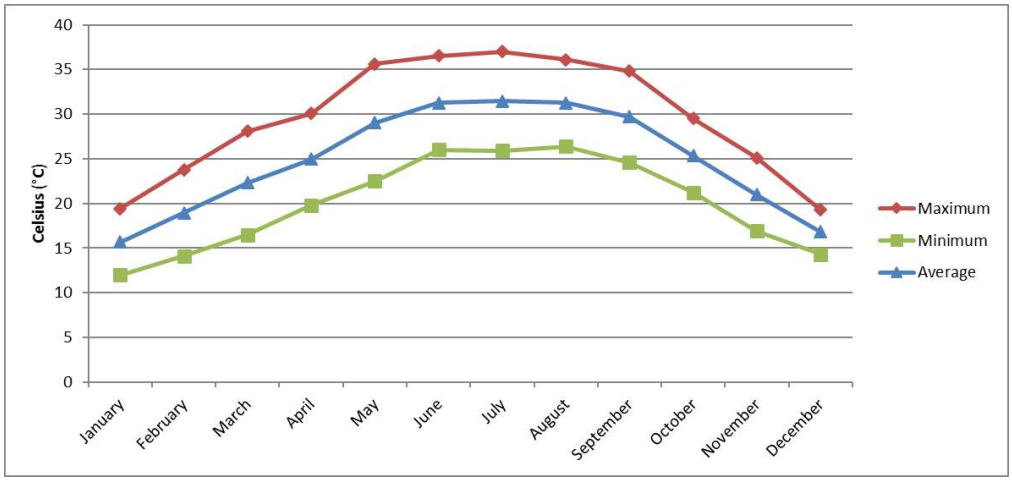

Figure 3–3): The average monthly temperature

Source: Statistical Yearbook of CAPMAS 2020, Cairo station

Relative Humidity

The average annual relative humidity is about 54.5%, and the average monthly relative humidity reaches its maximum value in December (64%) and its minimum value in March (48%), as shown in table 3–1.

Rainfall

Rainfall is very limited. The average monthly rainfall is about 2.8 mm and the annual rainfall is about 33.6 mm. The rainfall reaches its maximum value over the winter months from January (7.8 mm) and its minimum value in March (3.6 mm), and not occurred over the summer months. Storms can occur only occasionally and are usually of short duration, as shown in table 3–1.

Table (3–2): Meteorological Records of Cairo Station

Climatic Parameters	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Maximum Daily temperature (°C)	19.4	23.8	28.1	30.1	35.6	36.5	37	36.1	34.8	29.5	25.1	19.3
Minimum Daily temperature (°C)	12	14.1	16.5	19.8	22.5	26	25.9	26.4	24.6	21.2	16.9	14.3
Mean Daily temperature (°C)	15.7	18.95	22.3	24.95	29.05	31.25	31.45	31.25	29.7	25.35	21	16.8
Mean Daily Relative Humidity (%)	59	55	48	55	52	51	53	56	56	52	53	64
Monthly Rainfall (mm)	7.8	6.5	3.6	6.4	0	0	0	0	0	0	5.5	3.8
Wind Speed (km/h)	14	16	12	14	14	14	12	12	12	12	9	12
The prevailing wind direction	S-SW	W-SW	N-NE	NE-NW	N-NW	N-NW	N-NW	N-NW	N-NW	N-NE	N-NE	S-SW

Source: *Temperature, Humidity, and Rainfall: CAPMAS Statistical Yearbook - Climate Chapter, 2020. Wind Speed: weatherbase website for Cairo station 2001-2020. Wind Direction: windfinder website for Cairo station 2012-2015*

Wind

The wind speed ranges from 9 to 16 km/h (6.4 -8.6 knots). The wind speed reaches its maximum value in February (16 km/h) and its minimum value in November (9 km/h), as shown in Table 3–1.

Figure 3–4 shown the winds direction over the period of five years from February 2010 to February 2015 is shown in the figure 3–3. The prevailing winds direction occurs over the year in the North and North West directions (17.2%) as well as the North and West (13.8). The minimum winds direction occurs over the year in the South and East (not more than 4.0%).

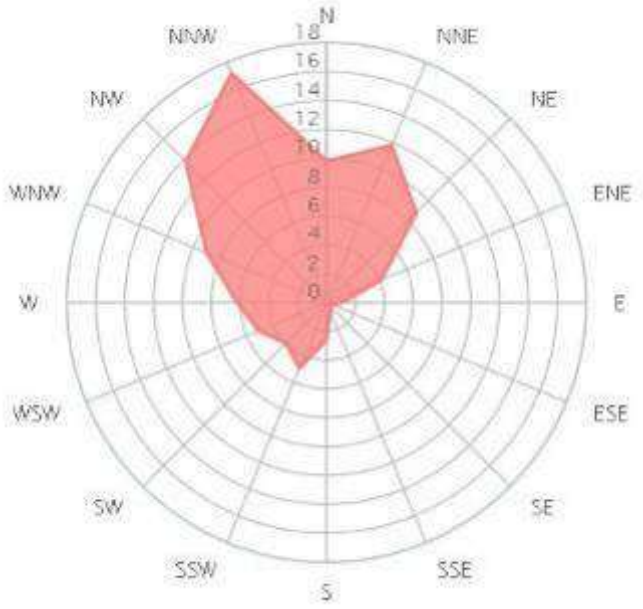

Figure 3–4): Distribution of Wind Direction at Cairo Station
Source: Windfinder climate website 2012-2015, Cairo station

3.1.4 Topography

The proposed LRT extends from the north to the south of the New Administrative Capital. The project area and its surrounding consist of Structural Plains lies. These plains are covered by sedimentary rocks belonging to Cretaceous-Tertiary age, composed of sand, gravel and basalt. In addition, some areas of these plains are covered by sand dunes.

Elevations in the study area are varied between about 315 m at the starting point of the proposed route to 410 m towards the south of the New Administrative Capital in the vicinity of Sokhna\ Kattameya road, as shown in the Figure 3–5. While, the minimum elevation on path is 308 m and the Maximum is 436 m. The land, through which the proposed route is located, is characterized by being flat and there are no sharp slopes.

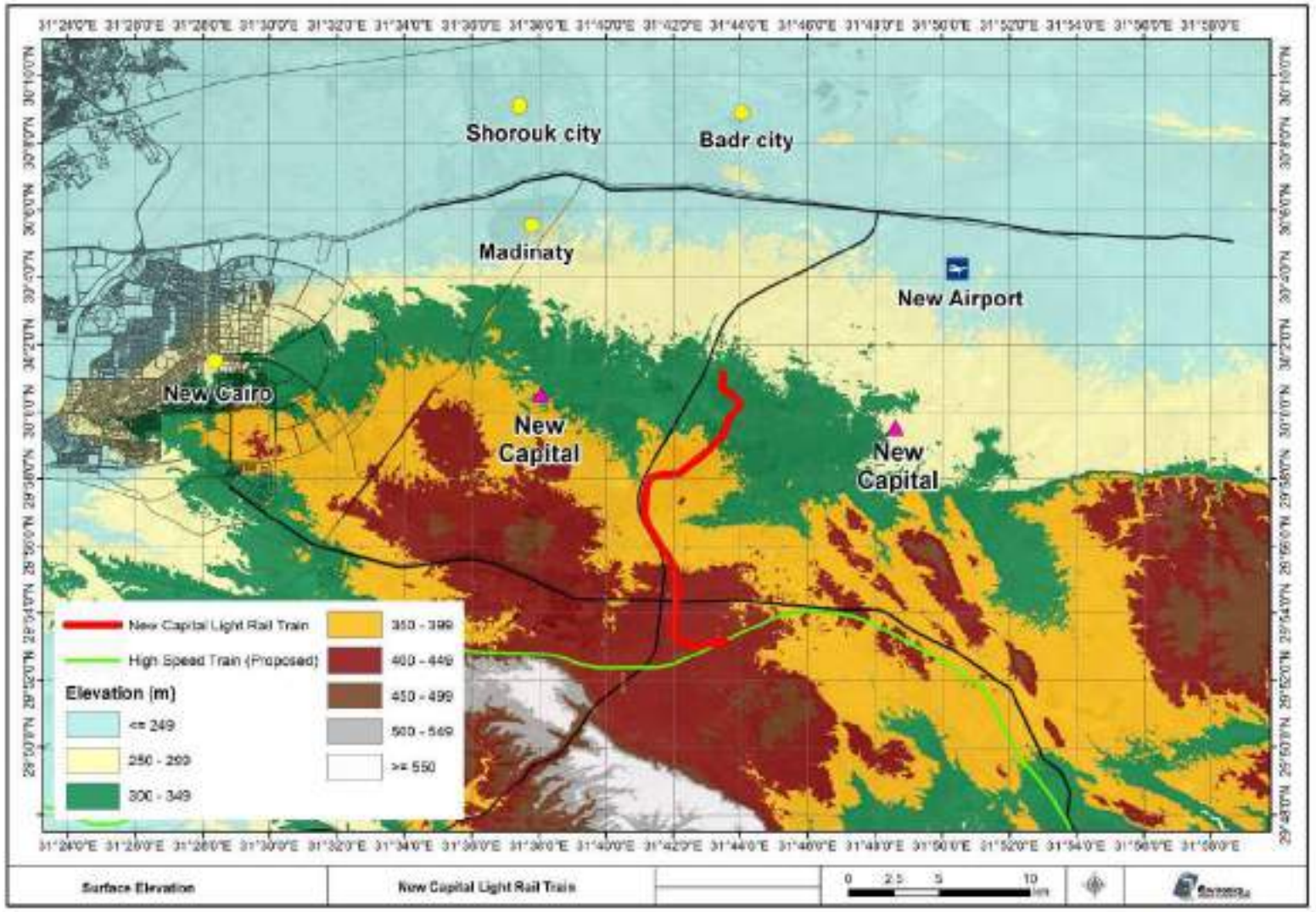

Figure 3–5): Topographic map shows the elevations at the project site and surroundings
Source: The digital elevation model (DEM) obtained for project area from NASA ASTER-GDEM

3.1.5 Geology

In general, the project geological column consist of several units: such as Miocene and Oligocene Rocks (belonging to Tertiary age), which constitute the major part of the land of the proposed LRT route, followed by Oligocene Rocks, belonging in turn to Tertiary age. The said geological column will be described below:

- Pliocene Rocks; Pliocene deposits underlie the Quaternary deposits and formed of Brown- red clay as well as sand and silt intercalations, with a thickness of up to about 200 m.
- Oligocene Rocks; Oligocene deposits underlie Miocene deposits and formed of silt mixed with sandstone and limestone.
- Eocene; Eocene deposits underlie the Oligocene deposits and formed of limestone mixed with silt.

Due to the length of the proposed LRT route, the project area will pass on or through several layers belonging in general to Tertiary ages. The study area comprises three geological formations ordered from north to south (Figure 3–6), as follows:

- Hagoul Formation (Tmh), along approximately 9 km: This formation represents the vast majority of geological formations beneath the proposed railway line. It is composed of river sand and gravel, followed by Homs Formation composed of Fossiliferous Limestone marl and sand beds at the base, after that there is a white limestone bed mixed with marl, forming what is known as el Sadat Formation. Hagoul formation is belonged to the Upper Pliocene Sediments dated to the Tertiary Period.
- *Maadi Formation* (Ted), along approximately 10 km: Fossiliferous sands and sandstones with clay and marl at the base, capped by brown fossilifirous sandy limestone bed (Ain Mousa bed). This Formation is belonged to Upper Eocene Sediments dated to the Tertiary age.
- Gebel el-Ahmar (Red Mountain) Formation (Toa), along approximately 3 km: This formation composed of colored continental sand mixed with Quarts and gravel. Gebel el-Ahmar Formation is belonged to the *Oligocene sediments* dated to the Tertiary Period.

Structural Geological Profile

In general, there is a normal fault in the project area, led to the occurrence of beds dated to Old Geological epoch (*Oligocene*).

Table 3–3): Shortcut the geological units in the project area are shown on below geological map

Geological Unit	Shortcut Key
Hagoul Formation	Tmh
Maadi Formation	Ted
Gebel el-Ahmar (Red Mountain) Formation	Toa

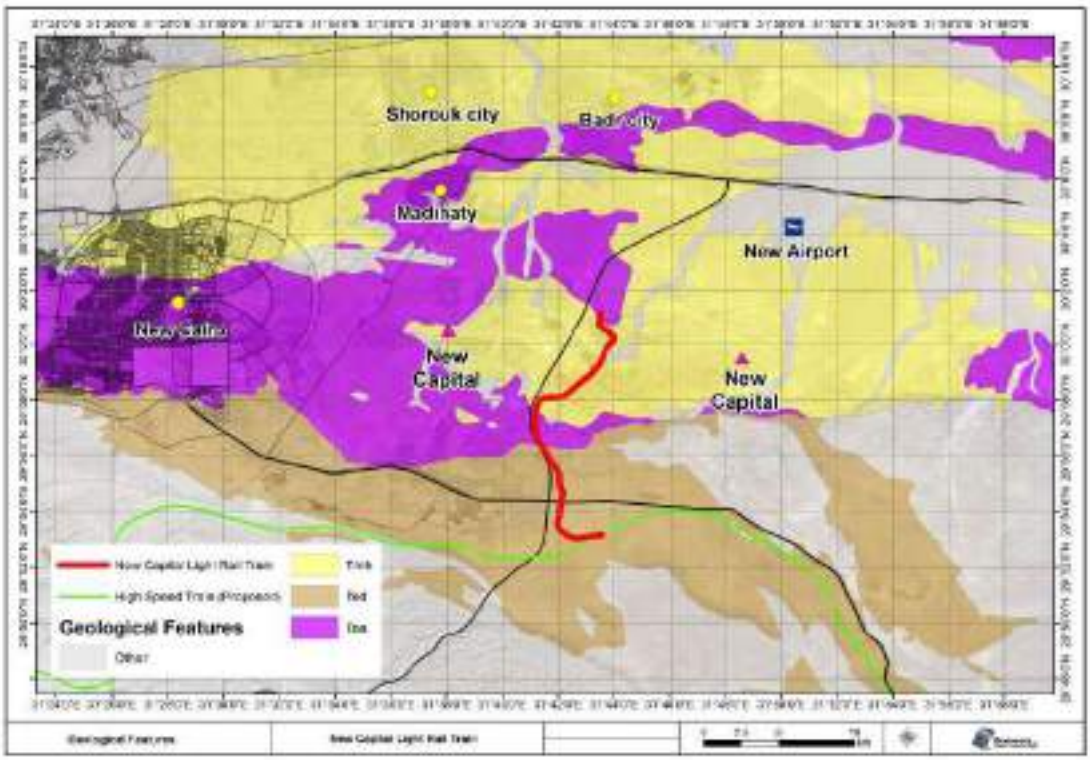

Figure (3–6): Geological Formations Map of the Project Area and surrounding are Source: The geological features obtained from the Egyptian Geological Map, 1987

3.1.6 Soil

The soil in the project area is located in same type. Soil consists of coarse sand and gravely-sand soil plus some sand dunes and basalt. It has a special composition, but not concreted. This type of soil is usually similar in its composition with Nile Delta shores Deposits.

Figure 3–7 presents the regional characteristics of soil in project area and surroundings.

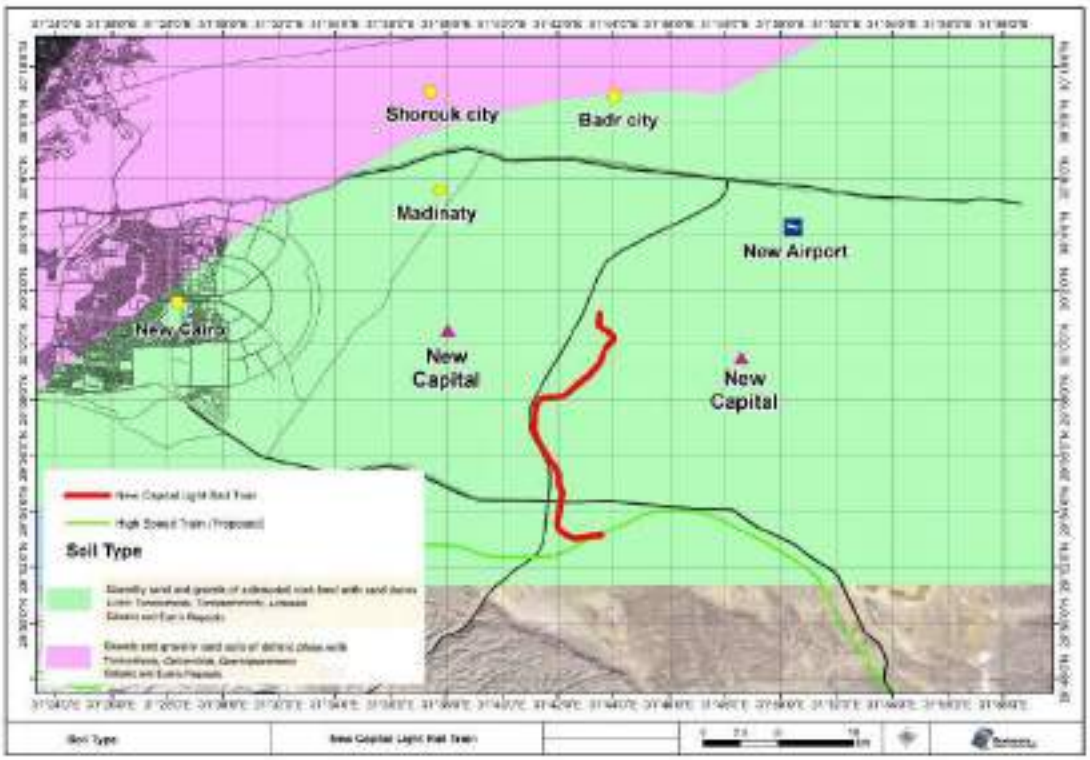

Figure 3–7): Regional soil types of project site and surrounding area
Source: The soil types obtained from the Soil Association Map of Egypt, 1975

However, the nature of the surface soil in some project areas, especially around New Capital stations 2&3, was changed as a result of grading and paving works in New Capital city (under development) and not specific for this project (Figure 3–8).

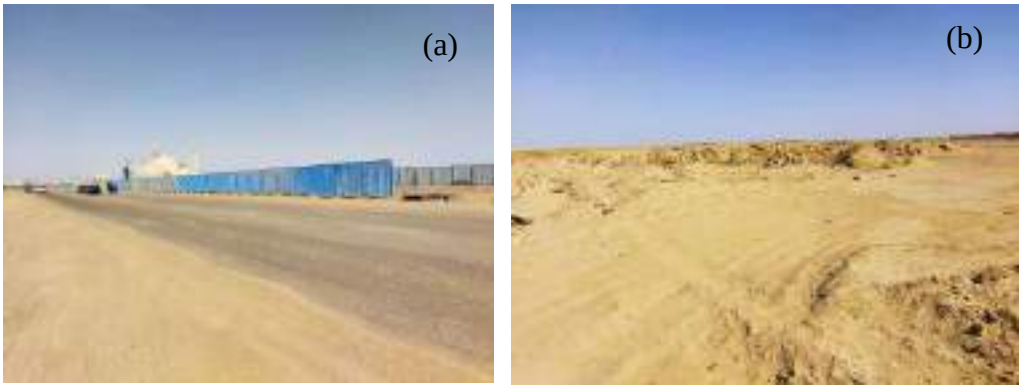

Figure (3–8): (a) Gravely-sand soil surrounding New Capital station 3 and (b) Coarse and gravel sand in interchangeable station area
Source: Site visit 22/04/2021

3.1.7 Geologic Hazards

a. Earthquakes

Egypt is classified as an aseismic country but throughout historical times earthquakes have repeatedly struck and severely damaged its major city of Cairo (Kebeasy, 2003). Most earthquakes within Egypt are along the edges of the Nile Valley, with very few in the Valley itself except in the

vicinity of the Aswan dam (Lake Nasser) and to the northeast of Cairo. The spatial distribution of earthquakes shows that the main activity occurs in the northern part of Egypt (north of 27◦N). Therefore, the country can be divided into two tectonic provinces: a northern part and a southern part (Badaway 2001). The seismicity of the northern part appears more prominent than that of the southern part.

In general, the distribution of earthquakes epicenters throughout Egypt is limited along three fault-structures:

- The Gulf of Al Aqaba- The Dead Sea fault zone
- The Red Sea, Gulf of Suez, Cairo and Alexandria fault zone
- Fayum, Cairo and Sinai fault zone.

The project is located within The Red Sea, Gulf of Suez, Cairo, and Alexandria fault zone. The earthquakes in this zone are classified under (Micro) type, in which the energy released by earthquakes ranges from 0-2 on Richter scale.

Figure 3–9 depicts spatial distribution of earthquakes epicenters throughout these two periods. From this figure, it is clear that most of earthquakes (more than 70%) have been reported along the northern Egypt and concentrated at the Sinai subplate boundaries. Moreover some of earthquakes are also reported inland of Egypt. This kind of earthquakes (i.e. the inland earthquakes) is relatively poorly understood and cause huge losses, as they going through a heavily urbanized areas.

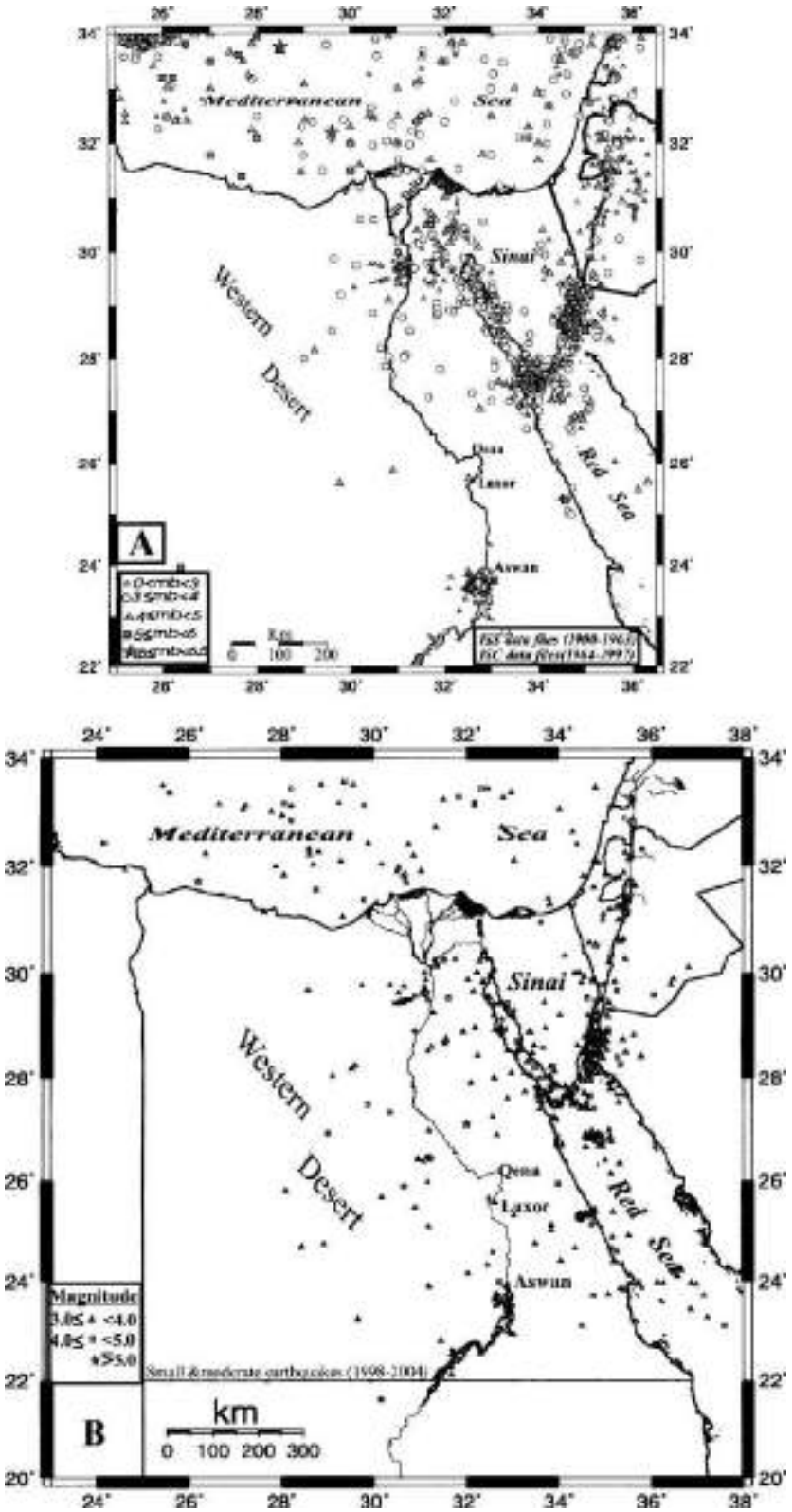

Figure (3–9): Spatial distribution of earthquake foci in Egypt (a) before ENSN installation (1900–1997) and (b) after ENSN installation (1998–2004). (Badaway 2005)

Greater Cairo and earthquakes

Greater Cairo and the surrounding areas have a long history with earthquakes. Maamoun (1979) investigated earthquake activity in the northern part of Egypt during 1847, 1870, and 1955 (Figure 3–10). Concerning the intensities, it was found that they range from VIII (Damaging) to V (Fairly strong) on the (MSK.64) Medvedev-Sponheuer-Karnik scale. The 1847 earthquake in Fayoum was a remarkable event with intensity VIII. Damage was reported in Cairo and as far south as Assuit. In the 1870 earthquake in Egypt, the intensity was VII in Alexandria and in a large part of the Nile Delta and Cairo. The 1955 earthquake was felt in the entire eastern Mediterranean basin, which led to damage in the Nile Delta between Alexandria and Cairo with a maximum intensity of VII.

Recent intensity data (1900-1992) were collected in 1994. Within this period, they reported a large number of local moderate earthquakes that have been felt in Egypt. These earthquakes have magnitudes varying from 3.5 to 6.6 and reported to be felt at distances varying from 10 to 700 km.

Ambrasyes et al. (1994) reported also many earthquakes that have been located outside the Egyptian territory but strongly felt in Egypt. Most of these earthquakes were located in the Hellenic Arc, Red Sea and Dead Sea. For some earthquakes (local and distant), intensity maps based on real observations were also available (see Maamoun et al., 1984 and Ambraseys et al., 1994). Within the period 1992 (Oct.)-2000 many earthquakes have been reported in Egypt. The most important ones are those of October 12, 1992 Cairo, November 10, 1995 Aqaba and October 9, 1996 Cyprus earthquake (see Ibrahem, 1995, and Osman & Ghobarah, 1996).

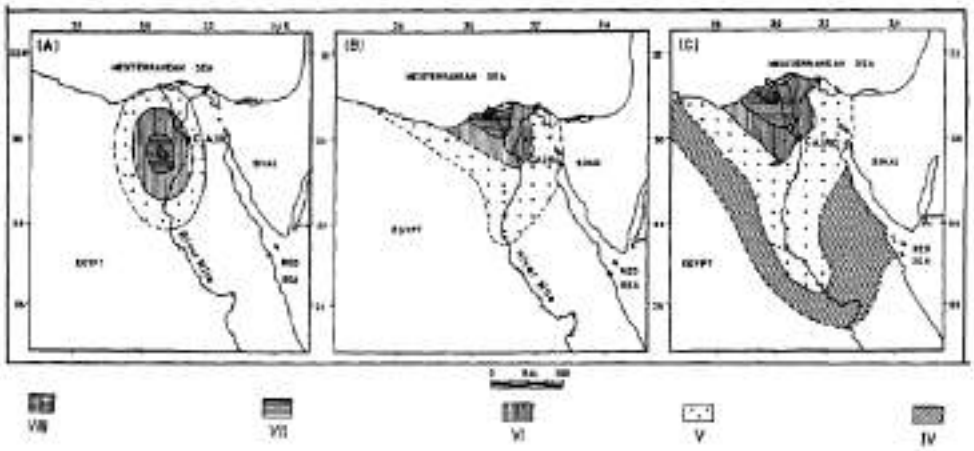

Figure 3–10): Intensity map of earthquakes of 7 August 1847 (a), 24 June 1870 (B) and 12 September 1955 (C). (Maamoun, 1979)

b. Floods

This part covers the topographical analysis that undertaken to understand the natural characteristics of drainage basins, as it represents the key factor in the formation of the surface runoff streams based on the slope degree and direction.

Figure (3–11) shows only one stream line order 3 intersected with the proposed LRT route. However, it is not expected to exposure for flood risk while the starting point of this stream line was cut-off with a new large-scale built-up area (the Military entity) and fenced by concrete walls. Moreover, the topographical characteristics of the project area will be changed according to the grading plan of the whole Masterplan.

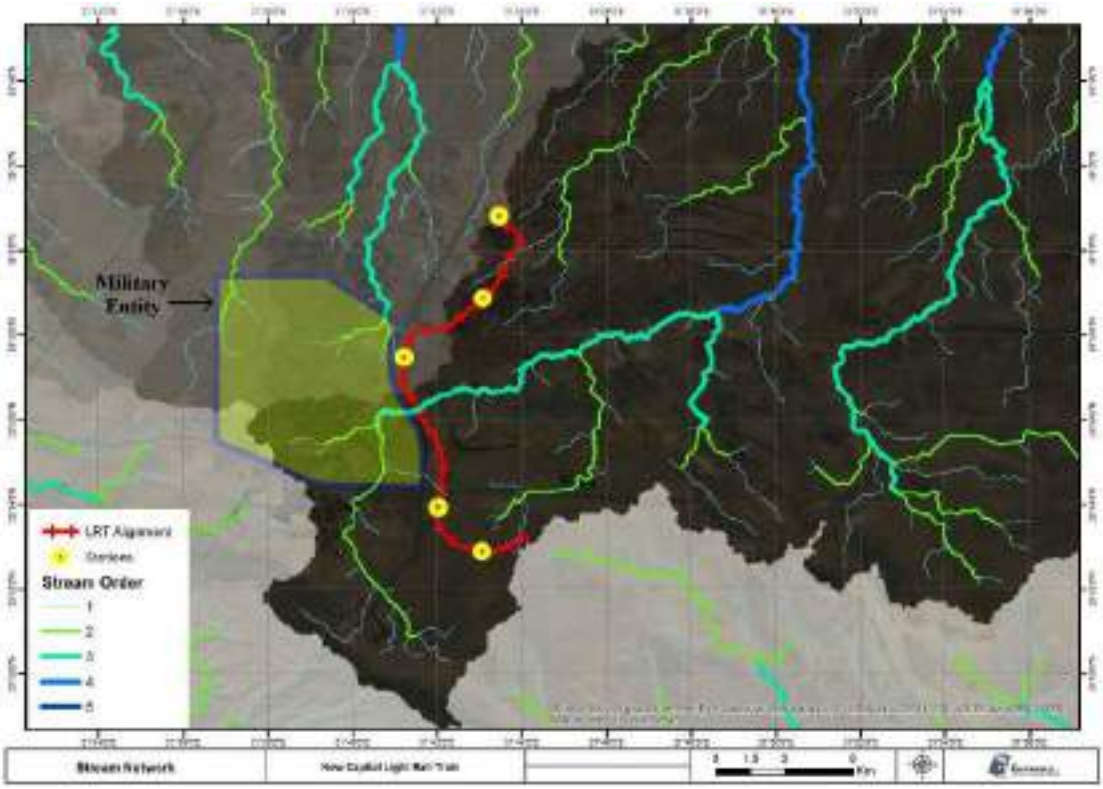

Figure (3–11): Potential flood risk in the project area

Source: The surface streams network was generated from the digital elevation model (DEM) obtained for project area from NASA ASTER-GDEM

3.1.8 Hydrology

The local groundwater aquifers (underground layer of water-bearing permeable rock formations) in the study area are represented in two types of water-bearing permeable rocks with different importance for exploitation, which has been drawn from the map of water resources in Egypt (scale 1:2.000.000). These aquifers systems are: Miocene sand aquifer and Eocene limestone aquifer.

For Hydrologic Characteristics, these local aquifers can be divided into two units, based on the productivity of groundwater (Figure 3–12), and are as follows:

- Local high productive aquifer belonged to the Quaternary (Holocene) age, in which most of the project area is located. This aquifer is always recharged either from irrigation water, surface water, rainfall or from the Nile River.
- Extensive and moderately to low productive aquifer, which is located at the south side of project area. The aquifer is recharged from the adjacent aquifers and with no recharge from rainfall and surface water.

Most of the project along about 17 km (77%) is located in the unit of Local low to moderate productive aquifer which consists mainly of sand and gravel belonged to the Tertiary age. The sand onsite is coarse and mixed with gravel, silt and clay, and often contain residues of gravel and rocks. This hydrological unit (aquifer) belongs to the Miocene age and lies at an average depth of up to about 75 to 100 m from the surface of the earth. The rest of the route about 5 km (33%) is located in the unit of Extensive and moderately to low productive aquifer, corresponding to Eocene age. This aquifer extends towards the south of the route until the final station area.

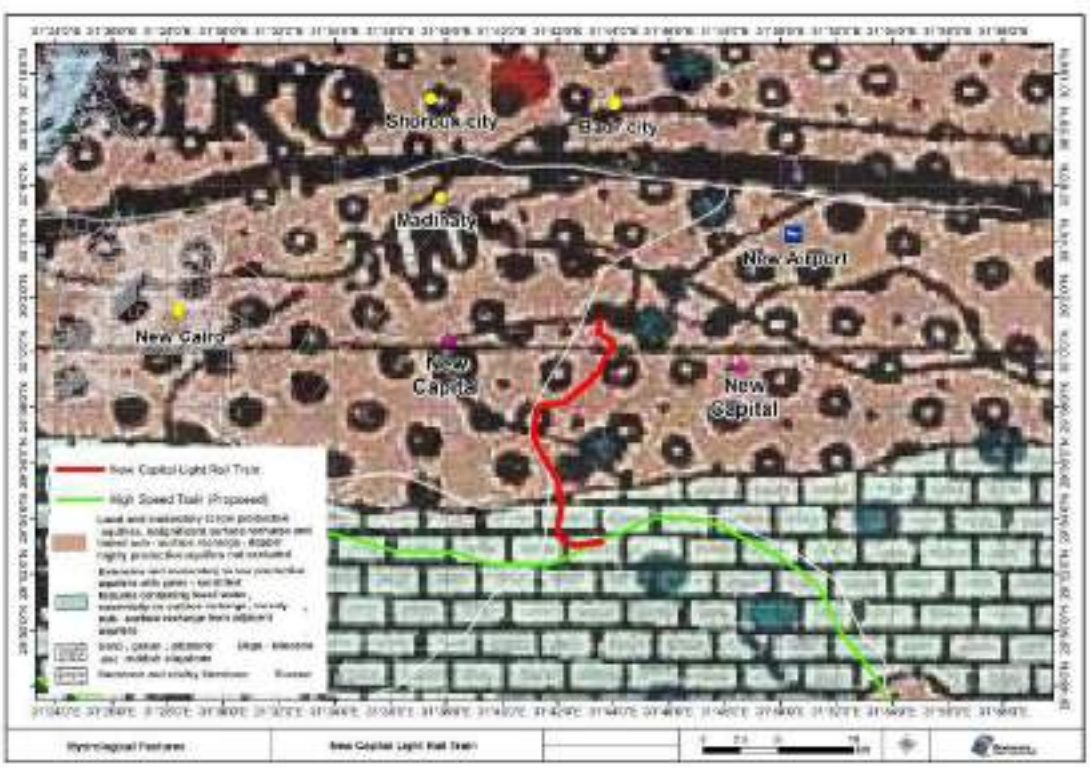

Figure (3–12): The hydrological map of the project site and the surrounding area

Source: The hydrological features obtained from the Egyptian Hydrological Map, 1999

3.2 Biological Environment

3.2.1 Habitat Types

This desert region is characterized by open Gravel/Sandy Desert and a sparse vegetation cover (less than 5%). This sector has the following habitats:

- Gravel/Sandy Desert
- Buildings (urban communities under construction, the New Administrative Capital)

a) Gravel/Sandy Desert

This is the least productive and arid habitat found in non-reclaimed areas and has a sparse vegetation cover. Vegetation is scant and largely confined to depressions where sufficient rainwater accumulates. The region has both Abu `Allawi valley (Abuallawi Wadi) and *el Gafra valley (el Gafra wadi).* Figures (3–13) and (3–14) show the project area characterized by its gravel/sandy desert habitat.

Figure (3–13): Project Area Gravel/Sandy Habitat (a)

Figure (3–14): Project Area Gravel/Sandy Habitat (b)

b) Urban Habitats

This is a man-made environment (*under construction*) has brought species that, otherwise, would not be present, as a result of the presence of water, food, waste and invasive alien species. Figure (3–15) shows the urban habitat already existing by the project area.

Figure (3–15): Project Area Urban Habitat

3.2.2 Biodiversity Value

The study area mainly encompasses a desert habitat that has minor biodiversity as well as man-made habitats which support common and widespread species.

It is worth mentioning that the area where the LRT will be built is a future urban area currently under construction. Thus, it can be said that the LRT will not have any significant biological impact during its construction and operation phases.

3.3 Socio-economic Environment

3.3.1 Methodology

Baseline information of socio-economic environment compiled for the proposed LRT route relied mostly on secondary and formal data sources, such as census issued by Central Agency for Public Mobilization and Statistics; reports of Ministry of Housing, Utilities and Urban Communities and some information from field observations, photographs (whenever possible).

As the project area is still under development, the New Administrative Capital, this means that there are no urban settlements at the present except for temporary workers' camps in different other projects. Therefore, this part of the study will cover the nearest urban communities to provide a general image of the social characteristics in the wider area. In addition, this part will cover the planned land uses around the proposed LRT route based on the Masterplan of the New Administrative Capital. The nearest residential area is located surrounding New Capital station 2, but it is still under construction and not occupied (Figure 3–16).

Figure 3–16): Residential buildings under construction nearest of New Capital station 2
Source: Site visit 22/04/2021

3.3.2 Socio-economic Conditions

The nearest urban communities are located north and west of the project site, Badr city 12 km, Madinaty 12 km, Shorouk city 14 km and New Cairo 20 km. According to the manual of administrative units in Arab Republic of Egypt issued by Central Agency for Public Mobilization and Statistics (CAPMAS) in November 2012, the urban communities adjacent to the vicinity of the proposed LRT route is located within the administrative jurisdiction of Cairo Governorate. Figure 3–17 shows the location of nearest urban communities.

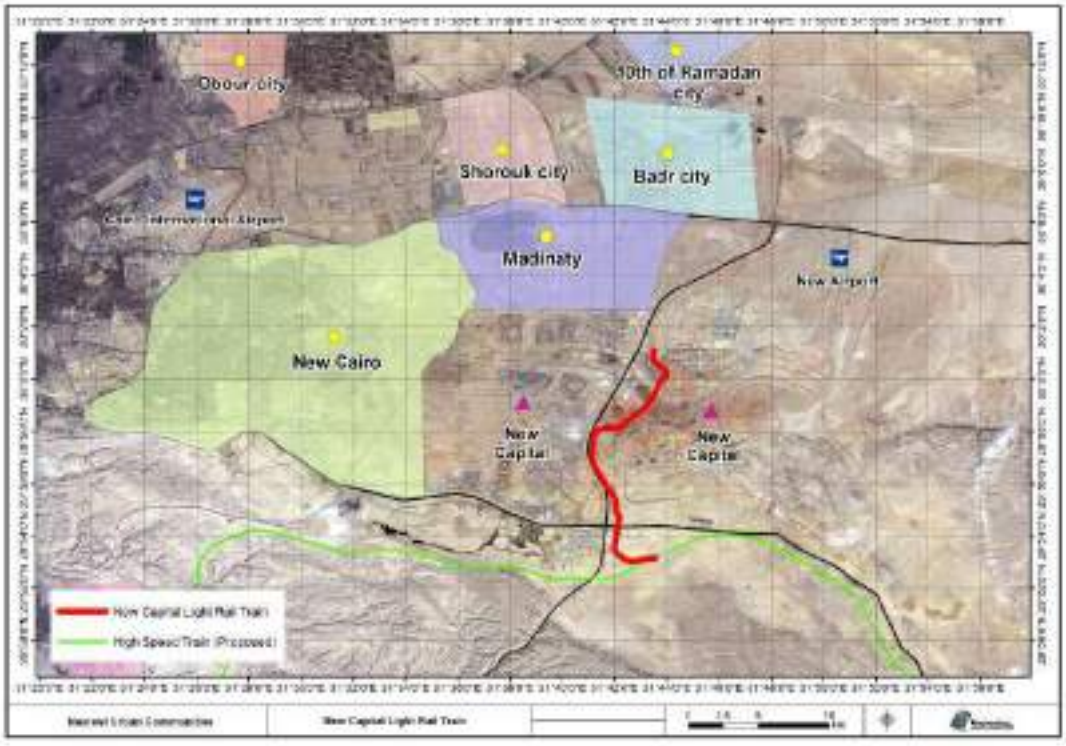

Figure 3–17): LRT route and Nearest Urban Communities
Source**:** The satellite image obtained for project area from Sentinal-2 satellite dated 02-02-2020

The social baseline is shown available quantitative data on city level, such as: population count; number of households; size of households; illiteracy rate; and unemployment rate. Data used in this section depends on CAPMAS census data 2017.

a. Badr City

The total population of Badr city is estimated at approximately 31,299 inhabitants, according to the last census in 2017, as shown in table 3–4. The number of households was 9,908 families, with an average household's size of 3 members. The illiteracy rate (29.1%) is higher than the national average of the governorate (16.2%), which means that more than a quarter of its education-age population suffered from illiteracy.

b. New Cairo City

The total population of New Cairo City including Madainty is estimated at approximately 297,387 inhabitants, according to the last census in 2017, as shown in table 3–4. The number of households was 89,360 families, with an average household's size of 3 members. The illiteracy rate, estimated at (5.5)%, is lower than the national average of Governorate (16.2%), this is because the city is considered one of new cities that provide job opportunities in administrative, commercial sector and also in the industrial zone. Moreover, there are residential and mixed-use projects still under development, which generate direct job opportunities in the construction sector.

c. Shorouk City

The total population of Shorouk city is estimated at approximately 87,285 inhabitants, according to the last census in 2017, as shown in table 3–4. number of households was 22,871 families, with an average household's size of 3.8 members. The illiteracy rate (3.7%) is significantly lower than the national average of the governorate (16.2%).

Table (3–4): Social indicators on city level, CAPMAS 2017

City	Pop.	No. of Households	Average Size of Households	Illiteracy rate
Badr	31,299	9,908	3.1	29.1%
New Cairo & Madinaty	297,387	89,360	3.3	5.5%
Shorouk	87,285	22,871	3.8	3.7%

3.3.3 Masterplan of the New Administrative Capital

This part shows the future land use of the project area while most of them are at present still under development. Figure 3–18 illustrates the masterplan of the New Administrative Capital while the LRT will pass from north to south as follow:

- Governmental district and commercial land use.
- The central park.
- Residential and Educational use and the exhibition city.
- Regional investment zone, commercial and mega mall.
- Olympic city.

The surrounding land use of the main stations as follow:

- New Capital Station 2: at the governmental district and beside Al Masa hotel.
- New Capital Station 3: at a residential area and the exhibition city.
- Military Entity Station: at the regional investment zone in front of mega mall and the northeast edge of the Military entity area.
- Sports City Station: south of Sokhna\ Kattamya road at proposed sports city
- Interchangeable Station with HST: at a vacant desert land where the LRT route will be connected with the High Speed Train.

Figure (3–18): The Masterplan of the New Administrative Capital and proposed LRT route

Source: The masterplan received from CREC-AVIC team, June 2021

3.3.4 Transportation in East of Cairo

This section overviews the transportation network in East of Cairo to better understanding of potential positive impacts of introducing the New Capital LRT in improving transportation networks while enhancing the public transportation, reducing greenhouse emissions, and reducing incidence of roads' accidents.

Smooth transportation is an effective success factor for investment projects. In this context, Egypt enjoys a foreign and domestic, land and air transportation network linking Egypt with the whole world, in addition to a great number of bridges all over the country to facilitate transportation. A good transportation network of roads is connecting the project area with surrounding, part of those was finished and other still under construction or planned, these include:

- The Regional Ring Road
- Cairo-Suez Road
- Sokhna-Kattamya Road

In addition to a new airport located north of the New Administrative Capital (under construction) and Cairo International Airport, which is located about 30 km northwest of the project site.

Figure 3–19 shows a network of various transportation modes contributes significantly to the economic development by transporting the passengers around the New Administrative Capital, Cairo downtown, West of Cairo, and all over the country through the Monorail and the proposed High Speed Train.

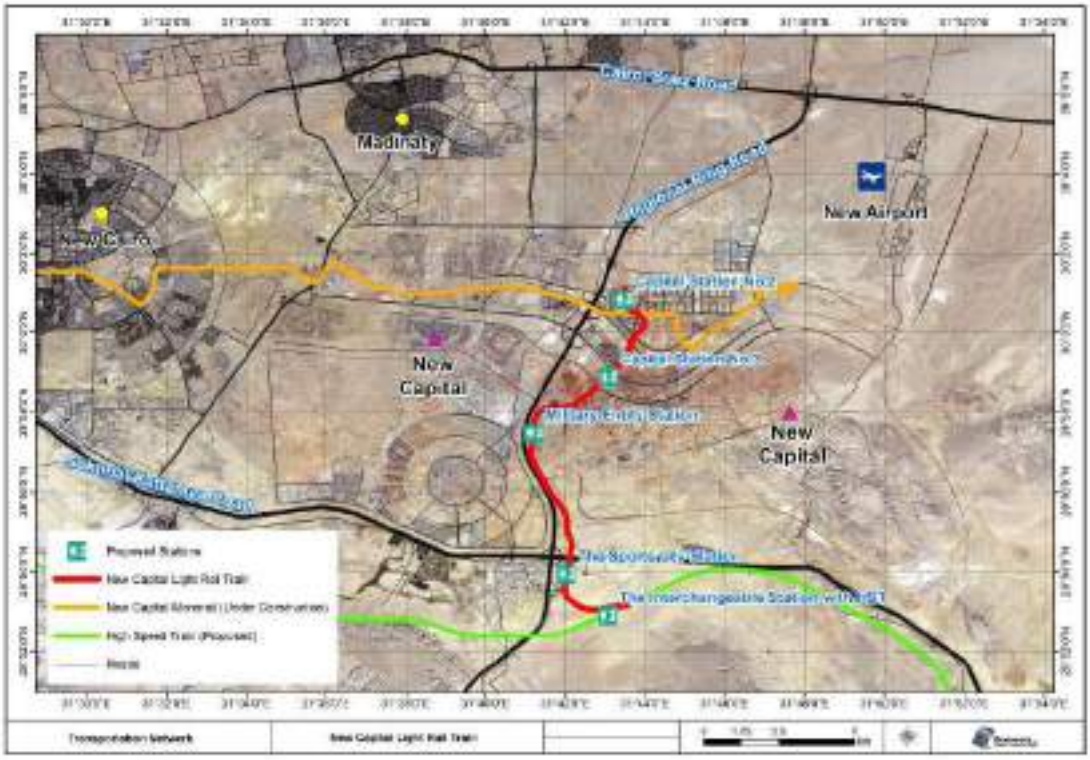

Figure (3–19): Transportation Network East of Cairo and New Capital LRT
Source: The satellite image obtained for project area from Sentinal-2 satellite dated 02-02-2020

4. Project Description

New Capital LRT (the project) is an extension of the LRT Phase I (10th of Ramadan LRT), which has been approved by the EEAA. New Capital LRT starts at the end of 10th of Ramadan LRT (phase two) at New Capital Station 2 and ends at an interchangeable station with the Sokhna-Alamein High Speed Train (HST) New Capital Station 6, with about 18.5 km total length.

The proposed alignment New Capital LRT along with LRT phase 1 will complete the connection of Cairo airport, Abour City, Shrouk City, Badr City and 10th of Ramadan City with the New Capital City. The alignment will serve the central area of the New Capital through interchange with LRT at New Capital 2. Moreover, parking lots and bus stations at each station will allow for interchanges with other means of transport in the future during the operation.

According to current route design proposal, there are 4 elevated stations along the line and 1 ground station, the Military entity station.

The project is planned to increase the connectivity along the New Capital city and to promote the connection with the new cities and Cairo center. It is planned to be completed in 24 months after the actual begging of the project implementation.

4.1 Station Locations

All the proposed stations will include a private car parking area and bus stop station. This parking will allow transfer between different means of transportation. In addition to pedestrian bridges and will be connected to parking area. The location of the proposed stations are as follows:

- **New Capital 2** is an elevated station located east of the City of Arts and about 650 meters north of the Masa Hotel. It will allow interchange with the Monorail through a linking area between them. This station is the connecting point with LRT phases 1 and 2 to reach the new communities east of Cairo.

Figure 4–1): 3D perspective of New Capital 2 station

- **New Capital 3** is elevated station located close to the Cathedral, Residential area and the proposed Green river area between the exhibition area and the investors district. The administrative and commercial zone is located about 500 m south of this station.

Figure 4–2): General Plan of New Capital 3

- **Military Entity Station** (New Capital 4) is a ground station located within the regional investment area near to the military entity zone. There is a residential district (R7) located about 1.2 km east this station.

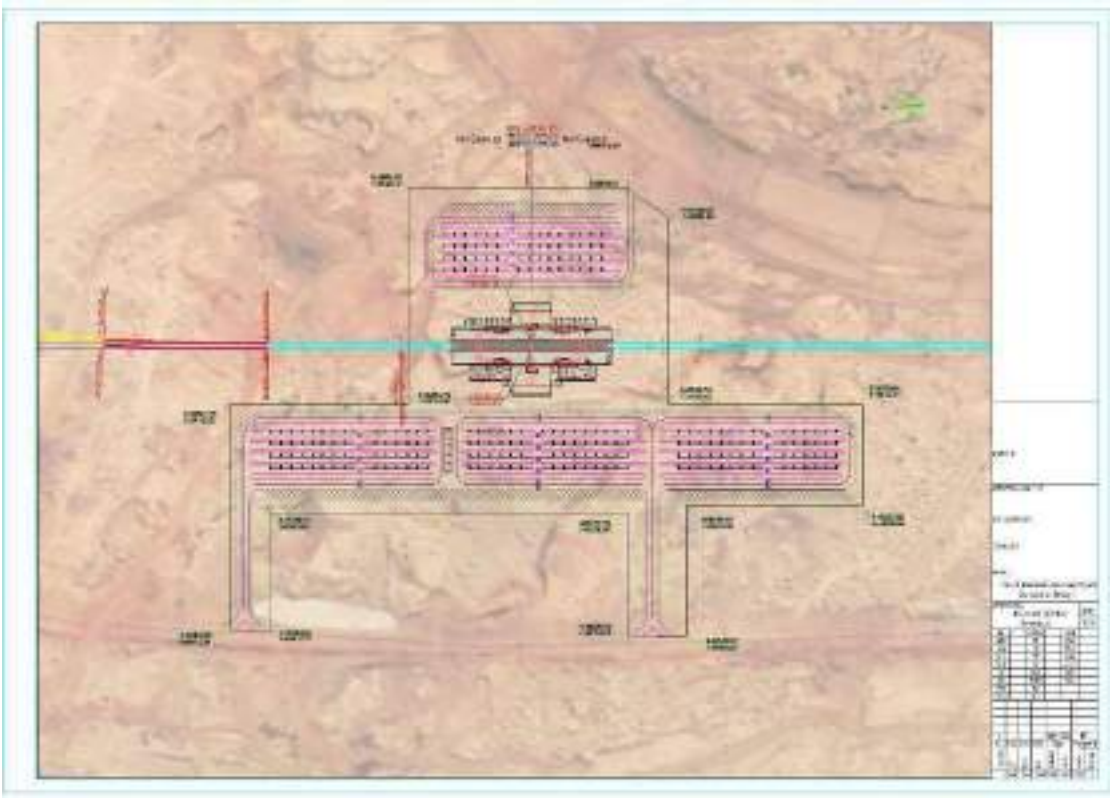

Figure (4–3): General Plan of Military Entity Station (New Capital 4)

- **Sports City Station** (New Capital 5) is an elevated station located at the south of the intersection between the Regional Ring Road and Cairo/ Sokhna Road near to the Olympic Sports City.

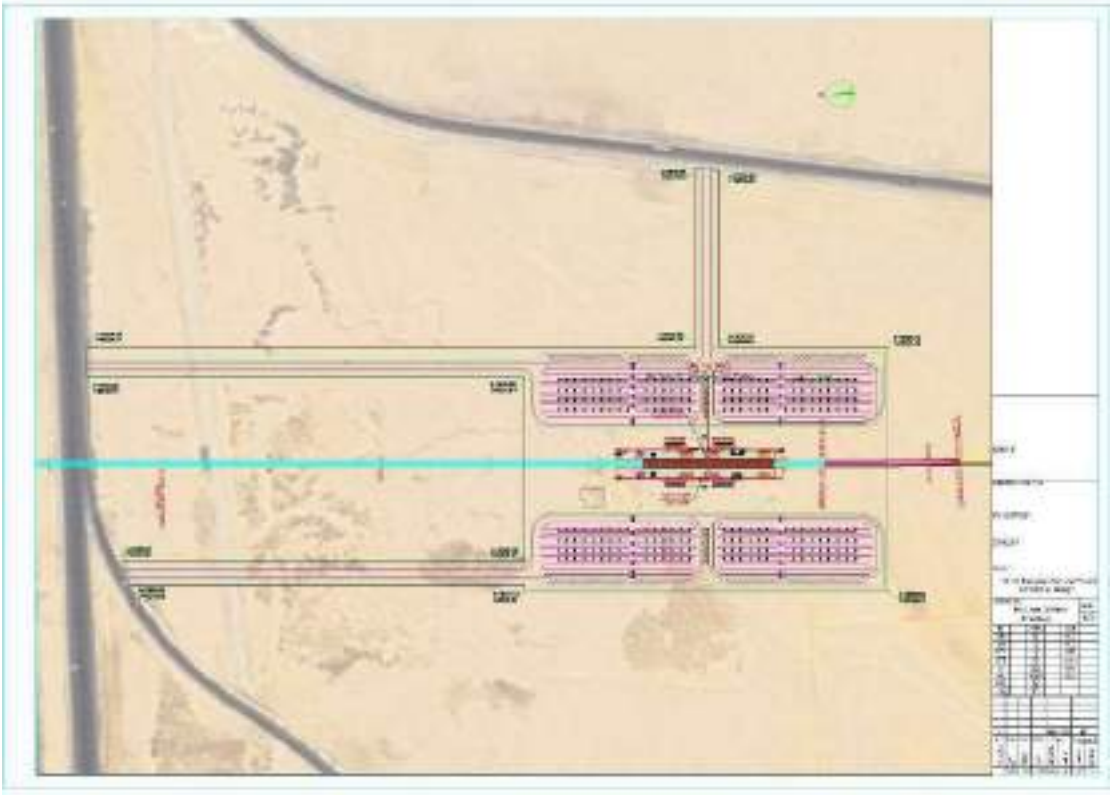

Figure (4–4): General Layout of Sports City Station (New Capital 5)

- **Interchangeable Station with HST** (New Capital 6) is elevated station and located about 2.7 km south east of Sports City Station. This station is designed to be connected with Sokhna-Alamein High Speed Train (HST) through an outdoor walking area to a separate building south of the station as shown in Figure (4.5).

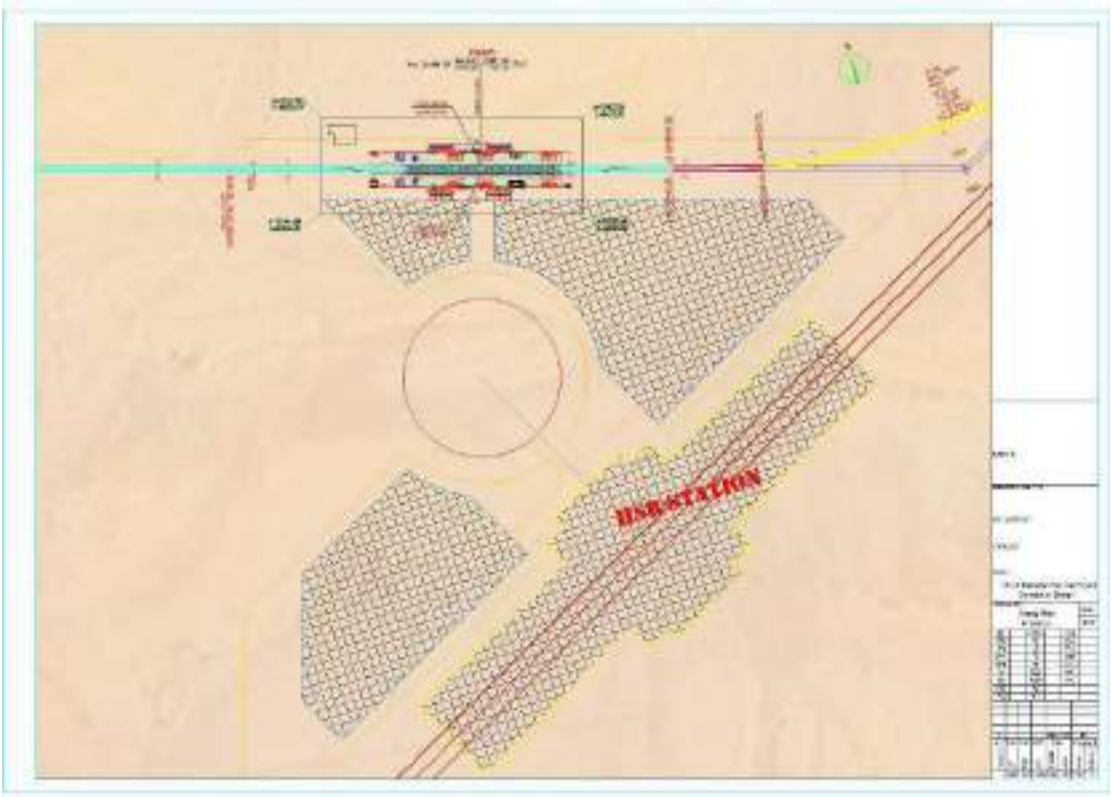

Figure (4–5): General Layout of Interchangeable Station (New Capital 6)

4.1.1 Route Longitudinal Profile

The proposed train trip will start from Capital station 2, near to the Governmental district and Al Masa Hotel, and passes the proposed central park down to Capital station 3, at the south, then the Military entity station, cross-over the Sokhna\ Kattameya road reaching to the Sports city station towards final station, where interconnected with the Sokhna-Alamein High Speed Train (HST), as per in the map below, which shows the location of the LRT route relative to the New Capital Master plan.

The total length of the line is about 18.5 km, with elevated segment of about 11.1 km that accounts for 60% of the total route length. The ground segment is 7.4 km that accounts for 40% of the total length (Figure 4.6). A total of 4 stations along the line will be at elevated level and 1 station at ground level, the Military entity station (New Capital 4). The ground segment along the Military entity area including the station and railway will be fenced from both sides with 3m height concrete walls.

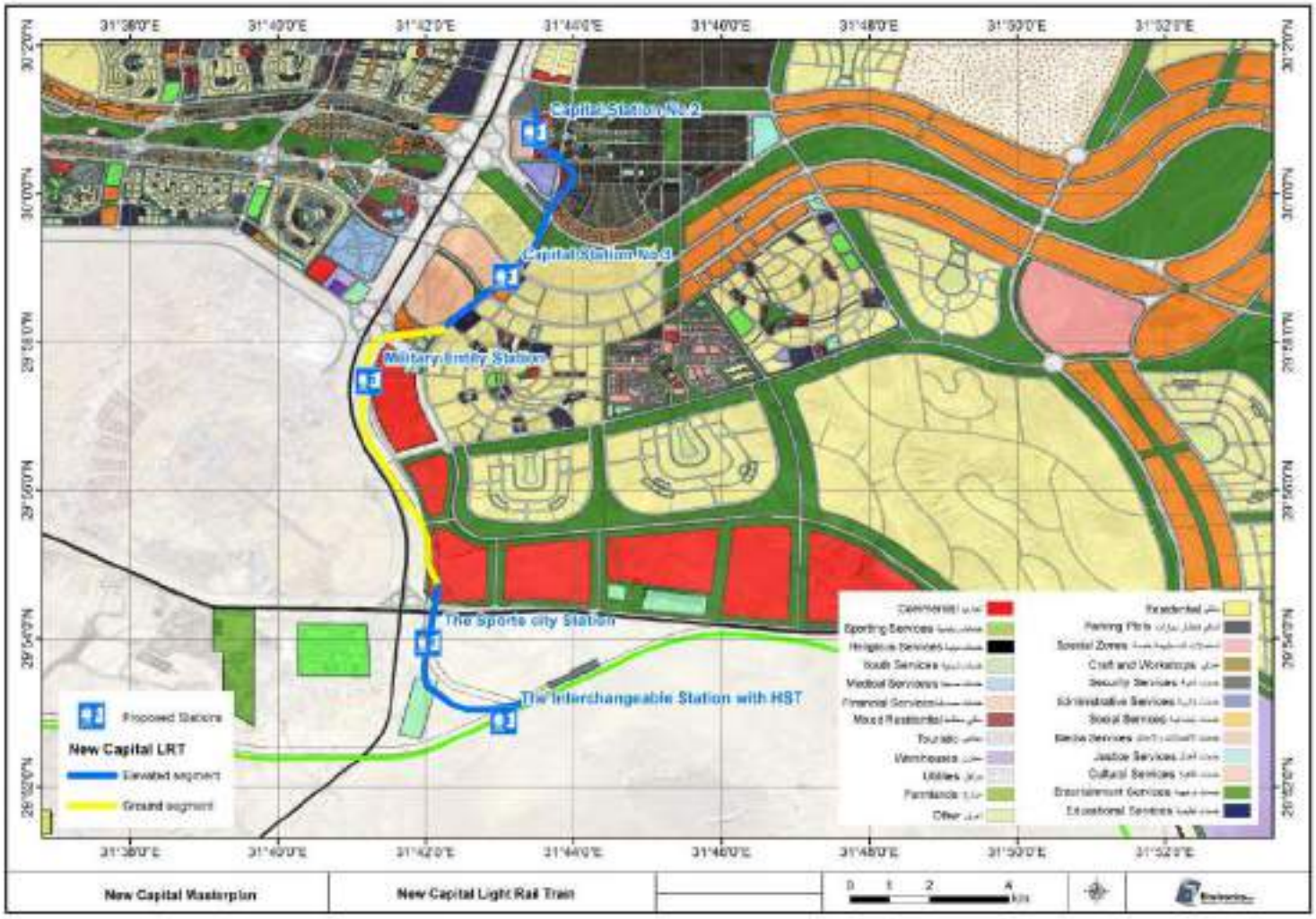

Figure 4–6): Elevated and ground segments of the proposed New Capital LRT

4.2 Basic Planning and Design Concepts

4.2.1 Route Selection

The route and stations were selected based on the following considerations to ensure that alignment/integration with the future plans for the New Capital city as follows:

- To connect the main governmental district with residential, services and business areas.
- To integrate with the planned land uses of the New Capital city.
- To ensure convenient transfer between the planned LRT and the High Speed Train and the Monorail.
- To consider connecting with other transportation modes.
- To consider cost reduction during construction.

4.2.2 Passenger Demand and Capacity

The main destinations are the governmental district and the military entity area. According the Transport Demand Forecasting Study for LRT phase 3, the expected hourly passengers transfer approximately 790 passenger/hour in 2022, 4538 passenger/hour in 2027, 7250 passenger/hour in 2032 and will be increased to reach 9088 passenger/hour in 2037.

4.2.3 Station Design and Facilities

Each station comprises a ground floor, a first floor, and an overpass at the access. The ground floor is a platform and the first floor are a concourse.

In typical stations, the platform will be located on one side of the road or over the median strip area. Overpasses will be set at one side or both sides of the station to connect to the concourse depending on the actual environment. A staircase, escalator, and one lift will be located on at least one side of the station to connect to the overpass and enter the station from the ground level. A parking area will be arranged around the station.

Passengers will enter the concourse via a pedestrian overpasses at both sides of the road, buy tickets and then take the train. The pedestrian overpasses can also function as pedestrian bridges. A shed will be set for the station overpass, and there will be a staircase beside every escalator.

The train formation of 6 cars. The effective length of station platform is 120m. The side platform width is 8 m wide, according to current passenger flow data.

The middle of the concourse will have free-access area and surrounded by two areas with paid access. Two groups of escalators and staircases, 1 set of staircases and 1 elevator will be installed at each platform.

The station platform will have seats for the passengers and the station's commercial spaces will be designed according to the actual needs of the local market. As for station finishing works, the special landscape, and station guide system design will be implanted in details.

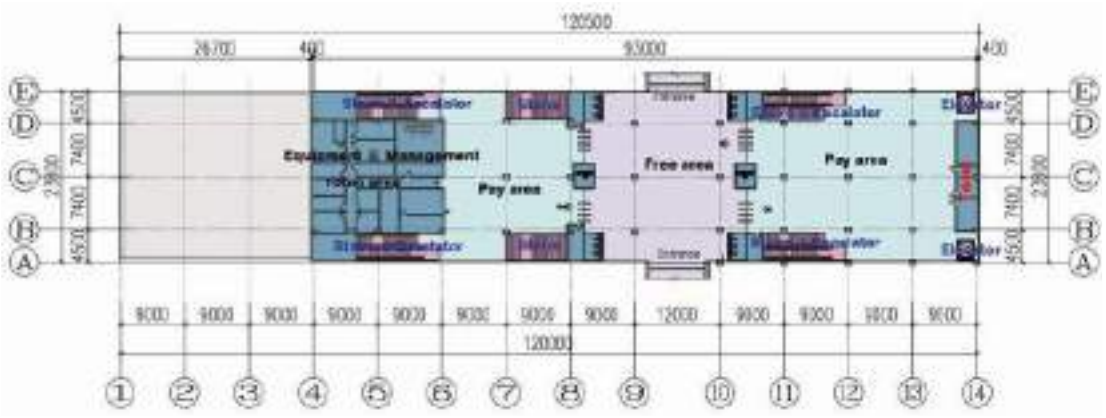

Figure 4–7): Plan of Typical First Floor (Concourse Level)

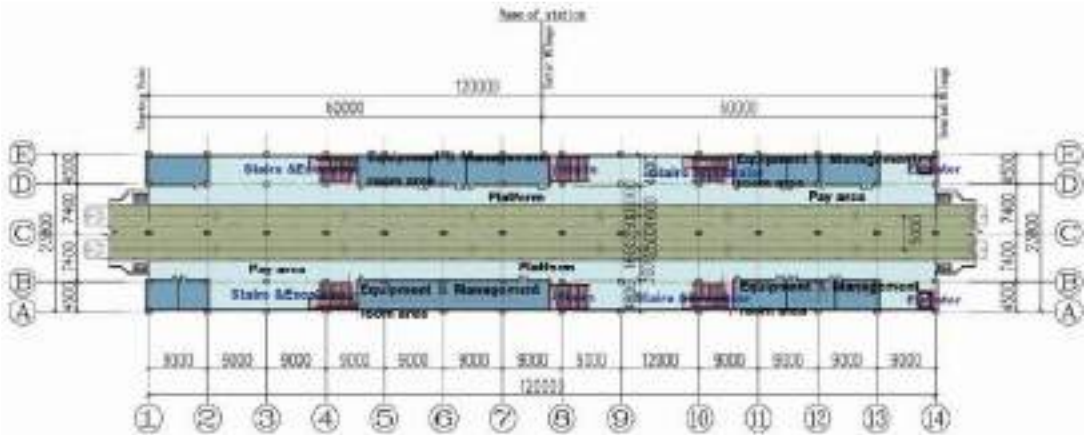

Figure 4–8): Plan of Typical Ground Floor (Platform Level)

In case of fire or other emergency, passengers will be requited use the concourse from the platform through the staircase with sufficient width, reaching a safe area outside the station through pedestrian bridge.

4.2.3.1 Design considerations for the Disabled

Each station overpass will be provided with vertical lift or ramps for the disabled to facilitate the access of the disabled. The disabled can use ground lift at the ground access, connecting the platform level with the concourse level. And their exits shall take the reversed flow. A tactile walkway will be set at train door position on the platform. It will extend from platform to access via concourse then reaching to another tactile walkway on road.

4.2.3.2 Station Facilities

The Concourse level will mainly comprise a train control room, toilet (for the employees), spare part room and some low current rooms. Toilets for passengers will be located in the paid –access zone on concourse level. The station platform level will be mainly provided with a step-down substation or combined traction and step-down substation and relevant equipment rooms.

Equipment and administrative rooms are shown in the table 4.1.

Table (4–1): Rooms in the station

Room location	Room name	Area (㎡)	Remark
Platform	Low current cable shaft	8	Public area
	Driver room	10	Public area
	Driver toilet	5	Public area
	Lighting distribution room	15	Public area
Concourse	20kv cable shaft	8	
	High voltage control room	35	
	Lighting distribution room	22	
	Low current work office	21	
	Traction cable shaft	8	
	Lighting power cable shaft	8	
	Low current cable shaft	8	
	Low current incoming cable room	8	
	Station master room (SMO)	53	Public area
	AFC Ticketing Office	22*2	Public area
	AFC Ticketing Management Room	35	
	Low Current Equipment Room	138	
	Low current battery room	37	
	Low current material room	15	
	Police room	22	Public area
	Police officer's room	21	Public area
	Civil defense room	20	Public area
	Male toilet	23	
	Female toilet	23	
	Male changing room	10	
	Garbage room	8	
	Male prayer room	10	
	Havc equipment room	42	
	First aid room	21	Public area
	Cleaning room	10	
	Low current duty room	22	
	Line staff office	18	
	AFC ticketing revenue office	16	
	Electrical maintenance staff office	19	
	Safe deposited room	13*2	Public area
	BMS duty room	16	

4.3 Construction Phase

This phase including also the pre-construction activities as it is only the earthwork that have the same impacts of construction activities. The construction and pre-construction impacts are same such as air and noise emissions, health and safety, traffic impacts etc. Therefore, the two phases will be covered later in one section.

4.3.1 Earthwork

This phase involves carrying out detailed surveying works along the line, stations and preparing the geotechnical studies to determine the characteristics of the soil at each station area specifically.

Followed by implementing the leveling works according to the surveying drawings, removing any barriers along the alignment, then fencing the line with temporary steel barriers on both sides.

4.3.2 Station construction

The ***stations*** are a two-level reinforced concrete frame structure. The main structure is constructed using all-round scaffold formwork, with rebar bent on site.

Pedestrian bridge ***foundation*** adopts reinforced concrete cast-in-place piles, using drilled hole, making reinforcement cage on site. The pier is reinforced concrete structure, casting with overall formwork, so as to ensure beautiful and uniform appearance. Foundation construction adopts drilled hole (punch hole) with the reinforcement cage constructed on site.

A steel structure is adopted for the road-crossing section of the ***bridge*** and reinforced concrete structure is chosen for the rest of the structure. Steel bridges manufactured in factory, transported to the site for hoisting installation. The pedestrian bridge's staircase is reinforced concrete beam and the pier is single-column rectangular pier. Piers of the pedestrian bridge are set at both sides of the road. The escalator section is reinforced concrete structure, constructed by means of casting concrete in all-round scaffold formwork.

The line will be fenced during construction phase, the height of the temporary steel barriers will be 3 m on both sides. However, it will be taking into consider a passage for movement between both sides, as needed at the implementation level.

4.3.3 Subgrade sections

Subgrade sections at the ground level segment, will require excavation and filling to reach the desired dimensions and slopes. For the embankment body, the embankment body should be as much as possible filled with the excavated soil. If the excavated soil is insufficient, the soil can be transported from another place. When filling material underneath the subgrade bed is weak, expansive soil or salt-containing soil, the bed bottom may be sealed with a geo-membrane. Depending on the embankment base soil, it can also be excavated and replaced with filler and compacted or just compacted.

For side slopes, the natural side slope will be adopted as much as possible, without protection. Sections behind abutments and high fill on culverts will be protected by precast concrete block. If the side slope is higher than 5m, a geo-grid will be laid horizontally on the side slope layer by layer.

Retaining walls will only be used as necessary. For example in,
- Sections where natural slope will affect existing roads, railways, buildings, structures, equipment, etc.
- Sections where right-of-way is limited.

4.3.4 Bridge section

As for the simply supported concrete beam: whole-span prefabrication transport and erection method sets large-scale girder manufacturing plant for prefabricating whole-span girder. After initial tension, the girder body will be moved from girder prefabricating platform to girder storage platform, and then will be directly lifted on the transporting girder vehicle and transport to site, and then lift to the right location.

As for the simply supported steel beam: After the production is completed in the factory, it is transported to the site by truck and erected to the exact position by lifting machine.

As for the continuous box concrete beam: full framing cast-in-place method is to erect supports at bridge location on site, including working procedures such as erecting formwork, binding reinforcement, concrete cast-in-place, tension of pre-stressing, formwork disassembly and removing temporary support.

4.4 Workplace

The main construction camp of LRT phase 1, the camp of main contractor (CREC-AVIC) will be used by for this project to accommodate some activities as follows:
- Maintance workshops for main contractor equipment's
- Raw materials storage area for rolling

This main camp is located about 17 km north of the first station of the alignment. It is already constructed and was included in the environmental approval of the LRT phase 1 project (**Annex 1**).

In addition, to separated 7 basecamps for sub-contractors will be constructed. The camp site selection depends on many factors, including the size and conditions of the site and availability of resources; the safety, security and protection it offers and cultural and social considerations. Choosing a site involves consideration of access, coexistence with surrounding communities, topography, trees and vegetation, the potential impact on the environment, environmental causes of disease and other public health issues. It is important that site offices are comfortable, attractive and versatile, as well as being suitably robust and secure. The camp facilities shall provide space for routine work office, meeting room, documentation room, worship room, sanitation, workshop, storage, parking lot and other basic services (Excluding

Accommodation). All these camps need to comply with the Main contractor's standards for similar facilities and all of them are under the supervision and management of the Main Contractor. Each camp will consist of the following facilities and components:

- Portable office and documentation Caravan;
- Meeting Caravan;
- Toilet, Sanitary Facilities & Laundry;
- Septic Tank;
- Temporary fencing and guard room;
- Storage area for vehicles, equipment, materials;
- Workshop;
- Vehicle Maintenance Area;
- Electrical System;
- Fire Fighting & Emergency Equipment;
- Access to temporary infrastructure;
- Waste disposal and burn Pit;
- First aid facilities.

All workers shall be identifiable by the surrounding community by their safety clothing (high-visibility jackets) and name tags. Workers shall follow the current HSE policy which applied in phase of the same project LRT Phase I.

4.5 Equipment

The main construction machinery and equipment will be in good condition, have an advanced technology and reliable performance.

Having backup equipment will be considered for critical operations so as not to affect the project duration or cause losses in case of equipment failure. Major machinery and equipment serving construction include trucks and rollers, excavators, drilling – grouting machines, air compressors, air pick, and heavy trucks among others. Material testing devices will be used as well.

4.6 Waste management

Regarding camping areas of construction workers, vehicle washing and construction machinery maintenance, a sedimentation tank will be set at the construction site where high turbidity wastewater will be created. The concrete used in this project will be ready-mix and will not be prepared at the construction site.

Domestic wastewater from construction workers will be discharged into septic tanks then collected by an authorized wastewater contractor.

Regarding construction waste, the useful part of construction waste will be recycled and utilized; construction waste will be cleared and removed in time, transported and properly disposed of. Construction waste will not remain on site for a long period of time, or placed out of site. After any process is finished the floor will be cleared of waste.

4.7 Operation and Maintenance

4.7.1 Water supply and sewage system

The water supply system includes flushing water (for station ground cleaning) and drinking water and the water drainage system includes sewage and wastewater. Water supply will be through existing municipal facilities.

Sewage and wastewater which can flow by gravity in the station are directly discharged into urban drainage network; lifting pump station should be installed in the case that sewage and wastewater in the interlayer or dead angle cannot move by gravity and then discharge into urban drainage network.

All types of water supply & drainage pipelines in the station will not, as much as possible, cross the substation, communication signals machine room, low current equipment room, control room and other electrical equipment rooms.

4.7.2 Fire-fighting system

Concrete fire pump stations and fire water tanks will be set up in all stations, and water will be supplied by pressurization and regulator system. The case considered as one fire emergency occurred in one light rail route at one time. Stations are configured with reliable fire hydrant water supply system. To insure prompt and effective fire-fighting action, different building should configure with various kinds of extinguisher based on different building function.

The fire hydrant for ground section and elevated section will be approved by relevant government division.

All fire pipelines should not pass through any electrical equipment room, such as the substation, communication & signaling equipment room, light current equipment room and control room. All design should follow Egyptian Civil Defense & Fire Fighting requirements and international standards and NFPA.

4.7.3 Communication

Communication system consists of subsystems such as transmission, telephone, wireless communication, video surveillance, radio, clock, passenger information, network, record, communication power source, grounding, etc.

4.7.4 Electro-mechanical Equipment

Electro-mechanical equipment includes a power supply system, lighting system, an HVAC system as well as escalators and elevators.

The power supply system is mainly composed of traction substation, section post, overhead contact system (OCS), step-down substation, overhead power line, electric monitoring system, lightning protection system & grounding system, and power supply workshop. The lighting system covers includes lighting purposes for all station areas. Escalators and elevators are used for vertical displacement between the platform and concourse.

a. Air Conditioning

For HVAC system design, current Egyptian code, Ashrae handbook and standard, Related NFPA standard and code, SMACNA will be followed.

No platform screen doors or platform edge doors installed along the trainway side of platforms. Calculation for ventilation load, air conditioning load, and minimum fresh air flow rate in non-public area shall be based on ASHRAE. Occupant load on public area related to calculation shall be based on summer peak rush hour. Air conditioning systems are not considered in the public area of concourse and platform in all Phase 3 stations.

Ventilation and air conditioning system in stations shall provide comfortable working environment for staff, suitable operation environment for equipment, and tenable environment in accordance with NFPA 130 in emergency conditions. On the premise of meeting the functional requirements, the design of ventilation and air conditioning system shall be simple, energy conservative, space-saving, and maintainable as far as possible.

Smoke management system shall be designed on assumption of a Single Fire Event (for entire 10th of Ramadan Railway line including its extension line), i.e., assume a single fire event from a single fire source within stations, vehicles, and tunnels of entire 10th of Ramadan Railway line including its extension line.

For the elevated stations (New Capital (3), New Capital (5) and Mastery), natural ventilation and natural smoke exhaust are preferred and adopted for the public area of platform floor. Mechanical ventilation and smoke exhaust system are adopted for the public area of concourse floor. For the at-grade station (New Capital (4)), natural smoke exhaust will be adopted for the platform area. For the entrance hall, setting roof vent for natural smoke exhaust.

HVAC system will serve the stations of Phase III excepts the reserved shop area located within the stations. For staff rooms the dx-split unit and fresh air system will be adopted for air conditioning. Mechanical ventilation system will be adopted for the rooms like garbage room, cleaning room, toilet, etc. For low current equipment room, rooftop unit will be adopted for air conditioning in this room.

4.7.5 Depot Area

Depot area will be located at about 1 km east the interchangeable station with the High Speed Train (HST). It consists of a comprehensive maintenance center, supplies warehouse and necessary office and living facilities. The depot area serves for train parking, train inspection, temporary repairs, regular maintenance, overhaul/ un-wheeling repair, general maintenance. As well as the HST will pass through the same depot area.

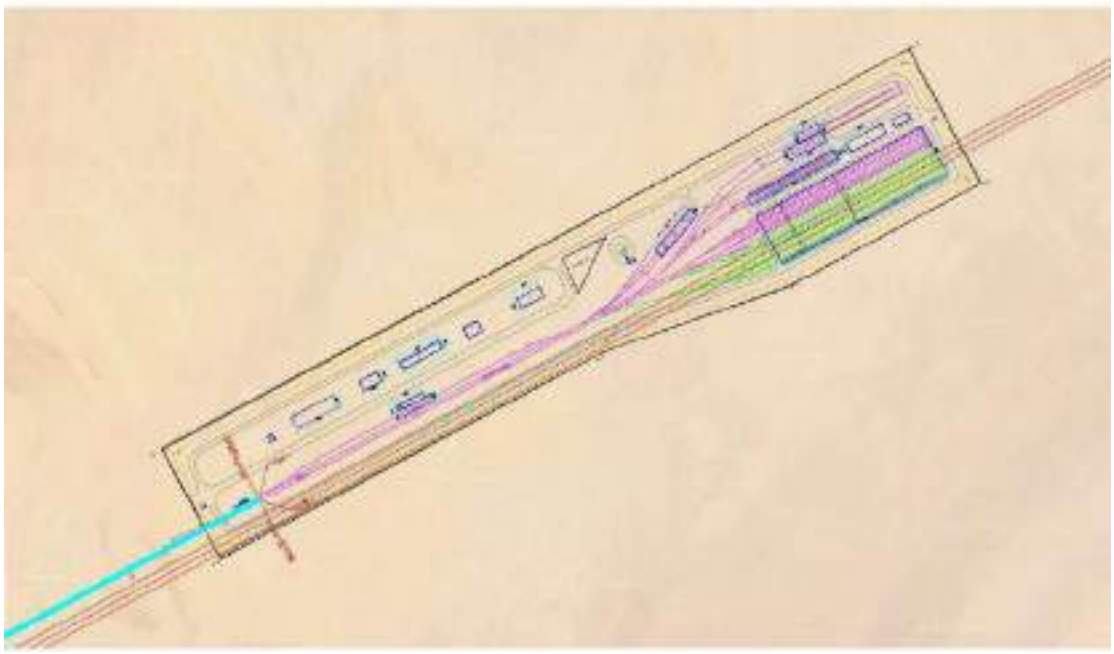

Figure 4–9): General Layout of the Depot Area

4.8 Rolling Stock

The rolling stock consists of motor cars with driving cabin, motor cars without driving cabin and a trailer car with pantograph. The rolling stock comprises 6 car-trains (Mc-Tp-M-M-Tp-Mc).
Mc: Motor car with cab
M: Motor car without cab
Tp: Trailer car with pantograph1

Table (4–2): Characteristics of Rolling Stock

No.	Description	Parameters
1	Total length of train (6-car composition)	118370mm
2	Basic length of car body (Mc,mm)	19500
3	Basic length of car body (Tp,M,mm)	19000
4	Basic width of car body (mm)	2800
5	Height of car (with new wheels, without pantographs) (mm)	4115
6	Height with pantographs dropped (mm)	4535
7	Clear height of saloon in the car (mm)	2285
8	Height of catenary(mm)	4875~5525
9	Height of floor from rail top (mm)	1240
10	Rigid wheelbase of bogies (mm)	2300
11	Height of coupler (mm)	840
12	Axle load (t)	≤17.5
13	Length between bogie centers (mm)	12600
14	Number of doors on each side	4
15	Clear height of passenger side doors (mm)	≥1850
16	Clear width of passenger side doors (mm)	≥1300
17	Clear height of cab side doors (mm)	≥1800

[1] Apparatus mounted on the roof of an electric train to collect power through contact with an overhead catenary wire

No.	Description	Parameters
18	Clear width of cab side doors (mm)	560
19	Wheel diameter (new/worn, mm)	915/845
20	Wheelset	1353±2 mm
21	Passing width of gangway	1300mm
22	Passing height of gangway	1900mm

The train is operated under various modes including;

- Automatic Train Operation (allowing for automatic train driving with a driver in the cab),
- Speed Limited Manual Driving (allowing for manual driving under speed control in order to avoid over-speed) and
- Manual Driving with Speed Ceiling (may be used on all tracks when the two other driving modes are not available). The use of this driving mode is strictly limited by the operating regulations) among others.

The noise measurement in the cars will meet the related international standard with ISO3381 and ISO3095. 2 overhead unit type air conditioning units are provided in each car and the capacity of refrigeration will provide filtered and cooled air to saloon. Air circulation rate is approx. 4000 m^3/h and the fresh air volume: ≥1280m^3/h

The air conditioning unit has pre-cooling, cooling, normal ventilation, emergency ventilation and other functions.

The cab is separately equipped with air conditioning unit with an air circulation rate of 700 m^3/h and a fresh air volume: ≥30m^3/h

4.9 Track

4.9.1 Track Description

The trains will roll on the left-hand track when facing the direction of traffic and will serve stations whose platform height is 1.19 m in relation to the rolling plane and located 1.6 m from the track centerline.

Table (4–3): Track characteristics

Track gauge	1435 mm
Track type	UIC 54E1rails are used for the main track, auxiliary track and yard track
Main track	Double track (left-hand)
Max Gradient of main track	30‰
Max Gradient of auxiliary track	35‰
Min curve radius on main line	1200 m for general sections, 800 m for difficult sections, 350m for very difficult sections
Min curve radius on auxiliary line	250 m for general sections, 200 m for difficult sections

4.9.2 Power Supply Conditions

Power supply method: Overhead contact line
Supply voltage: 25 KVAC
Voltage variation range: AC20KV-29KV

4.9.3 Electromagnetic Compatibility

Vehicle electromagnetic compatibility should satisfy the requirements of EN50121. Design and construction of the train vehicles will not interfere with the proper or safe operation of the vehicle external systems, or any wayside external systems, or equipment used by the public such as cellular phones. Compatibility with mobile telephone network will be ensured in the entire network and will provide good radio coverage particularly on board the trains.

5. Analysis of Alternatives

5.1 No Development Alternative

The alternative not to develop the LRT Phase III New Capital was used in this EIA as the scenario with which to compare the environmental impacts of project construction and operation. If the LRT III is not established, the project area will be deprived of the following environmental and social benefits:

A) ***Environmental benefits*** such as (1) ***improved air quality*** due to reduced air pollution from displaced on-road vehicle trips as the project is providing an alternative mode of transportation, which is less energy intensive and more environmentally friendly, (2) ***Reduced greenhouse gas emissions*** due to shifting to a cleaner form of transportation, (3) ***Reduced noise intensity*** the expected decrease in the number of potential road vehicles.

B) ***Socio-economic benefits*** including (1) ***encouraging and attracting investments in the Administrative Capital***, (2) ***reduced road traffic congestions*** as for the expected modal shift, (3) ***Improve modes of transportation from Greater Cairo region to the Administrative Capital and new urban communities***, (4) ***increase in a direct labor force*** during either construction and/or operation, (5) ***Providing safe and time-controlled transportation mode***, (6) ***reduction in the number of accidents***.

Considering that the impacts of the proposed project will be managed to levels where the environmental impact will be manageable, the "no development" alternative has not been given further consideration.

5.2 Route Selection

The New Capital LRT starts at the art city at the New Capital City then go to south along with the existing roads until the station of the military entity which form this point the alignment go in parallel east the regional ring road ,which intersect Cairo/Sukhna road, and continue to go in parallel with the regional ring road to end at the interchangeable station with the high speed train (HST). Furthermore, the alignment was chosen carefully to integrate with the plans of the New Administrative City. Therefore, LRT shall be built at the final route which is shown in project description chapter to avoid obstructions and to integrate with the future city plans.

5.3 Location of Stations

As described in the Project Description Chapter, there are five stations are proposed along the alignment which was initially intended to increase accessibility along the LRT for different areas where the LRT passing by in addition to be integrated with the New Administrative City's plans. The stations are currently including the following:

- **New Capital 2** is an elevated station located east of the City of Arts and about 650 meters north of the Masa Hotel. It will allow interchange with the Monorail through an area for pedestrian between them. This station is the connecting point with LRT phases 1 and 2 to reach the new communities east of Cairo.

- **New Capital 3** is elevated station located close to the Cathedral and the proposed Green river area between the exhibition area and the investors district. The administrative and commercial zone is located about 500 m south of this station.

- **Military Entity Station** (New Capital 4) is a ground station located within the regional investment area near to the military entity zone. There is a residential district (R7) located about 1.2 km east this station.

- **Sports City Station** (New Capital 5) is an elevated station located at the south of the intersection between the Regional Ring Road and Cairo/ Sokhna Road near to the Olympic Sports City.

- **Interchangeable Station with HST** (New Capital 6) is elevated station and located about 2.7 km south east of Sports City Station. This station is designed to be connected with Sokhna-Alamein High Speed Train (HST) through an outdoor walking area to a separate building south of the station.

5.4 Location of The Depot Area

Depot area will be located after the interchangeable station, about 1 km in a desert area devoid of sensitive biodiversity. It includes a comprehensive maintenance center, supplies warehouse and necessary office and living facilities. The depot area serves for train parking, train inspection, temporary repairs, regular maintenance, overhaul/ un-wheeling repair, general maintenance. As well as the HST will go through the same depot area.

The depot area is way from residential, industrial or any sensitive activities and away from the main roads to minimize potential impacts from the workshop on the surrounding environment.

6. Environmental Impacts and Mitigation Measures

6.1 Introduction

This project is an extension of the light rail train LRT phase I project, which has been approved by the EEAA, and it has existing HSE policies and plans, which are currently being applied in the LRT Phase I. Accordingly, this section will take into account these HSE plans including potential impacts and mitigation measures in addition to the literature review and good international practices. Moreover, the main contractor will include all the mentioned mitigation measures in this section in the contract of the sub-contractors to be incorporated in the construction management plan.

6.2 Methodology

Potential impacts from the proposed development activity are grouped into two categories; impacts from the proposed project on the surrounding environment; and impacts from the environment on the project (e.g. natural hazards and risks). In this context, the environmental assessment has been carried out in three main steps. These are:

1. Identification of potential impacts
2. Evaluation and assessment of the impacts in terms of their significance
3. Identification/proposition of mitigation measures for minimizing the effects of significant impacts.

6.2.1 Identification of Potential Environmental Impacts

Impact identification was based on the analysis of project specifications and its components, the baseline information collected in the field, literature review and previous project phase (LRT phase I).

Identified potential impacts were mainly concerned with construction and operation phases, including:

- Air and noise emissions
- Waste management
- Impacts on traffic
- Health and safety impacts
- Socio-economic impacts

A modification of the Leopold matrix (Table 6-2) has been designed so that the key potential impacts associated with the project become readily and immediately apparent. The layout of the matrix is arranged as follows:

- The “y” axis of the matrix consists of a list of activities presented according to construction and operation activities. It also consists of the list of aspects associated with each activity or group of activities.
- The “x” axis consists of the resources and receptors susceptible to impacts categorized as physical and socio-economic aspects. Identified resources and/or receptors were:
    - Air quality
    - Noise and vibrations

- Soil quality
- Public health and safety
- Employment
- Community mobility
- Workplace health and safety
- Roads and traffic

The identified potential impacts were categorized into as positive, negative or not applicable. However, this is a general classification since the impacts are not applicable to all areas of project implementation but rather to specific locations containing sensitive receptors.

6.2.2 Evaluation and Assessment of Impacts

The impact evaluation also takes into consideration the mitigation measures included in the existing company policies and management system, good international practice. This is in addition to measures of the Front End Engineering and Design (FEED).

Potential impacts were subject to a process of impact evaluation, based on the analysis of the proposed project components and activities, in order to determine the significance of the different impacts. Impact evaluation was based on four pre-set sub criteria to define the magnitude of the impact (high, medium, low) including;

- Impact duration (short term, medium, long term).
- Spatial extent (local, regional or national).
- Reversibility of the effect on receptor (direct, indirect).
- Exposure period (permanent, temporary).

Significant impacts will be defined based on Table (6-1) which provides a significance matrix between the magnitude of the effect (high, medium, low) and the sensitivity/ value of receptor (high, medium, low). Significant impacts occur where valuable or sensitive resources, or numerous receptors, are subject to effects of considerable magnitude. Conversely, effects are unlikely to be significant where non-sensitive resources, or small number of receptors are subject to only minor effects. Allocation of significant effects in intermediate situations will be a matter of professional judgment in each topic area.

Where an effect is considered to be significant, this significance will be generally classified as:

- Major impacts will usually result in long-term or irreversible effects on the social and/or natural environment.
- Moderate impacts will usually result in medium effects on the social and/or natural environment.
- Minor impacts will usually result in short-term effects on the social and/or natural environment.

Table (6–1): Significance Matrix

Sensitivity/ Value of Receptor	Magnitude of Effect		
	High	**Medium**	**Low**
High	Major	Major/Moderate	Moderate
Medium	Major/Moderate	Moderate	Moderate/Minor
Low	Moderate	Moderate/Minor	Minor

6.2.3 Mitigation Measures

This section describes the proposed 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 management and monitoring measures during construction and operation phases.

6.2.4 Residual Impacts

This section identifies the effects of the proposed development that remain after implementation of mitigation measures. The impact significance will decrease from one level to another depending on the effectiveness of the mitigation measure, e.g. A Major impact may become Moderate or Minor. Minor impacts will become Negligible after implementation of mitigation measures.

6.3 Impacts that are Not Applicable

The following impacts are not applicable due to the absence of the specific receptor at certain location or due to the absence of the exposure pathway between the activity and the receptor. These include:

- Impact of ***construction and operation activities*** on ***surface water*** is ***not applicable*** as there are no water bodies along the route.
- Impact of ***construction and operation activities*** on ***groundwater quality*** are ***not applicable*** as all the line will be at grade or elevated and there will be no contact with the groundwater table in the project area which is also deep.
- Impact of ***operation activities*** on ***land use change*** around the stations through attracting such activities as commercial ones. It is ***not applicable*** as the proposed project is located within New city (the Administrative Capital) which has a Masterplan as a legal document that regulates current and future land uses, therefore uncontrolled uses are not expected to appearance.
- The impact of ***construction activities*** on ***land acquisition*** *is* ***not applicable*** as the proposed project is located in the Administrative Capital on state lands.
- The whole project and depot area located in an ***area under urban development or devoid of biodiversity*** (Figure 6-1). Moreover, very low vegetation cover was also observed and no records were found for wild terrestrial life. The terrestrial life may have been already disturbed by the current construction activities of other projects in the Administrative Capital and will not be further affected by the establishment of the rail

and its associated infrastructure. Therefore, there will be ***no impact*** from ***construction and operation activities*** on the ***biological environment.***

Figure (6–1): Typical modified desert habitat in Administrative Capital city

Table (6–2): Summary of Potential Environmental Impacts

Activities (Sources of Impacts)	Aspects	During Construction	During Operation	Environmental Attributes / Receptors							
				Physical Environment			Socio-economic				
				Air Quality	Noise / vibration	Soil	Public Health and Safety	Road and Traffic	Employment	Workplace Health and Safety	Community Mobility
I. Construction works: Infrastructure. Stations, depot construction (*Construction Phase*)											
Hauling construction material and equipment	Using current highways to move construction material to and from project site	Present	Absent	-	-	NA	-	-	+	-	NA
	Potential spills from liquid tanks/ concrete/steel trucks	Present	Absent	-	NA	-	NA	-	NA	-	NA
Excavation works	Operation of mechanical equipment (bulldozers, excavators and loaders)	Present	Absent	-	-	-	NA	NA	+	-	NA
	Soil support and compaction	Present	Absent		-	-	NA	NA	+	-	NA
Disposal of Removed Material	Disposal of a portion of the excavated material to dump site (including truck/equipment movements)	Present	Absent	-	-	-	-	-	+	-	NA
Handling and storage of fuels and liquids	Leakage to soil	Present	Absent	NA	NA	-	NA	NA	NA	-	NA
Workplace and Construction Camp											
Activities related to Workforce Offices and Central Construction Camp and subcontractors camps	Central construction camp logistics	Present	Absent	NA	-	NA	NA	NA	+	-	NA
	Subcontractors camps establishment and logistics	Present	Absent	NA	-	NA	NA	NA	+	-	NA
	Municipal Solid Waste generation	Present	Absent	-	NA	-	NA	NA	+	-	NA
	Sewage generation	Present	Absent	-	NA	-	NA	NA	NA	-	NA
II. Rail Operation, Vehicle travel, Depot area											
Mobilizing Passengers	Providing affordable public transport mode as alternative of passenger cars	Absent	Present	+	+	NA	+	+	+	-	+
Economic development	Investment rate in the business and housing sectors	Absent	Present	-	-	NA	-	-	+	NA	+
	Attraction of controlled commercial activities around proposed stations.	Absent	Present	-	-	NA	-	-	+	NA	+
Locomotive maintenance at workshops (depot area)	Hazardous waste generation	Absent	Present	-	-	-	NA	NA	+	-	NA
Station operation	Municipal Solid Waste generation	Absent	Present	-	NA	-	-	NA	+	-	-
	Sewage generation	Absent	Present	NA	NA	-	-	NA	NA	NA	NA
Power supply and transmission	Emissions from electric utilities supplying electricity Electromagnetic interference with	Absent	Present	NA	NA	NA	NA	NA	+	-	NA

6.4 Positive Impacts

Based on project components and the existing environmental conditions, it is anticipated that the project would provide a set of long-term positive impacts on several key environmental and socio-economic factors. Positive impacts include:

- ***Environmental factors*** such as:
  1. ***Improved air quality*** due to reduced air pollution from displaced on-road vehicle trips as the project is providing an alternative mode of transportation, which is less energy intensive and more environmentally friendly.
  2. ***Reduced greenhouse gas emissions*** due to shifting to a cleaner form of transportation. As well as the proposed line will be connected to other public transit modes such as LRT phase 1, Monorail, and High-Speed Train. This factor will encourage individuals to reduce dependence on their private vehicles to move within/out of the city which reflected on the greenhouse gas emissions rate.
  3. ***Reduced noise intensity*** the expected decrease in the number of potential road vehicles compared to relying only on individual transportation means only.

- ***Socio-economic factors*** *such as****:***
  1. ***Encouraging and attracting investments in the Administrative Capital*** as the public and affordable transportations playing a vital role to foster and accelerate the development rate of the city.
  2. ***Reduction in road traffic congestions*** due to the expected modal shift from road transport rail
  3. ***Improve modes of transportation*** from Greater Cairo region to the Administrative Capital and new urban communities.
  4. The construction of the rail and its associated infrastructure will bring about ***job opportunities*** for drivers and construction workers as well as waste collectors/recycling companies and will allow for ***international knowledge transfer.*** During the operation, a rail workforce will be employed for operating and maintaining the rail system. Also waste collectors/recycling companies will be needed to dispose of waste generated from freight yards and train maintenance.
  5. ***Providing safe and time-controlled transportation mode*** due to the provision of a direct quick mode of transport that avoids road congestions and reaches the new governmental center in Administrative Capital, commercial, business services, and proposed residential areas.
  6. ***Reduction in the number of road accidents*** that will frequently and daily travel to the due to the Administrative Capital by passenger cars and microbuses.

In addition, the project design considers measures to reduce potential impacts, including:

- The route was chosen to be the smoothest route possible to avoid excess friction, hence fuel consumption.
- Elevated rail sections are designed in a way that does not affect road driver visibility.
- Stations and flyovers accommodate handicapped, elderly and strollers (wherever possible).

6.5 Assessment of Negative Impacts and Mitigation Measures

6.5.1 Construction Impacts

The construction and pre-construction impacts are same such as air and noise emissions, health and safety, traffic impacts etc. Therefore, the two phases are addressed in one section as no extra impacts are expected.

The project is located in the Administrative Capital, under development area, and has not been occupied yet. Therefore, the impacts related to the local community aspect, such as public health and community mobility, will not be affected as the receptors are not exist during construction phase.

The potential impacts resulting from the proposed rail and stations will mainly result from:

- Dust Emissions
- Air Emissions (vehicles, equipment & material)
- Noise (vehicles & equipment)
- Soil erosion and contamination
- Construction Waste (solid & hazardous wastes)
- Health and safety, accidents from vehicles & equipment

6.5.1.1 Impacts on Physical Environment

- ***Impacts on Air Quality***

  Source of Impact

  Construction activities generate dust and other forms of air pollution (particulate matter) and if not managed properly, could result to degradation of the surrounding air quality. In addition the movement of trucks and heavy material on-site and from out to site is a secondary source for dust. Such pollutants may remain suspended in the air depending on their particulate size and may cause adverse health effects. Even though such impacts are temporary in nature, these begin with construction activity and decline during finishing stage, yet it is imperative to employ control measures. The impact depends directly on the magnitude of the generated contamination, on the morphology of the site, the meteorological conditions, the proximity and sensitivity of the receptors.

  Planning and Design Mitigation Measures

  Use of equipment and machinery that is in good working condition will decrease emissions from the construction sites.

Impacts of air emissions on ambient air quality is considered **s*hort term, local, direct and temporary*** that is ***Medium*** of effect magnitude. Which effect on neighboring sensitive receptor the northern part of Al Masa hotel is ***Low*** value. The impact resulting from construction activities of the project is considered **Moderate/Minor** as the ambient air quality is already high due to the current construction activities of other neighboring projects.

Management Mitigation Measures

- Maintain machinery and vehicles in good working conditions to minimize fugitive emissions.
- All construction equipment will be frequently inspected to ensure that the generated fugitive emissions are within acceptable limits.
- Dust suppression measures at the site by water spraying,
- During dry periods, undertake works giving rise to dust only after surface watering of the areas concerned.
- Construction waste and excavated soils will be transported in confined vehicles and properly covered to avoid dust becoming air borne.
- Excavated materials shall be placed in the dumping/disposal areas designated for that purpose. Material shall be stabilized each day by watering or other accepted dust suppression techniques.

Residual Impacts

Minor if mitigation measures are applied.

- ***Noise Impacts***

Source of Impact

The receptors that may be affected by air emissions are the same ones expected to be impacted by noise emission.

Construction of rail track and facilities would require the use of equipment, which may generate high noise levels, and adversely affect sensitive receptor the northern part of Al Masa hotel. Impact devices, such pavement breakers and diesel generators create are a source of noise. Diesel-powered equipment and pneumatic impact tools create more noise than electric and hydraulic tools. Other sources of noise include movement of trucks and heavy material, idling, assembly on-site and inadequate physical separation between noise generators and noise receptors.

Planning and Design Mitigation Measures

Use of equipment and machinery that is in good working condition will decrease noise from the construction sites. Localized noise barriers will be erected as necessary around items such as generators or high duty compressors.

Noise impacts are ***short term, local, direct and temporary*** that is ***Medium*** of effect magnitude which impact on neighboring sensitive receptor the northern part of Al Masa hotel is considered ***Low***.

Management Mitigation Measures

- Machines in intermittent use will be shut down in the intervening periods between work or throttled down to a minimum. Where practicable the use of noisy equipment will be limited to core daytime periods.
- The workers on the jackhammers, and pavement breakers equipment will be provided with ear protective equipment.
- All vehicles and generators will be kept in a good condition and regularlyinspected.
- Maximize physical separation, as far as practicable, between noise generators and noise receptors.
- Arrange the working schedule for the worksite to reduce impacts at sensitive times.
- Schedule truck loading, unloading, and hauling operations so as to minimise noise impact near sensitive locations and surrounding communities.
- Select truck routes so that noise from heavy-duty trucks will have minimal impact on sensitive land uses.

Residual Impacts

Negligible if mitigation measures are applied.

- ***Impacts on Soil***

Source of Impact

The following components of the proposed scheme may cause impacts on soil erosion and quality:

- Earthworks, cuttings and embankments;
- Disposal sites;
- Track maintenance and drainage operations which may lead to contamination of soil;
- Potential leaks from fuel and materials.

Planning and Design Mitigation Measures

A waste management plan will be developed in accordance with the best practice guidelines for different construction activities including earthworks, disposal sites, and potential leaks as well as the company environmental management system This plan will ensure that all construction waste is stored, managed, moved, reused or disposed of in an appropriate manner by appropriate contractors in accordance with all relevant waste legislation.

Impacts on soil are ***short term, local, direct and temporary*** that is ***Medium*** of effect magnitude. However, the project is located in an urban environment as a part of a wider integrated urban development the Administrative Capital and the surface soil value was changed, the receptor value is ***Low***. This potential impact is considered **Moderate/ Minor**.

Management Mitigation Measures

- Store earthwork and construction wastes separately.
- Store excavated wet soil separately to avoid cross contamination.
- Provide storage tanks with sufficient capacity.
- Provide spill kit for handling accidental spillages on the worksite(s).
- accidental discharges into the soil shall be stored separately and sent to a certified treatment/disposal facilities.
- Formal prohibition on the discharge any hazardous material or mixture in the drainage area.
- Implementation of special provisions for the storage of used materials so as to limit the risk of leakage.
- Ensure separation of any contaminated materials and appropriate handling, storage and treatment.

Residual Impacts

Negligible impacts on soil from waste disposal.

6.5.1.2 Impacts on Socio-economic Environment

- ***Workplace Health and Safety***

Source of Impact

Construction activities may result in safety hazards to construction workers from slips, trips and falls. These impacts are short term in nature, as they disappear after the termination of the construction phase. Construction traffic can also pose safety hazards due to potential traffic accidents if proper precautions are not taken. Also, during the construction phase, the use of construction equipment generates localized noise pollution. (Table 6-3) gives the typical noise levels from construction equipment.

Table (6–3): Typical Noise Levels from Construction Equipment

Equipment	Noise Level in dB, 5m away from source	Allowable Limit as per Law 4/1994
Dozers	90	A maximum of 90 dB for 8 hours
Loaders	80	
Diesel Trucks	80	
Excavator	90	

Stockpiles of construction and other materials such as fuel, oil etc., might also pose health and safety hazards if improperly stored or handled.

Planning and Design Mitigation Measures

A Health and Safety system will be prepared by the project for the construction phase. Contractors will be required to abide by this system and take required measures before any work starts on site. The aim will be "Zero Incidents" with all incidents reportable. Safety training/induction will be provided before any new task is carried out at site. All precautions will be taken according to law 12/2003 and its executive decrees and Law 4/1994 concerning ensuring adequate occupation health and safety during construction.

Impact on workers' health and safety is ***short term, local, direct, and temporary*** that is ***Medium*** of effect magnitude. However, may result in reversible or irreversible effects such as in the case of accidents and the receptor is ***Medium*** value. Therefore, this impact is considered **Moderate**.

Management Mitigation Measures

- Incorporate HSE requirements in contractors contracts and purchase of adequate personal protective equipment
- Use of personal protective equipment and safety harness to prevent falling. Ladders and scaffolds will be frequently inspected .
- Adhere to strict public health and safety standards.
- 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, well ventilated area.
- Install fire extinguishers in designated places throughout the site.

Workplace noise will mainly affect the workers and will have a localized confined effect. The magnitude of the aspect is not high since as clear from (Table 6.3) the noise levels are within allowable limits for exposure to noise within a working day. Moreover,.

Workers will be provided with the necessary PPEs including ear protection equipment. Equipment and vehicles will be periodically maintained to minimize noise levels. This way the workers (receptors) will be protected and probability of exposure to noise will be minimized and thus potential impact eliminated.

Residual Impacts

Minor if mitigation measures and site management practices are applied.

- ***Road Network and Traffic***

Source of Impact

The possibility of accidents due to transfer of the construction equipment to the site, raw materials, mechanical components, train vehicles in addition to the interference between the projects' trucks movement with traffic movements generated from other development projects still under construction.

Planning and Design Mitigation Measures

Effects of roads and traffic during the construction phase especially in areas of a high rate of under-construction projects at the same time can be mitigated by coordination on the upper level with the stakeholders such as the City council.

6.5.1.3 Impact on roads and traffic is short term, regional, in direct, and temporary since it lasts only during the construction period that is Medium of effect magnitude and the receptor value is Low value. If not properly managed, this impact may be Moderate/ Minor.

Management Mitigation Measures

- All traffic management measures will be examined through coordination between NAT, City Council and the Contractor.
- Transferring construction equipment, raw materials, mechanical components, and train vehicles on regional and major roads during low traffic flow times as possible.
- Most construction operations will be within existing road rights or vacant lands without roads.
- Abide by speed limits for machinery and trucks; set limits in accordance with legislation on sensitive worksites and workshops.

Residual Impacts

Minor if mitigation measures are applied.

6.5.2 Operation and Maintenance Impacts

Impacts of the operation and maintenance phase are expected from the following activities:

- Operation of stations
- Operation of rolling stock
- Operation of parking spaces
- Operation of depot

6.5.2.1 Impacts on Physical Environment

- ***Impacts of Air Quality***

  Source of Impact

  The prime mover for the railway system shall be the electrical energy supplied by the grid. Compared to other modes of transport, the electric train is least polluting and can be classified as an environmentally friendly technology since no local air emissions are involved in running and operating the trains. On the contrary this impact is considered positive.

  However, there is a likelihood of temporary and localized increase in air pollution levels around the stations due to clustering of other modes of transportation such as cars and buses. The air quality at the depot may be jeopardized due to equipment maintenance activities.

  Planning and Design Mitigation Measures

  Planning for parking areas for buses and cars near stations in-advance with relevant authorities (Ministry of Interior, City Council, etc) will reduce emissions as congestions are reduced and this will make the impact Minor.

  This impact is a ***long term, local, indirect, temporary*** impact that is ***Low*** of effect magnitude and the value of the receptor is ***Low***. Purchase of machinery and equipment in good working conditions for the depot and workshops area will make the impact of emissions on air quality is **Minor**.

Management Mitigation Measures

Proper traffic management of the cars and buses clusters around the stations and proper housekeeping measures and maintenance of equipment and generators in good working conditions at the stations and depot area will reduce potential air pollution.

Residual Impact

Negligible if proper design measures are taken into consideration.

- ***Noise Impacts***

Sources of Impact

Noise is usually generated by the interaction of wheels and/or tires with their running surfaces. The interaction of steel wheels and rails generates:

- Rolling noise due to continuous rolling contact it is primarily by rail and wheel surface roughness.
- when a wheel encounters a discontinuity in the running surface such as a rail joint, turnout or crossover (where the train or rail vehicle switches off one track and onto another)
- Squeal generated by friction between wheels and rail on tight curves

As described in Chapter 4, the majority of activities/developments of the New Capital are not constructed, except for a few activities that are at the early stages of construction. In this respect, it is not possible at this stage to identify the exact distances from the potentially affected receptors as well as characteristics of details of the surrounding environment that may contribute to attenuation, diversion, absorption or shielding of noise from the LRT.

In this context, to assess the potential impacts of noise from the LRT on the surrounding receptors, the ***Inverse Square Law*** has been applied to identify the noise intensity reaching the different receptors. As sound generally decreases with distance, according to the ***Inverse Square Law*** of sound, the intensity of the sound is inversely proportional to the square of the distance of the wave-front from the signal source. Sound propagation is calculated using the following formula:

$$\mathbf{I2/I1 = [d1/d2]^2}$$

Although The Inverse Square Law is an idealization because it assumes exactly equal sound propagation in all directions. If there are reflective surfaces in the sound field, then reflected sounds will add to the directed sound and you will get more sound at a field location than the inverse square law predicts. If there are barriers between the source and the point of measurement, the propagated noise intensity may get less than the inverse square law predicts. Nevertheless, the inverse square law is a logical first estimate of the sound at a distant point in a reasonably open area.

As per the provided technical specifications of rolling stock the source noise data are as follows:

- Empty train is under static state and all auxiliary equipment in normal operation, noise measured at 7.5m horizontally from the center line of the running rail line does not exceed 75dB (A).
- At normal acceleration, coasting and deceleration, noise measured at 7.5m horizontally from the center line, does not exceed 82dB (A).
- Train running at constant speed of 60km/h±5%, noise measured at 7.5m horizontally from the center line of the running rail line does not exceed 82dB (A).

For the purpose of this assessment, a conservative approach has been adopted where the maximum noise level has been considered for noise estimation at the different receptors. In this respect, the assessment was based on maximum noise intensity of 82dB (A) throughout the LRT operations.

Accordingly, Table 6-4 below shows the noise levels at the boundaries of the land parcels of the different receptors[1]

Table (6–4): Noise intensity at the boundaries of the land parcels

Right side					**Left side**			
	Land Use	**Construction Status**	**Distance**	**Noise level dB (A)**	**Land Use**	**Construction Status**	**Distance**	**Noise level dB (A)**
1	Commercial	under construction	within		Conference city	under construction	60 m	~ 64
2	Governmental complex	under construction	110 m	~ 58	Al Masa Hotel	operated	50 m	~ 65
3	Educational service	under construction	35 m	~ 68	Commercial	under construction	35 m	~ 68
4	Science and Technology Parks, Mixed Use	under construction	85 m	~ 60	International Park	under construction	100 m	~ 59
5	Residential	under construction	85 m	~ 60	Residential	under construction	100 m	~ 59
6	Religious service	operated	40 m	~ 67	Cultural service	Planned	100 m	~ 59
7	Educational service and Residential	under construction	45 m	~ 66	Cultural service	Planned	100 m	~ 59
8	Unknown land use	planned	within		Cultural service and Unknown land use	planned	within	
9	Commercial - Mega Mall	planned	60 m	~ 63	Regional Ring Road	Existing	350 m	~ 48
10	Commercial	planned	180 m	~ 54	Regional Ring Road	Existing	220 m	~ 52

[1] It is expected that buildings will not be at these boundaries and accordingly the noise levels in the table are conservative and are likely to be lower

Right side					Left side			
	Land Use	**Construction Status**	**Distance**	**Noise level dB (A)**	**Land Use**	**Construction Status**	**Distance**	**Noise level dB (A)**
11	Commercial	planned	50 m	~ 65	Regional Ring Road	Existing	350 m	~ 48
12	Commercial	planned	within		Regional Ring Road	Existing	520 m	~ 45
13	Desert land	vacant land	free		Desert land	vacant land	free	Desert land
14	Desert land	vacant land	free		Desert land	vacant land	free	Desert land

The noise intensity estimation indicated that at all receptors at the different distances from the centerline are below or at the regulatory ambient noise intensity for 70 dB (A)2 during daytime (7.00 am – 10.00 pm) and 60 dB (A) during night time (10.00 pm – 7.00 am), except at a number of receptors within a distance of 60m from LRT centerline, where the noise limits moderately exceed the night time noise levels. However, it should be pointed out that these receptors are of mixed uses including mostly commercial, institutional or governmental developments for which the occupancy is limited to day time with no night time occupancy in addition to some residential areas.

Given the fact that that the calculations are approximate and precautionary, the results might imply that precautionary measures should be taken in the points where the sound levels are exceeding the regulatory standards.

However, as the calculations were based on:

- distance of receptors from LRT centerline as estimated from the perimeters of the allocated land parcel (because the specific locations of buildings are not available since most are not yet constructed or are at the early stages of construction)
- absence of noise attenuation/diffusion structures (such as walls, trees, vegetation, etc…),

Moreover, the noise intensity may decrease below the values given above due to the fact that the route includes concrete barriers installed at both sides of the alignment of height ranging between 1.5-2m at the elevated segments and of about 3 m at the grade sections, which could possibly contribute to shielding the noise from the LRT reaching the receptors.

<u>Planning and Design Mitigation Measures</u>

Necessity and effectiveness of planning the parking lots and/ or bus/ taxi pools at the new stations will be examined, to reduce the secondary impact of noise potentially caused by attracting the other transportation modes, with involving the responsible agencies for urban planning as well as local authorities in the further design stage of the Project. The depot area and final station do not have a significant impact on the ambient noise due to their location in a desert area without sensitive receptors.

[2] Assuming that the developments at the New Capital are located on roads equal or more than 12 m.

This secondary impact is ***long term, local, indirect, and temporary*** that is ***Low*** of effect magnitude. Which effect on neighboring receptors is ***Low*** and it is not located close directly to the stations. This impact is considered **Minor**.

Management Mitigation Measures
The planning and design mitigation measures addressed this impact and did not require further management measures as they reached a negligible impact.

Residual Impact
Negligible if mitigation measures are applied.

- ***Vibration Impacts***
  Source of Impact
  Vibration impacts may be expected from the rolling stock on neighboring structures in the future. However, all new buildings at the New Capital will be constructed according to the national and international building codes taking into consideration …….

  Planning and Design Mitigation Measures
  Vibration emanates from rail-wheel interaction and the same can be reduced by minimizing surface irregularities of wheel and rail, improving track geometry, providing elastic fastenings, and separation of rail seat assembly from the concrete plinth with insertion of resilient and shock absorbing pad.

  Impacts due to vibration are ***long term, local and indirect*** that is ***Low*** of effect magnitude. Thus potential vibration impact is considered **Minor**.

  Management Mitigation Measures
  The planning and design mitigation measures addressed this impact and did not require further management measures as they reached a negligible impact.

  Residual Impact
  Negligible if mitigation measures are applied.

- ***Electromagnetic Field (EMF) impacts***
  EMF from human-made sources is common and increasing in urban areas. Most people are exposed on a daily basis to a variety of sources and field strengths. The magnetic field from LRT operations decrease rapidly with increasing distance from the source but, and could be blocked by buildings and vegetation

  The strength of EMF levels from line sources are proportionate to the reciprocal of distance from the source (1/x, where x is the distance from the line). For example, the field strength at 20 feet (6 m) from the line would be 50 percent and the field strength at 40 feet (12 m) would be 25 percent of the field strength at 10 feet (3 m) from the line.

It is important to point out that the duration of EMF exposure could be quite short if, for example, one is simply driving or passing by, or extended, if one is in a residence or other structure adjacent to the power line. At a distance of 300 feet (90 m) and at times of average electricity demand, the magnetic fields from many lines can be similar to typical background levels found in most homes (NIEHS 2002).

The national Egyptian Electricity law 2015, article 55 has addressed the safe distances and ROW from different electricity sources as indicated below:

- 25 m at both sides for very high voltage lines 220 – 500 Kv
- 13 m at both sides for high voltage lines 66 Kv
- 5 m at both side for medium voltage lines 11 -22 Kv
- 5 m for very high and high voltage cables
- 2 m for medium and low voltage cables.

As per the technical specification of vehicles document, the LRT Rated supply voltage is AC25kV, which is closer to the medium voltage and accordingly will be subject to a safe distance of 5 m from both sides.

- ***Impact on Soil***

  Sources of Impact

  One of the possible sources which may cause soil pollution would be the maintenance works of rolling stocks and the workshops at the depot area.

  Planning and Design Mitigation Measures

  An oil pit will be installed at the end of pipe discharging the wastewater from the workshop, to separate the oil from oily wastewater. The wastewater after separating the oil will be discharged to a public sewage network or in other method according to the related national regulations.

  This impact is ***long term, direct, local and temporary*** that is ***Low*** of effect magnitude and the value of the receptor is ***Low***. It is considered **Minor**.

  Management Mitigation Measures

  - Comply with the Waste Management Plan which will be developed for operation activities.
  - Follow the emergency procedure for managing accidental discharges into soil, including arrangements for issuing a warning in the event of accidental discharge and removal to a certified facility for disposal of contaminated soil.
  - No pollutants or untreated liquid effluent may be discharged into the natural environment or public drainage system.
  - Ensure separation of any contaminated materials and appropriate handling, storage and treatment.

Residual Impact
Negligible if mitigation measures are applied.

6.5.2.2 Impacts on Socio-economic Environment

- ***Workplace Health and Safety***

Source of Impact
Exposure to air pollutants and higher noise levels, increased levels of heat & humidity at workplace at the depot and maintenance workshops area may result in impact on the occupational health and safety.

Planning and Design Mitigation Measures
A Health and Safety management plan will be prepared by the project for the operation phase. The aim will be "Zero Incidents" with all incidents reportable. The HSE personnel on site will be responsible for follow-up and inspection of performance. Safety training/induction will be provided before any new task is carried out at site. All precautions will be taken according to law 12/2003 and its executive decrees and Law 4/1994 concerning ensuring adequate occupation health and safety.

Impact on workers' health and safety is ***long term, local, direct, temporary*** that is ***Low*** of effect magnitude. However, may result in reversible or irreversible effects such as in the case of accidents so the value of the receptor is ***Medium***. This impact is considered **Moderate/ Minor**.

Management Mitigation Measures
Monitor of indoor air and noise quality related to occupational health and safety will be done on frequent basis to record levels of humidity and heat stresses at workplace environment.

Residual Impacts
Negligible after application of mitigation measures.

- ***Public Health and Safety***

Source of Impact
Potential impacts on public health and safety may be from accidents, fire and noise. The main sources of noise are from the operation of the rolling stock including engine noise (traction noise), cooling fan noise, wheel-rail interaction and electric generators. The roughness of the contact surfaces of rail and wheel and train speed is the factors, which influence the magnitude of rail - wheel noise.

Planning and Design Mitigation Measure
Emergency response plans and fire fighting plans will be developed, regularly updated and audited to ensure their effectiveness once required. A solid waste management plan will be developed and implemented within the boundaries of the project to ensure there are minimal impacts of illegal disposal on the users. Noise caused by rolling stock operations not expected to affect the users, as it is a temporary exposure.

This impact is a ***long term, local, indirect, temporary*** impact that is ***Low*** of effect magnitude and the value of the receptor is ***Low***. It can be considered **Minor**.

Management Mitigation Measures

- Continuous upgrading of emergency response plans will be carried periodically.
- Training of all levels of operating team on the normal and emergency procedures and plans.

Residual Impact

Negligible after application of mitigation measures.

- ***Impacts on Roads and Traffic***

Source of Impact

Impacts on roads and traffic due to the operation of the LRT project is considered mainly a positive impact.

However, the existence of rail station attracts more commercial activities which leads to more traffic flow. However, all stations including parking areas, for example in New Capital station 3 (Figure 6.2) shown connecting stations to parking areas.

Planning and Design Mitigation Measures

Planning for parking areas for buses and cars near stations will reduce traffic congestions. This impact is ***long term, direct, local and temporary*** that is ***Low*** of effect magnitude and the value of the receptor is ***Low***. It is considered **Minor**.

Management Mitigation Measures

NAT will coordinate with traffic departments on the Ministry of Interior to ensure traffic flow at station areas.

Residual Impacts

Negligible if mitigation measures are applied.

Figure (6–2): Connecting stations to surrounding area with parking areas

6.6 Impacts of the Environment on the Project

The surrounding environment may significantly affect the proposed project, particularly if unusual environmental circumstances are not taken into account within the project design. These impacts are typically referred to as natural hazards and include such aspects of seismic events.

- ***Seismic Hazards (or Earthquakes)***
  The study area (i.e. Greater Cairo) has experienced a concurrent risk of seismic activities classified as "Micro" where the intensity varies from 0-2 on the rector scale as mentioned in section 3-1-8.

  Planning and Design Mitigation Measures
  To mitigate the effects of seismic waves (or earthquakes), seismic risk factors will be considered in the construction of the LRT rail, stations and depot. In addition, the design team is required by law to follow the requirements of building technical codes regarding the seismic standards.

7. Environmental Management and Monitoring Plan

This section presents a description of the environmental management procedures required to alleviate potentially negative impacts associated with project. It also sets a preliminary environmental monitoring plan to enable early detection of any negative impact.

The proposed development activity will provide a fast and safe transportation service, improve connectivity, reduced traffic congestion, reduced fuel consumption, employment opportunities, and less air pollution. On the other hand, during the construction phase there are potential adverse impacts may result such as dust and air pollution, noise impact, generate waste, soil disposal, etc. The environmental issues likely to develop during project construction and operation phases could be minimized by making necessary considerations in the project design stage and adopting an Environmental Management Plan (EMP) in the construction and operation stages.

The main contractor has already developed a Health, Environment and Safety (HSE) plan that has been applied for Phase 1 of the LRT and it will be further developed and extended to include this phase (LRT New Capital) and the Environmental Management Plan (EMP) is a key part of the HSE plan. The LRT phase 1 obtained environmental approval from the EEAA as indicated in **Annex (1)** and this project is an extension of phase 1. The main contractor will provide this HSE plan as a required framework that the subcontractors should meet and adhere to during the construction phase. Moreover, the main contractor will include all the mitigation measures in the contract of the sub-contractors to be incorporated in the construction management plan.

7.1 Objectives of the EMP

The EMP consists of a set of mitigation and monitoring measures to be taken into consideration to eliminate adverse environmental and social impacts, offset them or reduce them to acceptable levels. The plan also includes the actions needed to be taken to implement these measures.

The EMP is considered an operational document that will be frequently updated by the project team to reflect the activities on site. As activities commence, the EMP will be reviewed and revised according to various project activities.

The Project Supervisor will be appointed by the Developer for continuous presence on-site for close inspection and management of the project activities.

A number of control measures will be applied as follows:

- Ensuring the application of all mitigation measures.
- Following up on the application of the monitoring plan.
- Application of the Emergency Response Plan.

The main contractor will ensure that the EMP will address but are not limited to the following:

- Defining the potential environmental impacts of project activities.
- Setting the actions needed to eliminate or minimize the associated impacts, control or mitigate the impacts.
- Assigning responsibilities for the delivery of the EMP and for ensuring compliance with it.
- Explaining used approach to co-operating with all relevant parties on environmental management.
- Setting how will measure, monitor, review and report on our environmental performance throughout this contract.
- Confirming that the Project personnel understand and implement environmental protection plan for both routine activities and unplanned events associated with the construction of the Project.
- Reducing the size and extent of physical disturbance.
- Ensuring that the public concerns are monitored.

7.2 EMP Components

The EMP consists of the following main components:

- ***Mitigation Measures*** to identify feasible and cost-effective measures that will reduce potentially significant adverse environmental impacts to acceptable levels.

- ***Management Requirements*** to support timely and effective implementation of environmental project components, mitigation measures, emergency and monitoring plans. These include institutional aspects as well as appropriate staffing and training. Therefore, a dedicated department must be assigned the responsibilities of managing and monitoring the implementation of the EMP to ensure proper consideration of the environmental and social aspects of the entire life cycle of the Project for both purposes of legal compliance and for environmental and social responsibility.

- ***Emergency Response Plan*** to manage risks that might occur.

- ***Monitoring and Validation Plan*** to provide information about key environmental aspects of the project, particularly the environmental impacts of the project and the effectiveness of mitigation measures.

7.3 Mitigation Measures

7.3.1 Construction Phase

The contractors commissioned for the construction will be required to undertake the following measures and include it in his contract. This will be done under the supervision of NAT's Health, Safety and Environment (HSE) Unit (or delegated persons that would take on the same mandates) as they are the entity responsible for construction of the project.

- ***Emission Control***
  - Maintain machinery and vehicles in good working conditions to minimize fugitive emissions.
  - All construction equipment will be frequently inspected to ensure that the generated fugitive emissions are within acceptable limits.
  - Dust suppression measures at the site by water spraying.
  - During dry periods, undertake works giving rise to dust only after surface watering of the areas concerned.
  - Construction waste and excavated soils will be transported in confined vehicles and properly covered to avoid dust becoming air borne.
  - Excavated materials shall be placed in the dumping/disposal areas designated for that purpose. Material shall be stabilized each day by watering or other accepted dust suppression techniques.

- ***Noise Control***
  - Machines in intermittent use will be shut down in the intervening periods between work or throttled down to a minimum. Where practicable the use of noisy equipment will be limited to core daytime periods.
  - The workers on the jackhammers, and pavement breakers equipment will be provided with ear protective equipment.
  - All vehicles and generators will to be kept in a good condition and regularly inspected.
  - Maximize physical separation, as far as practicable, between noise generators and noise receptors.
  - Arrange the working schedule for the worksite to reduce impacts at sensitive times.
  - Schedule truck loading, unloading, and hauling operations so as to minimize noise impact near sensitive locations and surrounding communities.
  - Select truck routes so that noise from heavy-duty trucks will have minimal impact on sensitive land uses.

- ***Soil Quality***
  - Store earthwork and construction wastes separately.
  - Store excavated wet soil separately to avoid cross contamination.
  - No pollutants or untreated liquid effluent may be discharged into the natural environment or public drainage system.
  - Provide storage tanks with sufficient.
  - Provide spill kit for handling accidental spillages on the worksites.
  - Earth soiled by accidental discharges into the soil shall be stored separately and sent to a certified treatment/disposal facility.
  - prohibition on the discharge any hazardous material or mixture thereof in the drainage area.
  - Implementation of special provisions for the storage of products so as to limit the risk of leakage.
  - Ensure separation of any contaminated materials and appropriate handling, storage and treatment.

- ***Workplace Health and Safety Measures***
  - Incorporate stringent HSE plans in contractors' contracts and purchase adequate personal protective equipment
  - Use of personal protective equipment and safety harness to prevent falling. Ladders and scaffolds will be frequently inspected.
  - Adhere to strict public health and safety standards.
  - 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, well ventilated area.
  - Install fire extinguishers in designated places throughout the site.

- ***Road and Traffic Management***
  Coordination will be done with the traffic department of the Ministry of Interior to plan for the construction near roadways. Measures include:
  - All traffic management measures will be examined through coordination between NAT, City Council and the Contractor.
  - Transferring construction equipment, raw materials, mechanical components, and train vehicles on regional and major roads during low traffic flow times as possible.
  - Most construction operations will be within existing road rights or vacant lands without roads.
  - Abide by speed limits for machinery and trucks; set limits in accordance with legislation on sensitive worksites and workshops.

7.3.2 Operation Phase

Items of the environmental management plan during the operation phase will be implemented through the Health, Safety and Environment Unit established in the "train operating" Company that will be established to be responsible for operation of the train.

- ***Housekeeping***
  Good housekeeping practices will be followed such as:
  - Minimizing spills during handling, transport and use of products.
  - Prevention of leakages through checking valves and joints along pipelines.
  - Optimizing the use of water and cleaning chemicals.
  - Periodic checking of isolation and leakage.
  - Performing the adequate noise and heat stress protection measures in the related places.

- ***Maintenance Program***
  Equipment will be regularly checked and cleaned to insure its proper functioning. Damaged equipment will be repaired quickly. Good record keeping of equipment checks, repairs, cleaning and equipment failure will be done to minimize equipment breakdown and any associated pollution releases. Maintenance measures include:

- Maintaining equipment history cards on equipment location, characteristics.
- Maintaining a master preventive maintenance (PM) schedule.
- Keeping vendor maintenance manuals handy
- Maintaining a manual or computerized repair history file.

- ***Spill Prevention and Storage***
  Spill and leak prevention are critical to pollution prevention. The following precautions will be followed:
  - Storage tanks will be tightly secured
  - Containers will have good valves with tight stopping devices to avoid spilling or dripping chemicals.
  - Storage containers will have legible signs indicating the contents of the container, health hazard warnings and spill cleanup procedures in case of emergencies
  - Diesel storage and handling areas will be bunded to contain spillage until it can be dealt with. Spillage in these areas will be pumped back into the storage and the residue cleaned up.

- ***Solid Waste Management***
  Solid waste generated from different project activities will be safely managed during all phases. These phases involve generation, handling, storage and provisions for final disposal. This includes for instance reduction of solid materials spills from depot area.
  - Follow the emergency procedure for managing accidental discharges into soil, including arrangements for issuing a warning in the event of accidental discharge and removal to a certified centre for the treatment of earth soiled by the accidental spillage of products.
  - No pollutants or untreated liquid effluent may be discharged into the natural environment or public drainage system.
  - Ensure separation of any contaminated materials and appropriate handling, storage and treatment.

- ***Hazardous Substances Management***
  According to law 4/1994, management of hazardous materials includes the following measures:
  1. Labelling
  2. Safe Storage
  3. Providing material safety data sheets (MSDSs) used and distributed
  4. Personal protection equipment (PPE) used during handling
  5. Training of workers on handling these materials safely
  6. Preparing a contingency plan for accidental emergency.

- ***Fire Fighting Plans***
  All buildings will be provided with passive smoke detection and fire hose reels for first aid fire fighting. In the case of fire, the initial response will be to sound the alarm and evacuate the buildings. Fire fighting water storage tank will always be full and stand by. Personnel will be trained in

fire fighting techniques with the use of fire extinguishers and water hoses. These will be placed in strategic places.

- ***Workplace health and Safety measures***
  Monitoring of indoor air quality related to work environment will be done on frequent basis to record levels of humidity, noise, and heat stresses at workplace environment.

- ***Public health and safety measures***
  - Continuous upgrading of emergency response plans will be carried periodically.
  - Training of all levels of operating team on the normal and emergency procedures and plans.

- ***Vibration Control***
  Vibration emanates from rail-wheel interaction and the same can be reduced by minimizing surface irregularities of wheel and rail, improving track geometry, providing elastic fastenings, and separation of rail seat assembly from the concrete plinth with insertion of resilient and shock absorbing pad.

  In sensitive areas, track on floating slab could be provided so as to avoid propagation of noise/vibration to adjacent structures. Additional screening of noise/vibration can be arranged by providing parabolic noise/vibration reflecting walls on each sides of the track.

Tables 7-1, 7-2 and 7-3 summarize the main mitigation and management measures for significant impacts in pre-construction, construction and operation phases. They provide mitigation/management measures for significant impacts and estimated costs for their implementation. They also identify the parties to incur the costs and implement the measures.

Table (7–1): Main mitigation measures, implementation costs and responsibilities during the construction phase

Impact	Mitigation/Management measure	Estimated cost of measure ($)	Party incurring the cost	Party implementing the measure	Other Concerned Entities
Air Quality	- Maintain machinery and vehicles in good working. - Use dust control measures. - Minimize particulate matter from being deposited. - Wash construction equipment - Cover vehicles transporting soil or friable material. - Place excavated materials in dumping/disposal areas designated for that purpose.	No incremental cost as all management measures	Construction Contractor	Construction Contractor, supervised by NAT	--
Noise	- Pneumatic impact tools and equipments used at the construction site shall have intake and exhaust mufflers. - Use construction equipment manufactured or modified to dampen noise and vibration emissions - Maximize physical separation between noise generators and noise receptors - Keep noisier equipments and activities as far as possible from noise sensitive locations. - Schedule truck loading, unloading, and hauling operations so as to minimize noise impact near sensitive locations. - Minimize noise intrusive impacts during most noise sensitive hours. - Construct temporary physical noise barriers. - Select truck routes so that noise from heavy-duty trucks will have minimal impact on sensitive land uses.	No Incremental cost as it incorporated in purchase of equipment	Construction Contractor	Construction Contractor, supervised by NAT	--

Impact	Mitigation/Management measure	Estimated cost of measure ($)	Party incurring the cost	Party implementing the measure	Other Concerned Entities
Soil Quality	- Store earthwork and construction wastes separately in dumping area. - Store excavated wet soil separately to avoid cross contamination. - No pollutants or untreated liquid effluent may be discharged into the natural environment or public drainage system. - Provide storage tanks with sufficient capacity for dangerous liquid waste. - Provide spill kit for handling accidental spillages. - Earth soiled by accidental discharges into the soil shall be stored separately. - Formal prohibition on the discharge any hazardous material or mixture thereof in the drainage area. - Implementation of special provisions for the storage of products so as to limit the risk of leakage. - Ensure separation of any contaminated materials and appropriate handling, storage and treatment.	No incremental cost as all management measures	Construction Contractor	Construction Contractor, supervised by NAT	Concerned Governorate
Workplace Health and Safety Measures	- Use of personal protective equipment and safety harness. Ladders and scaffolds will be frequently inspected. - Adhere to strict public health and safety standards. - 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, well ventilated area. - Install fire extinguishers in designated places throughout the site	No incremental cost as all management measures	Construction Contractor	Construction Contractor, supervised by NAT	--

Impact	Mitigation/Management measure	Estimated cost of measure ($)	Party incurring the cost	Party implementing the measure	Other Concerned Entities
Traffic and Roads	- Transferring raw materials and different project components mechanical components during low traffic flow times as possible. - Most construction operations will be within existing road rights or vacant lands without roads. - Obey speed limits for machinery and trucks; set limits in accordance with legislation on sensitive work sites and workshops.	No incremental cost as all management measures	Construction Contractor	Construction Contractor, supervised by NAT	Traffic Department., Ministry of Interior

Table (7–2): Main mitigation measures, implementation costs and responsibilities during the operation phase

Impact	Mitigation/Management measure	Estimated cost of measure	Party incurring the cost	Party implementing the measure	Other Concerned Entities
Housekeeping	- Minimize spills during handling, transport and use of products. - Prevent leakages through checking valves and joints along pipelines. - Optimize the use of water and cleaning chemicals. - Periodic checking of isolation and leakage. - Perform the adequate noise and heat stress protection measures.	Normal cost of operation	Train Operating Company	Train Operating Company	
Maintenance Program	- Regularly check and clean equipment to insure proper functioning. - Quickly repair damaged equipment. - Keep good record of equipment checks, repairs, cleaning and failure - Maintain equipment history cards - Maintain a master preventive maintenance (PM) schedule. - Keep vendor maintenance manuals handy - Maintain a manual or computerized repair history file - Prepare maintenance schedule for mechanical work	Normal cost of operation	Train Operating Company	Train Operating Company	
Spill Prevention and Storage	- Storage tanks will be tightly secured - Containers will have good valves with tight stopping devices. - Storage containers will have legible signs - Diesel storage and handling areas will be bunded to contain spillage until it can be dealt with.	Normal cost of operation	Train Operating Company	Train Operating Company	

Impact	Mitigation/Management measure	Estimated cost of measure	Party incurring the cost	Party implementing the measure	Other Concerned Entities
Solid Waste Management	- Safely manage waste during all phases to include generation, handling, storage and provisions for final disposal. - No pollutants or untreated liquid effluent may be discharged into the natural environment or public drainage system. - Follow the emergency procedure for managing accidental discharges into soil.	Cost of Fees Paid to Waste Contractor	Train Operating Company	Train Operating Company	
Hazardous Substances Management	- Proper management in accordance with Law 4/1994	Normal cost of operation	Train Operating Company	Train Operating Company	
Fire Fighting Plans	- Provide all buildings with passive smoke detection and fire hose reels for first aid fire fighting. - Fire fighting water storage tank will always be full and on stand by. - Provide fire extinguishers - Train personnel in fire fighting techniques with the use of fire extinguishers and water hoses.	Cost of fire fighting system	Train Operating Company	Train Operating Company	Civil Defense, Ministry of Interior
Vibration Control	- Minimize through proper engineering design and installation of vibration-absorption material.	Incurred during construction Cost of Maintenance	Train Operating Company	Train Operating Company	

7.4 Management Requirements

The following presents an outline of the required management procedures for the project. It is the responsibility of the National Authority for Tunnels (NAT) during the construction phase and then later in the operation phase it is the responsibility of the operating company to assure that operation activities are conducted in a manner which would minimize potential adverse impacts.

7.4.1 Environmental Register

According to the Executive Regulations of Law 4 of 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 shall include, but not be limited to, the information listed in Annex 3 of the Executive Regulations (whenever relevant).

The environmental register will contain all self-monitoring results as well as the following items:

- List of raw material
- List of products
- List of hazardous materials and wastes
- Wastewater analysis results
- Gaseous emissions analysis results
- Workplace noise, dust, heat
- Solid waste description (quality and quantity)

7.4.2 Organizational Structure and Responsibility

The responsible team to implement the environmental management plan is the HSE department in the main contractor. The current structure of this team (Figure 7.1) as follow:

Project Deputy Manager

- Holds overall responsibility for the delivery of environmentally responsible delivery of the project.
- Holds overall responsibility for ensuring the project complies at all times with Egyptian legislation, company management systems.
- Makes sufficient suitable resources available to support the delivery of this plan.

HSE Manager

- Ensures compliance at all times with Egyptian legislation, company management systems.
- Ensures compliance with this Environmental Management Plan.
- Work with the client team, Project Manager, and others as necessary to investigate and address any non-conformances or environmental incidents and realize improvement opportunities to achieve the project's environmental and social objectives.
- Assess resource needs to support the delivery of this plan and work with the Project Manager to make such resources available.

- Carry out regular reviews of the Environmental Management Plan as part of the overall management system review and in response to any incidents to ensure it stays effective, relevant and up to date.

Environment and Social Engineer

- Develop the project Environmental Management Plan and update it as necessary following management system review or in response to any incidents.
- Ensure compliance at all times with Egyptian legislation, company management systems.
- Ensures compliance with this Environmental Management Plan.
- Monitor and report on all areas of environmental and social performance according to the project requirements, as set out in this plan and the E&S Monitoring Plan.
- Provides training/awareness on the project's E&S approach and ensures the application of these provisions by suppliers and subcontractors, in conjunction with the Training.
- Complete site inspections to ensure ongoing compliance with this plan.
- Work with the client team, Project Manager, HSE Manager and others as necessary to investigate and address any environmental non-conformances and incidents and realise improvement opportunities to achieve the project environmental and social objectives.
- Provide the first point of contact for all related enquiries or complaints, including liaison with the public and all stakeholders regarding E&S issues.
- Develops the project Waste Management Plan and updates it following management system review or in response to any incidents.
- Monitors and report on waste management according to the project requirements.
- Develop the project dust management plan and update it as necessary. following management system review or in response to any incidents.
- Monitor and report on dust management according to the project requirements.

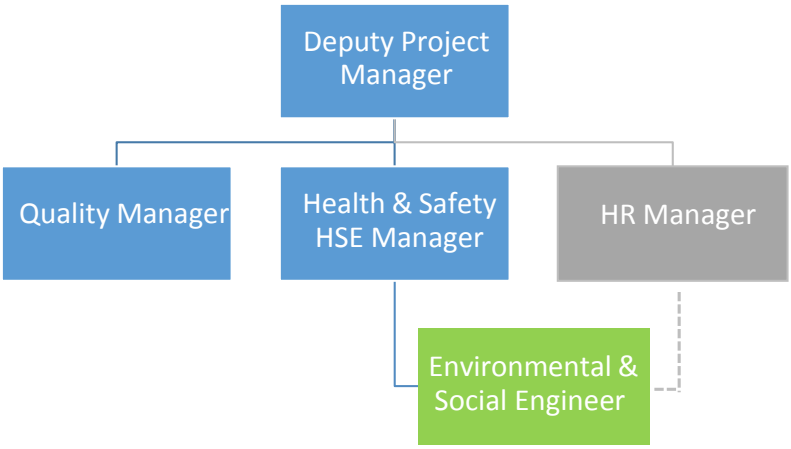

Figure (7–1): HSE organizational structure
Source: CREC-AVIC

7.5 Emergency Response Plan

The emergency measures are principally adopted to avoid any failure in the system such as lights, fire, means of escape, ventilation shafts etc. The aim of Emergency Action Plan (or Emergency Response Plan) is to identify areas, population and structures likely to be affected due to events of accidents. The action plan shall also include preventive action, notification, warning procedures and co-ordination among various authorities. These are discussed hereafter.

7.5.1 Emergency Lights

Each station is provided with emergency battery-operated lamps. A network of batteries should supply power to at least 25% of the lights on stations and sidewalks. An adaptor is to be provided at the end of each platform. The adaptors will be continuously revived, and the lamps are connected to them in reciprocal manner in order not to have complete power cut incase on goes out of service.

7.5.2 Fire Protection

The building materials shall be of appropriate fire resistance standard. 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 a station shall include provision for the following:

- Fire prevention measures,
- Fire control measures,
- Fire detection systems,
- Means of escape,
- Access for fireman, and
- Means of fire fighting.

Accumulation of refuses of any inflammable material like paper, plastic cartons constitute a major fire hazards and shall not be permitted.

All aspects of fire prevention and control shall be dealt in close collaboration with the fire fighting authority.

A minimum of 30 minutes supply of water is to be assured in the case of fire. The pumps/overhead tanks shall have the capacity to discharge the water at the rate of 1100 liters per minute at a head of 21 m at 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.

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 CO_2 gas, are utilized for fire fighting. 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, between Metro Rail Transport System property and any adjoining structures which allow free access into the Metro Rail Transport System property shall be protected by fire doors, fire shutters, fire dampers etc. as appropriate. Fire detection and alarm systems shall also be provided.

Emergency personnel will perform drill rescue techniques periodically. Safety, emergency response and first aid training will be provided at induction upon recruitment. All staff will also be required to attend refresher courses.

- ***Preparations***
  - Identify the human, administrative and organizational elements as well as the equipment and locations necessary to fight hazards.
  - Identifying human resources for the management of emergency incidents
  - Identifying the required types of training for participants in the plan with specific execution timelines.
  - Drawing up maps of available resources in cases of emergency crises or disasters locating the emergency management centre and locating points for distributing supplies and equipment for fire fighting, rescue, protection, medical aids. The maps shall also locate evacuation points and safe shelters.
  - Identifying the required individual and group protection and rescue supplies
  - Drawing up maps and detailed sketches locating escape paths and evacuation plans – partial and total – in case of emergency, and specifying the time-line for execution.
  - Identifying the concerned parties bound to provide support and services in emergency incidents specifying the kind of help and coordination, especially in rescue missions and fire fighting, ambulance and medical care. The mechanism of asking for help shall also be specified.
  - Identifying fire prevention supplies (number, types and distribution of fire fighting equipment maps and of fire fighting water and also related annexed points in addition to back up water tanks – warning equipment – electronic fire fighting equipment, escape points - back-up power supplies.)
  - Checking programs of regular maintenance of the equipment and constructions of the worksite.

- ***Implementation***
  The plan shall include levels of implementation performed by individuals or groups according to the following steps:

- **Warning and Calling Plan**
  The selected warning method shall be effective in communicating the hazard to all workers on-site and in ensuring their awareness of the nature of the hazard giving them the chance to face it or escape from it.

- **Response**
  This is undertaken according to the type of hazard, its spread and consequences through trained human personnel.

- **Ambulance and medical services**
  A provision for an ambulance car or a field clinic on–site shall be guaranteed to receive the injured and provide them with medical care and immediately transport to hospitals.

- **Recording**
  The above-mentioned steps are recorded in terms of time and duration of execution, cost, efficiency and the responsible group in each step.

  Record-keeping and reporting are important aspects of the Emergency Response Plan. There will be a mechanism of reporting incidents involving injuries, property damage, environmental damage, and near accidents. Such information and records will be used for improving response procedures and minimizing and controlling potential hazards. General information that will be recorded is listed below:
  - 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.

- ***Post Emergency Actions***
  After overcoming the danger, an accurate and 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.
  - 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.

7.5.3 Fire Prevention and Safety Measures

Fire prevention measures shall be designed and implemented to minimize the risk of outbreak of fire by appropriate choice, location and installation of various materials and equipment. In stations planning, potential sources of fire can be reduced by:

- ***Fire Prevention***
  - Use of non-combustible or smoke retardant materials where possible,
  - Provision of layout which permits ease of maintenance for equipment and cleaning of the station premises,
  - Provision of special storage spaces for combustible materials such as paint and oil.
  - Good housekeeping.

- ***Safety***
  Following provisions will be required from fire safety point of view:
  - Portable fire non-aqueous extinguishers of carbon dioxide, chemical dry powder etc. at suitable places.
  - Automatic smoke venting facilities.
  - Fire resisting doors shall be provided at appropriate places along the escape routes to prevent spread of fire and smoke.
  - The travel distance for fire escape shall not exceed 20 m where escape is available in more than one direction.

- ***Fire Alarm and Detection System***
  A complete fire detection system with equipment complying with the requirements of the local civil defence and Fire Authority shall be provided through out each station and ancillary buildings including entrance passageways, subways etc. to give visual and audible indication of alarm conditions actuated by the operation of break glass contact or fire sensors e.g. detector heads, linear heat detecting cables, etc.

  Manually operated call points shall be provided at every hydrant and nose reel points, station head wall, tail wall and other locations. Alarm bells shall be installed in each plant room complex at both platform and concourse level and shall be clearly audible at all points in the room/area. Beam detector or heat detector shall be installed at roof level, ceiling and floor cavity, whilst linear detecting cables shall be installed in under platform cable ducts and cable shafts.

A station fire control and indicating panel shall be provided and installed in the station controllers room, for the control, indication and monitoring of the whole detection and fire fighting systems. When an alarm point is operated, the fire pump shall start to operate automatically.

- ***Access for Firemen***
  A secondary access to the station, not used by passengers for evacuation, shall be available to firemen. The entry point shall be easily accessible from the road.

7.6 Monitoring Plan

Environmental monitoring program is a vital process of any management plan of the proposed development projects. This helps in signaling the potential problems that might result from the proposed project and allow for prompt implementation of effective corrective measures, ensuring that environmental protection is achieved through early detection of negative environmental impacts. The environmental monitoring will be required for the construction and operational phases.

The main objectives of environmental monitoring are:
- To assess the changes in environmental conditions,
- To monitor the effective implementation of mitigation measures,
- To warn significant deteriorations in environmental quality for further prevention action.

Monitoring programs will be designed for a number of parameters. The monitoring results will be fed into the decision making process as a trigger for the implementation of corrective actions, in order to maintain compliance with environmental laws and regulations, ensure environmental protection and workplace safety, as well as ensure appropriate operation of the mitigation measures and the management plans.

In order to meet the above objectives, the following parameters need to be monitored during construction and operation phases:
- Air and noise quality,
- Soil measures,
- Waste management,
- Workers' health and safety.

It is important to note here that environmental monitoring is a dynamic process. The proposed locations, parameters, and frequencies are subject to further changes, based on the results of the first monitoring round (s).

As previously mentioned, according to law 4/1994, any development projects shall maintain an environmental register to track the different environmental aspects of their activities. The environmental register will contain all self-monitoring results as well as the following items:
- List of raw materials used in construction.

- List of hazardous materials and wastes generated.
- Air quality analysis results
- Workplace hazards and safety (e.g. noise, dust).
- Solid waste description (quality and quantity)

7.6.1 Construction Phase

a. Air Quality

Visual inspection of exhaust gases from construction equipment shall be carried out by the construction contractor, under the supervision of NAT.

Ambient air quality and noise levels will be monitored before the construction, and at regular intervals during the construction phase. The results of monitoring prior to construction acts as a baseline to which the air quality survey during construction. Results of ambient monitoring are compared to limits set in Article 35 of Law 4/1994 and article 34 of its Executive Regulations (ERs) (amended by Decree 1741/2005) and Annex 5 of the ERs).

The following table shows the monitoring scheme for air quality.

Table (7–3): Monitoring scheme for Ambient Air Quality During Construction

Monitoring Parameters	Monitoring location	Costs of implementation of measure	Monitoring duration	Frequency	Party incurring the cost	Party implementing the measure
TSP, PM_{10}	Al Masa Hotel and another one	US 300 per location	1 hour during working hours	Every Month	Construction Contractor	Construction Contractor, supervised by NAT

b. Noise Intensity

Sites for noise monitoring include areas with heavy machinery and equipments e.g. jack hammers, pavement breakers, etc.

Measurements beyond the site shall be conducted to delineate noise emissions in the northern part of Al Masa hotel. As such, spot measurement of noise during the construction activities shall be conducted. Noise levels recorded shall be compared to levels set within the guidelines. The limit stipulated in Law No. 4, 1994 for workplaces with 8 hour shift is 90 decibel (A).

Table (7–4): Monitoring scheme for Noise During Construction

Monitoring Parameters	Monitoring location	Costs of implementation of measure	Monitoring duration	Frequency	Party incurring the cost	Party implementing the measure
Noise intensity	Al Masa Hotel and another one	US 200 per location	1 hour during working hours	Every Month	Construction Contractor	Construction Contractor, supervised by NAT

c. Soil quality measures

Monitoring oil spillage or any leakages will be monitored at frequent intervals. This will be done for the entire length of alignment, focusing on areas of higher exposure to impact such as the location of sub-contractors camps.

d. Solid and Hazards Waste measures

A log of solid waste will be maintained to include volumes of waste for re-use, recycle and/or final disposal. Treatment procedures and final fate of solid wastes (including delivery to licensed contractors) will be recorded and kept in the environmental register.

e. Workplace Health and Safety

Auditing of Health and Safety measures according to legally complying HSE plans shall be ensured. Monitoring of health risk issues that might arise throughout the construction life time will be done. Monitoring COVID-19 cases and allow for proper measures as early as convenient.

Regular visual inspection and medical checkups shall be sufficient for workers' health and safety monitoring. Any reoccurring incidents such as irritations, rashes, respiratory problems, etc, shall be recorded and appropriate mitigation measures updated and enhanced.

Providing a first aid medical service in addition to preparing a list of the nearest clinics and hospitals in case of any emergency event.

Management shall monitor workers to assure that all health and safety and protective gear are being used for their assigned purpose.

7.6.2 Operation Phase

a. Air Quality

The electric train will have no impacts on air quality. However, secondary impacts due to traffic congestion at the stations from other modes of transport out of project operator authority. However, the good planning for parking areas for buses and cars near stations in-advance with relevant authorities (Ministry of Interior, City Council, etc) will reduce emissions.

b. Noise Intensity and Vibrations

Noise intensity is anticipated to mainly impact on neighboring receptors existing or in the future. It is the same case of Air emissions as the parking areas make the noise levels to increase during the morning and evening hours, and at the depot area. Therefore, appropriate planning for parking areas near stations in-advance with relevant authorities (Ministry of Interior, City Council, etc) will reduce cognition as well as the noise intensity. However, noise inspection would, therefore, include areas near power houses (e.g. diesel generators, turbine area, air compressors). Which is under control of the project operator.

c. Solid and hazardous waste

A log of solid waste will be maintained to include volumes of waste for re-use, recycle and/or final disposal. Treatment procedures and final fate of solid wastes (including delivery to licensed contractors) will be recorded and kept in the environmental register.

d. Workforce Health and Safety

Auditing of Health and Safety measures according to HSE plans in compliance with common standards will be ensured. Regular visual inspection and medical checkups shall be sufficient for worker health and safety monitoring. Management shall monitor workers to assure that all health and safety and protective gear are being used for their assigned purpose.

Table 7-5 presents the proposed monitoring measures, their estimated cost and the party responsible for implementation for the operation phase.

Table (7–5): Proposed monitoring measures for Operation Phase

Monitoring Measures	Criteria/indicator to be monitored	Costs of implementation of measure	Party incurring the cost of measure	Party implementing the measure
Air Quality	Visual inspection	No cost	Train Operating Company	HSE Department (Environment Unit)
Noise Intensity and Vibrations	Noise inspection\ hearing and observation	No cost	Train Operating Company	HSE Department (Environment Unit)
Solid and hazardous waste	- Volumes of waste for re-use, recycle and/or final disposal - Treatment procedures and final fate of solid wastes	Management measures requiring minimal cost	Train Operating Company	HSE Department (Environment Unit)
Workforce Health and Safety	Inspection on use of health and safety gear	No cost	Train Operating Company	HSE Department (Industrial Safety Unit)
	Medical treatment of workers in case of Injuries and/or illnesses	Cost of Workers Health Insurance	Train Operating Company	HSE Department (Health Unit) Healthcare facility for serious cases
	Checking first aid kits and safety gear.	No cost	Train Operating Company	HSE Department (Health Unit)

The HSE Department, through its three Units, would be responsible of monitoring performance and quality. It would carry out of the following activities:

- Coordinating with inspecting agencies the inspection works and accompanying them during inspections, report-writing and follow up;

- Following up the work plan implementation during work preparation and making sure that time schedule is followed, as well as following up shortage causes when they occur;
- Inspection and preliminary supervision of supplies, services in the site and workshops;
- Checking that the necessary safety equipment are available (according to working conditions);
- Assuring that equipment and fire extinguishers are properly working;
- Check the expiry date of food offered to employees and workers;
- Assuring that medicines, medical instruments and first aid kits are available and not expired;
- Following the inspection processes of the site equipment and examining all units before and after working hours.

7.7 Environmental Management Plan Review

The project management is authorized to change and re-issue the EMP. The HSE Manager shall be informed of any changes made by the Project Management and is authorized to change and re-issue procedures for environmental control. Moreover, each procedure would be regularly reviewed by the HSE Manager. He is also responsible for ensuring that the workforce is complying with procedures, informing the staff of any changes and ensuring that the staff is aware of changes before starting any works.

Annex (1)

Environmental Approval of the 10th of Ramadan Light Rail Train (LRT) Phase I

جمهورية مصر العربية
رئاسة مجلس الوزراء
وزارة الدولة لشئون البيئة
جهاز شئون البيئة
الإدارة المركزية لتقييم التأثير البيئى

جهاز شئون البيئة
الإدارة المركزية لتقييم التأثير البيئى
13 JUL 2015
إدارة وثائق تقييم التأثير البيئى

رقم القيد : ٢٥٥٩
التاريخ : ١٢ / ٧ / ٢٠١٥

الموضوع : دراسة تقييم أثر بيئى (ج)

السيد المهندس / إسماعيل عبد المنعم نجدى
رئيس مجلس إدارة الهيئة القومية للأنفاق

تحية طيبة وبعد ،،،

بالإشارة إلى كتاب سيادتكم الوارد لنا بتاريخ ٢٠١٥/٦/٢٣ والمرفق به دراسة تقييم التأثير البيئى(ج) بشأن إبداء رأى الجهاز في مشروع / خط القطار الكهربائى (المرحلة الأولى-العاشر من رمضان) (بطول ٦٧,٨كم) ، عدد ١٢ محطة فوق مستوى سطح الأرض ، ورشة واحدة بعد محطة بدر ، عدد(٣) محطات تغذية بالقرب من محطة المستقبل ومحطة الروبيكى ومحطة العاصمة الإدارية الجديدة .

نتشرف بالإحاطة بأنه بعد مراجعة وتقييم الدراسة المقدمة وإلى جلسة الإستماع التى عقدت بمدينة بدر بتاريخ ٢٠١٥/٥/١٧، فإن جهاز شئون البيئة يوافق على المرحلة الأولى للمشروع بشرط الالتزام بجميع المواصفات والإجراءات التي وردت بالدراسة المقدمة للجهاز والالتزام بجميع الأسس والاشتراطات التى نص عليها القانون رقم ٤ لسنة ١٩٩٤ والمعدل بالقانون رقم ٩ لسنة ٢٠٠٩، ولائحته التنفيذية المعدلة بقرار رئيس مجلس الوزراء رقم ١٠٩٥ لسنة ٢٠١١ و القرار رقم ٧١٠ لسنة ٢٠١٢ والقرار ٩٦٤ لسنة ٢٠١٥ مع الالتزام بالإشتراطات الآتية:

١. الإلتزام بمسار القطار بحيث ينقسم مساره إلى قسمين: القسم (أ) من آخر محطة فى المرحلة الثالثة للخط الثالث لمترو الأنفاق (محطة عدلى منصور) إلى محطة رمضان (٢) بطول ٥٢,١٢٢كم، القسم (ب) من محطة الروبيكى إلى محطة المطار الجديد بطول ٢٣,٧٩١كم ، وعدد المحطات الواردة بالدراسة وهى كالآتى

القسم أ	محطة (١)	عدلى منصور
	محطة (٢)	العبور (١)
	محطة (٣)	العبور (٢)
	محطة (٤)	المستقبل
	محطة (٥)	الشروق (١)
	محطة (٦)	الشروق (٢)
	محطة (٧)	بدر
محطة تبادلية	محطة (٨)	الروبيكى
القسم ب	محطة (٩)	المنطقة الصناعية
	محطة (١٠)	رمضان (١)
	محطة (١١)	رمضان (٢)
	محطة (١٢)	العاصمة الجديدة

٢. الإلتزام بالتنسيق مع الجهات المعنية (وزارة الداخلية - وزارة الكهرباء – وزارة الإتصالات – أجهزة المدن المار بها مسار القطار المشار إليه – الشركة القابضة لمياه الشرب والصرف الصحى – الإدارة العامة للمرور- الهيئة العامة للتخطيط العمرانى .....أخرى) .

٣. الإلتزام بإقامة سلم ثابت وسلم متحرك ومصعد على أحد جانبى كل محطة وممرات منحدرة للكراسى المتحركة وجسور مشاه علويه للمحطات ومواقف للسيارات ومحطات للأتوبيس كملحق للمحطات كما ورد بالدراسة .

٤. الإلتزام بإقامة غرفة تحكم بالقطارات وغرفة لقطع التيار ومحطة خفض جهد أو محطة سحب فرعية بكل محطة كما ورد بالدراسة .

٥. الإلتزام بعمل نظام كودى لأجهزة التهوية والتكييف [illegible] المحطات كما ورد بالدراسة .

٦. الإلتزام بالمواصفات الفنية لرصيف القطار الكهربائى بكل محطة (طول الرصيف ١٢٠ متر – اتساع ٨ متر – مقاعد للركاب – مناطق تجارية وفقاً للإحتياجات الفنية للمحطة) كما ورد بالدراسة .

هذه الموافقة من صفحتين (٢/١)

٣٠ طريق مصر حلوان الزراعى – خلف فندق سوفيتل المعادى – القاهرة الرقم البريدى ١١٧٢٨ ت : ٢٥٢٥٦٤٥٢ فاكس : ٢٥٢٥٦٤٩٠
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جمهورية مصر العربية
رئاسة مجلس الوزراء
وزارة الدولة لشئون البيئة
جهاز شئون البيئة
الإدارة المركزية لتقييم التأثير البيئى

رقم القيد : ٢٨٥٩
التاريخ : ١٣ / ٧ / ٢٠١٥

٧. الإلتزام بإقامة سياج أثناء مرحلة التشغيل وإقامة سور على طول مسار الخط بالكامل كما ورد بالدراسة .
٨. الإلتزام بعمل صيانة للمعدات والمولدات بصفة دورية بمنطقة الورش بالجانب الجنوبى بعد محطة بدر المتضمنة (مركز شامل للصيانة – مخزن للإمدادات) كما ورد بالدراسة .
٩. الإلتزام بإعادة مسار طريق جنيفا إلى مساره الأصلى عقب الإنتهاء من عمل النفق المطلوب كما ورد بالدراسة.
١٠. الإلتزام بعمل التعديلات اللازمة لأبراج الضغط العالى القريبة من المنطقة الصناعية بالعاشر من رمضان حتى لا تتعارض مع مسار القطار المشار إليه كما ورد بالدراسة .
١١. الإلتزام بالحصول على موافقة وزارة الموارد المائية والرى فى حالة مرور مسار القطار بمنطقة أعمال حماية من السيول .
١٢. الإلتزام بالقيام بالأعمال اللازمة للحماية من المخاطر الطبيعية (السيول) مع ضرورة الحصول على موافقة وزارة الموارد المائية والرى على تلك الأعمال .
١٣. الإلتزام بفصل الزيوت والشحومات والرواسب الناتجة عن **مياه الصرف الخاصة بالورشة**، والإلتزام بعزل خزان تجميع مياه الصرف عن التربة المحيطة وكسحه بصفة دورية بواسطة جهة معتمدة للتخلص منه فى أقرب محطة لمعالجة الصرف الصحى حال مطابقته للقوانين والقرارات المنظمة لذلك ، وعدم الصرف على مسطحات مائية .
١٤. الالتزام بإعداد خطة مواجهة للطوارئ أثناء عمليات الإنشاء والتشغيل .
١٥. الإلتزام بخطة الإدارة البيئية وبرنامج الرصد وإجراءات تخفيف الآثار السلبية طوال مراحل المشروع وإعداد خطة للإخلاء كما ورد بالدراسة .
١٦. تحديد برنامج زمنى للمشروع أثناء مراحل الإنشاء وموافاة الجهاز بها .
١٧. الإلتزام بعدم تجاوز الحدود القصوى لملوثات الهواء الواردة بالملحق أرقام (٨،٦،٥) من اللائحة التنفيذية المعدلة برقم ١٠٩٥ لسنة ٢٠١١.
١٨. الالتزام بعدم تجاوز الحدود القصوى لمستويات الضوضاء بما يتفق مع الملحق رقم (٧) من اللائحة التنفيذية المعدلة برقم ١٠٩٥ لسنة ٢٠١١ .
١٩. الالتزام بالمعايير الواردة بالملحق رقم (٩) من اللائحة التنفيذية المعدلة برقم ١٠٩٥ لسنة ٢٠١١ بشأن صحة بيئة العمل وعوامل الأمان للعاملين.
٢٠. التخلص السليم من المخلفات السلبية للنشاط بتجميعها وتسليمها إلى جهة معتمدة بالتنسيق مع أجهزة المدن المار بها القطار المشار إليه كما ورد بالدراسة .
٢١. الالتزام بالتداول السليم والأمن بيئياً للمواد الخطرة المستخدمة أثناء مرحلة الإنشاء طبقاً للمادة رقم (٣١) من اللائحة التنفيذية المعدلة بالقرار رقم ١٠٩٥ لسنة ٢٠١١.
٢٢. الالتزام بالتخلص السليم والأمن بيئياً من المخلفات الخطرة الناتجة عن النشاط بما يتوافق مع المعايير والقوانين المنظمة كما ورد بالنموذج بما يتوافق مع المادة رقم (٢٨) من اللائحة التنفيذية المعدلة بالقرار رقم ١٠٩٥ لسنة ٢٠١١.
٢٣. إعداد السجل البيئي وجعله متاحا عند التفتيش البيئي مع إعداد سجل المخلفات الخطرة طبقاً للمادة رقم(٣٣) والجدول رقم (٢) من الملحق رقم (٣) من اللائحة التنفيذية.

هذه الموافقة من الناحية البيئية فقط دون الإخلال بأي قوانين أو قواعد أو قرارات أخرى تخص هذا النشاط مع الإحتفاظ بحق جهاز شئون البيئة فى إيقاف الأعمال بالتنسيق مع الجهة الإدارية فى حالة حدوث أى مخالفات لقانون البيئة مع تحمل الشركة لمسئوليتها تجاه الأضرار البيئية وتعتبر هذه الموافقة لاغية فى حالة عدم الإلتزام بأى شرط من الإشتراطات الموضحة بعاليه .

وتفضلوا بقبول وافر التحية والتقدير...

(هذه الموافقة من نسختين ٢/١)

الرئيس التنفيذي
(م/ أحمد أبو المسعود)

٣٠ طريق مصر حلوان الزراعى – خلف فندق سوفيتل المعادى – القاهرة الرقم البريدى ١١٧٢٨ ت : ٢٥٢٥٦٤٥٢ فاكس : ٢٥٢٥٦٤٩٠
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