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The Egyptian Natural Gas Holding Company

GASCO

Nubaria-Metnama Natural Gas Pipeline, Egypt

Submitted by:

EcoConServ ENVIRONMENTAL SOLUTIONS

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Draft Report

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TABLE OF CONTENTS

TABLE OF CONTENTS i
LIST OF ACRONYMS AND ABBREVIATIONS iv
1. Introduction 1
1.1 Background 1
1.2 Project Overview 1
1.3 Approach and Methodology 2
1.3.1 Approach to Study 2
1.3.2 Data Collection Methodology 3
1.3.3 Stakeholders Consultation 4
2. Legal and Administrative Framework 6
2.1 Applicable Environmental Legislation in Egypt 6
2.1.1 Law 4/1994 for the Environment 6
2.1.2 Law 38/1967 for General Cleanliness 9
2.1.3 Law 48/1982 for Protection of River Nile and Watercourses 9
2.1.4 Law 117/1983 for Protection of Antiquities 11
2.1.5 Law 4/1988 concerning Petroleum Pipelines 11
2.2 Applicable Social Legislation in Egypt 11
2.3 World Bank Guidelines and Safeguard Policies 12
2.3.1 OP 4.01 – Environmental Assessment 12
2.3.2 OP 4.11 – Physical Cultural Resources 13
2.3.3 OP 4.12 – Involuntary Resettlement 13
3. Description of the Environment 14
3.1 Administrative Districts 14
3.1.1 Qalubia Governorate 14
3.1.2 Menoufia Governorate 15
3.1.3 El Beheira Governorate 16
3.1.4 6th of October Governorate 17
3.2 Location and Land Use 18
3.3 Climate 19
3.4 Soil 21
3.5 Geology 22
3.5.1 General outlines 22
3.5.2 Geomorphology 24
3.5.3 Tectonic Frameworks 25
3.6 Groundwater 28
3.6.1 Groundwater Hydrology 28
3.6.2 Groundwater Flow 31
3.6.3 Hydraulic Parameters: 31
3.6.4 Recharge and Discharge: 31
3.6.5 Hydrochemistry 32
3.6.6 Groundwater Fluctuation and Rising Problems 32
3.7 Surface Water 32
3.8 Flora and Fauna 33

3.8.1 Flora 33
3.8.2 Fauna 36
4. Project Description 40
4.1 Pipeline Components 40
4.1.1 Pipeline Route 40
4.1.2 Valve Room Locations 41
4.1.3 Pressure Reduction Station 42
4.2 Design Gas Composition and Flow Rate 42
4.3 Work Schedule 44
4.4 Equipment Used During the Construction Phase 45
4.5 Construction Activities and Methodologies 45
4.5.1 Planning and system design 45
4.5.2 Mobilization of equipment, materials, and workers 46
4.5.3 Site preparation and excavation 46
4.5.4 Pipe Storage 46
4.5.5 Foundations Structural Work or Civil Work 47
4.5.6 Trenching Lowering and Laying 47
4.5.7 Backfilling 48
4.5.8 Welding and Weld Inspection 48
4.5.9 Valves and Tie-ins 49
4.5.10 Pipe Cleaning 49
4.5.11 Disposal of Chemicals 49
4.5.12 Special Crossings 49
4.5.13 Dewatering 54
4.5.14 Magnetic Cleaning and Geometric Pigging 54
4.5.15 Drying and Commissioning 54
4.5.16 Breaking of infrastructure pipes 55
4.5.17 Records and Operating Manuals 55
4.6 Pipeline Surveillance 55
4.6.1 Pipeline Patrolling 55
4.6.2 Leakage Survey 56
4.7 Description of Operation Phase 57
4.7.1 Normal operation 57
4.7.2 Repairs and replacement 57
5. Analysis of Alternatives 58
5.1 The “No Action” Alternative 58
5.2 Construction Alternatives 58
Horizontal Directional Drilling (HDD): 58
Open-Cut Method: 59
5.3 Routing Alternatives 59
6. Assessment of Main Environmental and Social Impacts 61
6.1 Positive Impacts 61
6.2 Potentially Negative Impacts During Construction 63
6.2.1 Waste Generation 63
6.2.2 Reduction of Traffic Flow 64
6.2.3 Air Emissions 65
6.2.4 Noise 66

6.2.5 Soil Quality 67
6.2.6 Flora and Fauna 67
6.2.7 Damage to Infrastructure 68
6.2.8 Stability of Existing Structures 68
6.3 Potential Negative Impacts During Operation 69
6.3.1 Air Emissions 69
6.3.2 Impacts of Excavation Works 69
6.4 Potential Social Impacts 69
6.4.1 Negative Social Impacts During Construction 70
6.4.2 Negative Social Impacts During Operation 70
6.4.3 Affected parties 71
6.4.4 Key Issues for Consideration 71
7. Environmental and Social Management Plan (ESMP) 73
7.1 Objectives of the ESMP 73
7.2 Management and Monitoring Activities During Construction Phase 73
7.2.1 Management of Traffic 73
7.2.2 Management of Air Emissions 74
7.2.3 Management of Noise 75
7.2.4 Management of Excavation Activities Posing Risk on Infrastructure 75
7.2.5 Management of Dewatering and Tunneling Activities Posing Risk to Structural Stability 76
7.2.6 Management of Waste Disposal 77
7.2.7 Management of Social Impacts 78
7.2.8 Management of Culturally Valuable Sites 80
7.3 Management and Monitoring Activities During Operation Phase 87
7.3.1 Management of Repairs and Maintenance 87
7.3.2 Mitigation Measures for PRS Safety Aspects 87
7.3.3 Mitigation Measures for Social Impacts during operation 88
7.4 Criteria for Environmental and Social Screening the Activities of the Project 92
7.5 Institutional Framework for Implementation 95
7.5.1 Environmental Management Structure of the Implementing Agency 95
7.5.2 Required Resources 96
8. Public Consultation 98
8.1 Scoping Phase 98
8.2 Public Consultation 98
Annex A: Baseline Social Data 104
Annex B: Compensation and Grievance Forms 110
Annex C: Public Consultation Documents 113

LIST OF ACRONYMS AND ABBREVIATIONS

CAPMAS	Central Agency for Public Mobilization and Statistics
EDHS	Egyptian Demographic and Health Survey
EEAA	Egyptian Environmental Affairs Agency
EGAS	Egyptian Natural Gas Holding Company
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FGD	Focus group discussion
GASCO	Egyptian Natural Gas Company
MOSEA	Ministry of State for Environmental Affairs
NG	Natural Gas
NGO	Non Governmental organizations
PPM	Parts Per Million
PRS	Pressure Reduction Station
RPF	Resettlement Policy Framework
UNDP	Human Development Report
WB	World Bank

1. Introduction

1.1 Background

In a country where natural gas is abundant, affordable, and the cleanest of fossil fuels, it is increasingly becoming the fuel of choice. Gas is gaining tremendous momentum as a core item in Egypt's energy strategy accounting for more than 50% of Egyptian hydrocarbon. Demand on gas is soaring like never before as many industries are shifting to gas for better performance, substantial savings, and environmental compliance.

The Ministry of Petroleum manages the utilization of gas in all sectors as well as the implementation of major gas projects covering discovery, delivery, and triggering untapped potential, encouraging the use of natural gas serving different industries (power generation, fertilizer production, iron and steel, industrial cities), while satisfying the local market requirements of natural gas as a fuel, a feedstock for the petrochemical industry, and opening new markets for Egyptian natural gas.

The process of maximizing natural gas utilization in Egypt is witnessing outstanding development, rapid progress, and foreign investment through increasing the value added to petroleum products to achieve self-sufficiency of LPG and gas derivatives used as feedstock for the petrochemicals.

The global energy industry focuses increasingly on the exploration and development of natural gas. The development of the know-how and the utilization of interactive technology have completely reshaped oil and gas exploration in Egypt leading to the discovery of a host of new gas fields in the Mediterranean, especially the deep water gas discoveries, and the western desert.

Focus is increasingly on new technologies for the conversion of gas into marketable products. In response to the energy market change, Egypt has been very keen to play a key role in gas processing in a bid to achieving self sufficiency of LPG and other gas valuable components and derivatives either as feed stocks for the petrochemical industry or as an export option stimulating a wave of national or international projects, adding new dimensions to the gas industry and giving rise to the establishment or the development of petrochemical projects in Egypt. It is a step forward towards achieving integration between all companies working in the gas business.

1.2 Project Overview

The aim of the proposed project is to supply natural gas to the North Giza power station and support national gas grid. In Egypt, the domestic market for natural gas is currently under-supplied and demand is growing. Due to major recent discoveries, natural gas is likely to be the primary growth engine of Egypt's energy sector for the foreseeable future. Egypt's natural gas sector is now expanding rapidly. In the Nile Delta region, which has become a world-class natural gas basin, the total quantity of natural gas

produced from fields and delivered to GASCO reached 43.3 bcm in 2005, achieving 14% development.

The Egyptian Natural Gas Company (GASCO) is carrying out multiple projects to support the expanding national gas grid. Among them is a proposed 32" diameter, 105 km long pipeline to transport natural gas from the Nubaria power station to a Pressure Reduction Station at the North Giza power station, and continuing to join the Metnama pipeline at an area called Nawa or Ezbet Swelem. Laying of the pipeline will involve digging trenches where possible, but upon encountering waterways, a new trenchless technology called Horizontal Directional Drilling (HDD) will be employed. The project also includes any necessary control stations, compressor stations, pumping stations, etc. that may be constructed along the way.

The planned path of the pipeline runs through agricultural lands and inhabited areas, crosses several major transportation routes and waterways (including the Nile), and may potentially encounter and disrupt sites of general cultural or ecological importance in the region. EcoConServ has been asked to prepare an Environmental and Social Impact Assessment (ESIA) including a Resettlement Policy Framework (RPF). The study examines the effects of the planned activities on existing environmental and social conditions in areas affected by the project, and proposes measures for monitoring and mitigating any potential negative outcomes. The requirements of the Egyptian Environmental Affairs Agency (EEAA) for Environmental Impact Assessments of Oil and Gas Sector Projects, and the relevant World Bank (WB) Environmental and Social Safeguard Policies have been integrated in the preparation of this ESIA.

1.3 Approach and Methodology

1.3.1 Approach to Study

The approach of the study will be according to the following steps:

- Conduct several visits with the team of experts, to the site for carrying out site reconnaissance and baseline data collection at the local concerned authorities.
- Assess the potential environmental and social impacts of the project in the study area by carrying out baseline surveys.
- Assess risks and hazards associated with the project activities
- Compare the impacts in relation to relevant national and international requirements and guidelines.
- Develop screening criteria for acceptability of project intervention from environmental and social aspects.
- Develop an environmental and social management plan for the mitigation of the potentially negative impacts and for monitoring compliance with the relevant environmental laws.
- Produce a comprehensive ESIA and RPF.
- Hold two public consultation events to be publicly announced and well-attended by relevant stakeholders of the project.

- Assess the capacity of the implementing agencies to implement the developed environmental and social management framework.
- Develop a capacity building program to cover any identified gaps in the capacity of the implementing agencies regarding environmental and social measures.

1.3.2 Data Collection Methodology

1.3.2.1 Physical and Biological Data

A site visit was conducted in order to collect information and data about the pathway of the pipeline and to come up with the nature of the pathway. In order to do so, the visit was established in a way to trace the exact route proposed by GASCO (as much as possible), from the source point to the end point. Many stops occurred during the visit in order to examine fauna, flora, type of crops in agricuture lands and source of irrigation, soil type, existance of water bodies (surface and groundwater), drainage networks, main geologic features and outcrops, and geomorphologic and topographic features. Many pictures were taken for the main observation during the visit.

The geologic and geomorphologic studies will include geologic history (surface and sub-surface), lithostratigraphic succession and the main geologic structures such as faults and folds features, and earthquake history, if any. In addition to topographic and geomorphologic features of the landscape of the areas, in case of the existence of drainage patterns and high land zones, a quantitative geomorphologic study will be performed in order to estimate the flood risk that might affect the sites.

For the purpose of the flora and fauna studies, the pipeline pathway was investigated as one transect starting from the start point at Nubaria power station to the end point of Nawa. All different species and other plant and animal signs (e.g. dens) were recorded by direct observation during active searches. All habitats and recorded species were documented by photographs.

1.3.2.2 Social Data

This study was carried out during February 2011. This survey relied upon two sources of data, namely secondary and primary data.

The secondary data was collected from previous reports i.e.:

1. Egyptian Human Development Report 2010 (EHDR),
2. The Egyptian Demographic and Health Survey 2008 (EDHS),
3. Information and census data from the Egyptian Central Agency for Public Mobilization and Statistics (CAPMAS),
4. Egypt's Description by Information 2007, Volume 1 & 2 and the 8th edition

The primary data was collected from the following groups:

1. GASCO staff i.e. site engineers, environmental protection engineers, lawyers,

2. Community members along the line side i.e. farmers, landlords, peasant, Bedouins and vehicle drivers

In addition to the above mentioned sources, documentation with photos took place in order to have a clear overview of different area characteristics that might play a major role during the construction and operation of the line.

Moreover, previous projects implemented by GASCO were analyzed in order to have a clear idea about the current monitoring and compensation strategy applied. Additionally, the level of community resistance to different types of compensations provided was investigated.

1.3.3 Stakeholders Consultation

Stakeholders' consultation was a core part of the preparation of the ESIA and the RPF for this project. The various stages involved several consultation activities where stakeholders were given the opportunity to contribute to the ESIA and the RPF. The stakeholders' consultation has been conducted during the following main phases:

1.3.3.1 Scoping Phase

As part of the scoping phase of the ESIA, collective consultation meeting was planned
The announcement of the planned meeting was published on the National Newspaper El Ahram on 27 Jan However, due to the various consequences of the 25th January Revolution and the country's wide protests that ensued over the following weeks, governmental and private sector offices were closes, wide curfews were across the country and the security situation in the country was unstable. It was quite difficult to carry out the meeting collectively on the planned time. Few days later and after relative stability of the conditions, the consultant carried out a field survey for the planned route. The field surveys involved comprehensive investigations to evaluate the environmental and social assessment of the proposed project. Interviews were carried out with different groups, in order to include their inputs about the proper scope of the study, and what they consider the most important environmental and social impacts. The following stakeholders were met with:

- Environmental Department manager at GASCO,
- The head of Geodesy Department at GASCO,
- A lawyer at GASCO,
- 1 ferry worker
- 3 farmers
- 6 people from the current North Giza electricity station

It is worth mentioning that the sample was interviewed along the line of the project in agricultural areas that might be affected by the project implementation. The study team was guided by the engineers from GASCO.

The team believes that the adopted approach during the scoping phase was the most efficient given the current event in Egypt. The adopted approach allowed for reaching the persons who will be more likely affected by the projects including farmers and Bedouins located within the project route.

1.3.3.2 Public Consultation Phase

Stakeholder participation and consultation should be core to the ESIA preparation process in order to ensure that the analysis and the proposed mitigation plan clearly reflect the views and interests of the various groups of stakeholders, particularly the potentially affected groups. As part of the Public Consultation phase, a draft version of the Executive Summary of the ESIA report was reviewed by a group of project stakeholders. Questions and comments were heard regarding the details of the report, and these suggestions were then incorporated into the final version of the report, to ensure that it accurately reflects the concerns of those most directly affected by the project activities.

2. Legal and Administrative Framework

2.1 Applicable Environmental Legislation in Egypt

2.1.1 Law 4/1994 for the Environment

The Law for the Environment, its Executive Regulations Decree 338/1995, is the key legislation governing environmental protection in Egypt. The law stipulates in Articles 19 through 23 that an Environmental Impact Assessment should be prepared for development projects, as a step in the licensing procedure. In case the project has been approved, the law obliges the project proponent to keep an Environmental Record to document the environmental performance of the project. EEAA Guidelines of EIA for Oil and Gas Sector, January 2005, has classified "Distribution Network of Natural Gas for Cities" as a Category C Project, which requires a full EIA according to certain conditions, which have been followed in preparation of this study.

The Law regulates in Articles 29 through 33 the handling of hazardous substances and wastes. The law stipulates that handling of hazardous substances should be after having license from a competent administrative authority, which is the Ministry of Petroleum in this project. The Ministry of Petroleum has issued a list of substances that are classified as hazardous. Among these substances are the odorant agent used in Pressure Reducing Stations, and possible lubricating oils. Empty containers of such substances will be classified as hazardous waste. The Executive Regulations of the law details in Articles 26 through 28 the steps of granting handling license. Article 33 and Annex 3 of the Executive Regulations specify the required data to be recorded in the Environmental Register related to hazardous materials and wastes.

The Executive Regulations of Law 4/1994 gives limits for noise levels in working environment, which apply to excavation/construction activities in the project, and the ambient noise levels in different locations, which applies to areas near construction works of the project. Both limits are given in Tables 2.1 to 2.3 below.

Table 2-1: Noise intensity and maximum exposure periods in working environment

Noise intensity level (LAeq) - Decibel	95	100	105	110	115
Period of exposure - one hour	4	2	1	1/2	1/4

Table 2-2: Noise intensity and maximum number of intermitted impacts[1] from heavy hammers

Noise intensity level (LAeq) - Decibel	135	130	125	120	115
Number of permissible impacts - impacts	300	1000	3000	10000	30000

[1] Impact is considered intermittent if the period between impacts is one second or more

Table 2-3: The maximum permissible limit for noise intensity in the different areas

TYPE OF AREA	PERMISSIBLE LIMIT FOR NOISE INTENSITY DECIBEL (LAeq)					
	DAY		EVENING		NIGHT	
	From 07:00	To 18:00	From 18:00	To 22:00	From 22:00	To 07:00
Residential rural areas, hospitals and gardens	45		40		35	
Residential suburbs with low traffic	50		45		40	
Residential areas in the city	55		50		40	
Residential areas in which can be found some workshops or commercial establishments or which are located on a main road	60		55		50	
Commercial and administrative areas or downtown	65		60		55	
Industrial areas (heavy industries)	70		65		60	

Protection of air environment from pollution is governed by Law 4/1994 in Articles 34 through Article 47. The Executive Regulations has determined in Annex 5 maximum concentrations of air pollutants in ambient air, which are listed in Table 2.4. In Annex 6 of the Executive Regulations are standards for emissions from fuel machinery, which are applicable to excavation machinery (trencher, excavators … etc.). These standards are given in Table 2.5.

Table 2-4: Maximum limits for air pollutants in ambient air

POLLUTANT	MAXIMUM LIMIT (μ/m^3 if otherwise identified)	EXPOSURE PERIOD
Sulphur Dioxide	350 150 60	1 hr 24 hrs 1 year
Carbon Monoxide	30 Milligrams/cubic meter 10 Milligrams/cubic meter	1 hr 8 hr
Nitrogen Dioxide	400 150	1 hr 24 hrs
Ozone	200 120	1 hr 8 hr
Suspended Particles Measured as Black Smokes	150 60	24 hrs 1 year
Total Suspended Particles (TSP)	230 90	24 hrs 1 year
Respirable Particles (PM_{10})	150 70	24 hrs 1 year
Lead	0.5 1.5	1 year (daily averages) in urban areas 6 months (daily averages) in industrial areas

Table 2-5: Maximum limits air pollutants in vehicle emissions

Type of vehicle	Pollutants	Vehicles manufactured before 2003	Vehicles manufactured starting 2003	Method of measurements
Gasoline	Hydrocarbons (ppm)	900	600	During speed 600-900 rpm
	CO %	4.5 volume	2.5 volume	During speed 600-900 rpm
Diesel	Opacity	30		At maximum acceleration

Law 4/1994 includes also articles that control excavation works and correspondent waste disposal. Article 39 of the Law stipulates that developers carrying out excavation, construction or demolition works should take precautions to safeguard against air pollution during production and transportation of excavation/construction waste. The executive regulations, Article 41, identify these precautions as:

- Storage of excavation/construction waste should not cause obstruction to pedestrian movements. Waste liable to dispersal shall be covered to avoid air pollution.
- Transportation of excavation/construction waste should be though licensed and sufficiently equipped vehicles with suitable special box or an air-tight cover to prevent loose particles of waste and debris from escaping into the air or dropping on the road, special loading and unloading equipment and In good condition according to the rules of safety, solidity and lights and fitted with all safety equipment.
- Disposal of excavation/construction waste should be in licensed locations by the local authority. These locations should be away at least 1.5 km from residential areas, at a lower contour level, and leveled after being filled in with the waste.

2.1.2 Law 38/1967 for General Cleanliness

The conditions mentioned in the previous paragraph are also mentioned in Law 38/1967 for General Cleanliness and its Executive Regulations. Article 15 of the Executive regulations stipulates that vehicles hauling construction waste should have tight cover to prevent dispersion or falling of its contents.

2.1.3 Law 48/1982 for Protection of River Nile and Watercourses

This law regulates the discharge of effluent into the Nile and associated waterways, in view of their protection from pollution. It generally:

- Imposes licensing by the Ministry of Public Works and Water Resources, (MPWWR) of the discharge of all solids, liquids and gaseous effluents;
- Specifies quality standards of effluent;
- Prohibits the use of drainage water unless the suitability is ensured;
- Entrusts the Ministry of Interior (Police) with control of waterways;
- Provides authority to the irrigation engineers of MPWWR to inspect all types of establishments licensed to discharge effluents to waterways;
- Entrusts the Ministry of Health (MOH) with the collection of samples and laboratory analysis;
- Creates a fund to receive fees and fines, to be used for laboratory analysis and studies, subsidizing water treatment, and rewarding informants on law violation; and
- Defines penalties.

Decrees issued by MPWWR further specify fields of application, regulations and standards. The following tables indicate the relevant regulatory limits for discharging effluent to non-fresh water sources (identified as drains of all types, lakes, ponds, or other enclosed surface water bodies).

Table 2-6: Standards and specifications of sewage and industrial liquid effluent which are licensed to discharge into brackish or saline surface water bodies.

Parameter	Maximum limit (mg / I)

	Sewage Effluent	Industrial Liquid Effluent
Temperature	35°C	35°C
pH	6-9	6-9
Biochemical Oxygen Demand	60	60
Chemical Oxygen Demand (Dichromat)	80	100
Chemical Oxygen Demand (Permanganate)	40	50
Dissolved Oxygen	Not less than 4	……
Oil and Grease	10	10
Dissolved. Solids	2000	2000
Suspended Solids	50	60
Coloured Substances	Free of col. sub.	Free of col. sub.
Sulphide	1	1
Cyanide	….	….
Phosphate	….	0.1
Nitrate	5	40
Fluorides	….	0.5
Phenol	….	0.005
Total heavy metals	1	1
All pesticides	nil	nil
Total Coliform (MPN/100 ml)	5000	5000

When sewage effluents or industrial effluents mixed with sewage effluents are discharged into non-fresh surface water bodies, the effluents must be treated with chlorine for disinfection prior to discharge according to the request of the relevant authority, such that the residual chlorine will not be less than 0.5 mg / L per minutes after its addition.

Table 2-7: Standards and specifications of brackish or saline surface bodies into which discharge of treated liquid effluent

Parameter	Standards and Specifications (mg/I unless otherwise noted)
Temperature	Not to exceed 50 C above normal average
Dissolved Oxygen	Not less than 4 mg/I at any time
pH	Within the range 7 - 8.5
Synthetic Detergents	Not to exceed 0.5 mg/I
Phenol	Not to exceed 0.005 mg/I
Turbidity	Not to exceed 50 mg/I

Total Dissolved Solids	Not to exceed 650 mg/I
Total Coliform (MPN / 100 ml)	Not to exceed 5000 mg/I

Articles 2 and 3 of the Executive Regulations of Law 48/1982 states that it is forbidden to use the banks of watercourses for storage of waste or materials that could be dispersed, chemicals or toxic materials except in areas licensed from Ministry of Irrigation and Water Resources. These articles may be most relevant for sites near the Nile/water courses, and sites were the pipeline will be laid by tunneling watercourses, in relation to excavation waste, lubricating oils, or chemicals used in tunneling equipment.

2.1.4 Law 117/1983 for Protection of Antiquities

The law defines antiquities as each structure or movable object produced by different civilizations. The definition includes productions of arts, science, literature and religions from ancient ages unit 100 years ago. The definition also includes human corpses, and species from the same age, remained from ancient ages. All discovered antiquities are registered by Decrees of the Minister of Culture, this registration implies certain standards and precautions. Standards that are applicable to the project are:

- It is not allowed to demolish all or parts of structures, renovate or change the structure features (Article 13)
- The Minister of Culture identifies beatification zones surrounding the site. These beatification zones are considered part of the site, and it is not allowed to construct or excavate or plant trees inside these zones. (Articles 19 and 20)
- Each person finds a movable antiquity, or parts of antiquity structure, should notify the nearest administrative authority within 24 hours and should keep the antiquity in its discovered status. The antiquity becomes State's property. (Article 24)

2.1.5 Law 4/1988 concerning Petroleum Pipelines

Law 4/1988 identifies a minimum safe distance of 6 meters from petroleum pipelines to be established, within which future construction is not allowed.

2.2 Applicable Social Legislation in Egypt

The Government of Egypt’s policy is to compensate or assist people whose property is affected by any governmental projects. Although at this time there is no possibility of land expropriation, it is worth briefly mentioning the legislation that might cover any potential expropriations for any future expansion of the project. For the time being it is not necessary to prepare a detailed Resettlement Framework as the project will not result any land expropriation.

Expropriation Article 34 of the Constitution declared that “Private ownership shall be safeguarded and may not be placed under sequestration except in the cases defined by law and in accordance with a judicial decision."

Other relevant laws governing expropriation and compensation include:

- Law 577/54, which was later amended by Law 252/60 and Law 13/162, establishes the provisions pertaining to the expropriation of real estate property for public benefit and improvement.
- Law No. 27 of 1956, which stipulates the provisions for expropriation of districts for re-planning, upgrading, and improvement, and the amended and comprehensive Law No.10 of 1990 on the expropriation of real estate for public interest.

The general provisions guiding expropriation of private property (according to Law 577/54, Law No. 27 of 1956, Law No. 252 of 1960, and Law 577/54) include the following:

- Property expropriation shall only include tangible real estate property; there shall be no expropriation of movable possessions.
- Expropriation is applicable only to property privately owned by individuals, thus, public property is excluded from the procedures.
- The expropriation shall include land and constructions (structures).
- The purpose of expropriation shall only be for realizing public interest.
- The administrative authority has the right to assess the circumstances related to expropriation as well as the authority for implementation of property expropriation, which is justifiable by the objective of achieving public benefit. The administrative authority may not be challenged or judged on the grounds that it could have chosen more appropriate real estate property to achieve public benefit than the one that it has already chosen.
- The administration shall estimate the area it sees necessary for the establishment of a project. This right shall not be only restricted to the real estate property required for the project, but also includes expropriated property.

It should be noted that the new law has not restricted the right to request the purchase of the remaining un-expropriated portion of real estate whether it is a building or land.

Law No. 252, issued in 1960 and amended by Law 577/54, was created to balance the rights and guarantees of individuals with the rights of the state in expropriating private property. This law stipulated that any judgment which justifies property expropriation for public benefit or interest must be made by presidential decree.

In addition, a ministerial decree 346/2007 was developed by the Ministry of Agriculture in order to provide the opportunity for each governorate to address the prices of their vegetation according to individual characteristics of each governorate

2.3 World Bank Guidelines and Safeguard Policies

The World Bank has identified 10 environmental and social safeguard policies that should be considered in its financed projects. The objective of these policies is to prevent and mitigate undue harm to people and their environment in the development process. Following are the policies which could be triggered by the project activities.

2.3.1 OP 4.01 – Environmental Assessment

According to the World Bank Operational Policy OP 4.01, the Nubaria-Metnama pipeline is classified among Category A projects. Projects under this Category are likely to have significant adverse environmental impacts that are sensitive[2], diverse, or unprecedented.

The environmental impacts that are likely to be caused by the project shall be analyzed in this study, classified according to its sensitivity and reversibility. Mitigation measures shall be identified for all expected negative impacts, along with an Environmental Management and Monitoring Framework presenting mechanisms for implementation of these mitigation measures.

2.3.2 OP 4.11 – Physical Cultural Resources

The region contains many sites, building and monuments that fall under the definition of Physical Cultural Resources[3]. Because the project will include significant excavations in areas which may be near sites of cultural value, there shall be specific attention in this study to identify locations of such sites, mitigation measures for controlling effects on such sites. These mitigation measures are also reflected in the Environmental Management and Monitoring Framework.

2.3.3 OP 4.12 – Involuntary Resettlement

According to the WB's safeguard policy on Involuntary Resettlement, physical and economic dislocation resulting from WB funded developmental projects or sub-projects should be avoided or minimized as much as possible. Unavoidable displacement should involve the preparation and implementation of a Resettlement Action Plan (RAP) or a Resettlement Policy Framework (RPF), to address the direct economic and social impacts resulting from the project or sub-project's activities causing involuntary resettlement.

It is not envisaged that the project on hand will result in the physical or economic dislocation of people. However, a RPF has been prepared in order to outline a proposed approach and work plan to guide the implementation, handover, and monitoring and evaluation of the resettlement process, in case OP 4.12 is triggered at any point.

[2] A potential impact is considered "sensitive" if it may be irreversible (e.g., lead to loss of a major natural habitat) or raise issues covered by OP 4.10, *Indigenous Peoples*; OP 4.04, *Natural Habitats*; OP 4.11, *Physical Cultural Resources*; or OP 4.12, *Involuntary Resettlement*.

[3] Physical Cultural Resources are defined as movable or immovable objects, sites, structures, groups of structures, and natural features, and landscapes that have archeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance.

3. Description of the Environment

3.1 Administrative Districts

The administrative areas of the relevant governorates, including 6th of October, Giza, Qalubia, Cairo and Helwan, are not currently defined. The engineers from GASCO did not have clear information as to which parts were affiliated with different governorates. The available information in most of the reports excluded 6th of October. Therefore, the study team relied upon information provided by the Local Council of 6th of October Governorate. However information regarding Giza Governorate still includes 6th of October. The following is a discussion of the background information provided by national reports, mainly *The Description of Egypt by Information, 2007* which contains the following details about the governorates.

3.1.1 Qalubia Governorate

Qalubia Governorate
Source: Description of Egypt by Information 2007

Qalubia forms a part of the Greater Cairo Region along with Cairo and Giza Governorates. The governorate's total area covers 1124.28 km², and comprises 7 marakez, 10 cities, 2 districts and 47 rural local units annexed by 197 villages. According to the preliminary results of the 2006 census, the population is estimated at 4.24 million people, of whom 37.7% live in urban areas and 62.3% in rural areas. The population's natural growth rate is 20.7 per thousand. The district of Shoubra El Khaima is the agricultural starting point for lower Egypt governorates. The governorate hosts one of the most important mega projects - the underground metro - which extends from Shoubra El Khaima to Cairo and Giza Governorates and has streamlined the traffic in Greater Cairo Region. The governorate also represents one of Egypt's major agricultural and industrial zones. It is famous for growing maize, cotton, wheat, citrus fruits, bananas, apricots and many kinds of vegetables. It is also a major supplier of agricultural crops for Cairo. The largest industries in Qalubia are found in Shoubra El Khaima, and include spinning and weaving, electric appliances, plastics, cars, oil refining, food packing and processing, metal products and glass. In addition, the Abo Za'bal industrial zone is famous for fertilizer and chemical industries. The governorate is currently planning to establish an integrated

industrial zone in El Khanka City. Qalubia is also rich in many monumental and tourist sites including Atreep in Banha Markaz, Tal El Yahoodia in Khanka, Abo El Manga Barrages, Koum Ashfeen Church in Shebeen El Kanater, the Revolution Museum and El Kanater El Khairyia. El Kanater El Khairyia draws tourists and visitors from across the country to enjoy the natural sceneries, promenades, and parks stretching across 500 feddans. In cooperation with the Cabinet Information and Decision Support Center (IDSC), 66 information and decision support centers were established and are staffed by the highest caliber of the governorate's employees. An IT training center was also established in the governorate's Main Department (Diwan Aam) and has provided training for 13,579 students, fresh graduates and working staff of the governorate's administrative body.

3.1.2 Menoufia Governorate

Menoufia Governorate was named after Menof city, an ancient Pharaonic city called "Bear Noub" or the Gold House. Menof was the capital of Menoufia from the Islamic conquest until 1826, when Mohamad Alị moved the capital to Shebin El Kom. Shebin El Kom is located on the main green road connecting Cairo with Alexandria and linking Gharbeyia, Kafr El Sheikh, El Behera, and Alexandria. Menoufia is located in the Delta region, which encompasses Gharbeyia, Menoufia, Dakahleyia and Kafr El Sheikh. The governorate covers an area of 2499 km², and comprises 9 administrative marakez, 10 cities, 2 districts, 70 rural local units annexed by 315 villages and 901 hamlets. According to the preliminary results of the 2006 census, the population is about 3.3 million people; of whom 20.4% live in urban areas and 79.6% in rural areas. The population growth rate has reached 18.7 per thousand. Agriculture is the population's main activity due to the region's fertile soil; the total cultivated area covers 356.1 thousand feddans. It is famous for growing cotton, maize and wheat, and also produces vegetables such as potatoes and string beans, a large portion of which are exported. The governorate also contributes to Egypt's industrial activity, hosting large industries such as spinning and weaving. Furthermore, it is famous for the silk carpet export industry in Sakyet Abo Sha'ra village, and the seashell works in Sakyet El Monkedy. Menoufia's industrial development is represented by several industrial establishments and other

Menoufia Governorate
Source: Description of Egypt by Information 2007

developmental projects that have provided job opportunities. Two industrial zones that enjoy great investment potential are the Mubarak industrial zone in Qwesna, and the industrial zone southeast of Sadat City. Cultural and historic features of the governorate include several Islamic places, churches, and old monasteries including mosques of the Sufi Seedy Sheble El Aswad in Shohada City, Seedy Khamees in Shebin El Kom, El Abbasy Mosque, and the churches of Mar Gergis and Virgin Mary in Shebin El Kom. The governorate also hosts the Denshway Museum, which commemorates the Denshway incident in pictures and statues, late President Sadat's Museum in Meet Abo El Koum, his birth place, as well as various tourist villages and gardens. Within the framework of developing basic information infrastructure to support decision-making processes at all levels, 83 centers and information units were established on the different levels of the governorate. These include Marakez, cities, specific directorates, central departments in the governorate's Main Department (Diwan Aam) as well as in rural local units. The centers employ highly qualified local administration staff. An IT training center was also established in the governorate's Main Department and has provided training for 9979 students, fresh graduates, and working staff of the governorate's administrative body. An internet site was established to provide information to decision makers and researchers, and has contributed to disseminating knowledge both locally within the governorate and internationally.

3.1.3 El Beheira Governorate

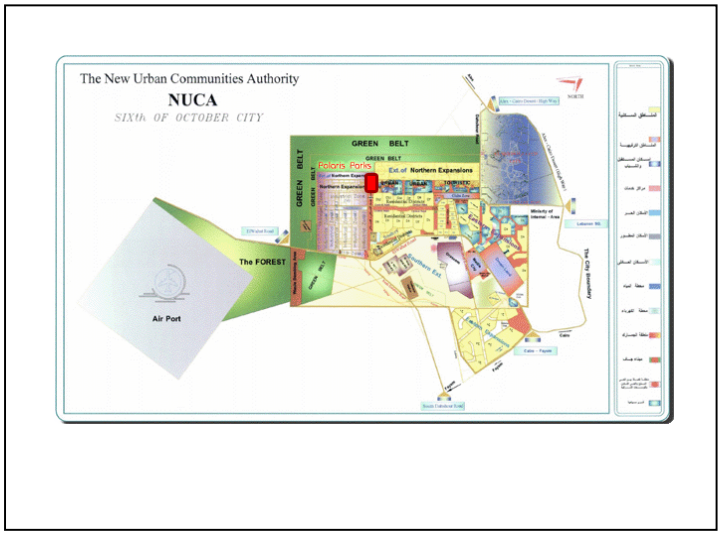
El Beheira is located within the Alexandria Region, which encompasses Alexandria, Matrouh, and El Beheira governorates. Two major arteries run through the governorate: Cairo-Alexandria Green and Desert Roads. Geographically, the governorate is characterized by a vast desert in the south and the west, cultivated areas stretching to the eastern borders of the Rosetta Branch of the Nile, and Edco Lake and the Mediterranean Sea in the north. The governorate covers an area of 9826 km², representing 1% of Egypt's total area and encompassing 15 marakez, 15 cities, 84 rural local units, 497 villages and 5737 hamlets. According to the preliminary results of the 2006 census, the total population is 4.74 million people; 19.2% of whom live in urban areas and 80.8% in rural areas. The population natural growth rate has reached 19.1 per thousand. El Beheira is one of Egypt's richest governorates in natural resources. The

El Beheira Governorate
Source: Description of Egypt by Information 2007

Rosetta Branch of the Nile secures perennial water resources for the vast cultivated areas of the governorate, and there are fishing resources on the Mediterranean Sea, the Rosetta Branch and Edco Lake. Natural gas was discovered off the north shores, in addition to the availability of sand and clay quarries as well as salinas in the south and the west. Roads arteries extend across El Beheira and recently the international coastal road has been constructed in the North. El Beheira encompasses by far the largest agricultural lands in terms of the area, estimated at 1557 thousand feddans. The governorate is famous for its diversified agricultural production, particularly cotton, rice, wheat, maize and potatoes. It is first among the governorates with regards to fruit and vegetable production and the export of citrus fruits, potatoes, tomatoes, artichokes, watermelon, string beans, and peppers. The governorate also contributes to the industrial activity with spinning and weaving industries in Kafr El Dawar, established 75 years ago. Cotton ginning, chemical and dye industries are also located in the governorate, which hosts four industrial zones in Netron Valley, Rosetta, Hoosh Eisa and Nubaryia. As an extension of the Alexandria coast, El Beheira also features many tourist attraction sites. Rosetta City is known for unique architectural and historical monuments, especially Islamic architecture, and for the discovery of the Rosetta stone. The Netron Valley is characterized by its moderate weather and various famous Coptic monuments. In cooperation with the Cabinet Information and Decision Support Center (IDSC), 131 information centers, covering all administrative levels, were established and developed, and are staffed by highly qualified governorate employees. Eleven IT training centers were established as well as an internet site to provide information to students, decision makers and researchers, and has contributed to disseminating knowledge both locally within the governorate and internationally.

3.1.4 6th of October Governorate

6th of October Governorate is a newly constructed area established in order to reduce the overcrowded population in Greater Cairo. It was named after the 6th of October victory in 1973. It was announced as a governorate in year 2008 according to the presidential decree 114 on the 16th of April 2008. It is located 35 km from Cairo. Giza and Menofiya Governorates form its northern borders, Fayoum Governorate forms the southern border, the administrative boundaries of Giza Governorate and River Nile form the eastern borders and the administrative boundaries of Matouh and Beheira Governorates form the western border. 6th of October Governorate is distributed into 14 districts (*Hai*), and the total populated area is



about 42.39% of the governorate area. The total population is 680.000 thousand people, and can be described as seasonal residential, as the majority of the residents are university students and professors who come to live there during the school year. The governorate is one of the most famous industrial areas in Egypt. The master plan of the city was designed to separate the industrial areas from the populated area, with the industrial zone located in the southwest of the city.
The gas pipeline project will cover the area located in agricultural zone of Qalubia, Menofiya and El Beheira Governorates, all of which encompass old agricultural lands. This project is entirely different from the other project that will be implemented in Dahshour – Itfeeh, as the land in this case is not reclaimed land and the residents are very different. These differences may result in different impacts on the affected population and the compensation in this case might be greater.
The project will extend along 105 km, among which about 20 km are roads and crossings in the Nile. Therefore, the total agricultural areas to be expropriated will be about 400 feddans of agricultural land. The team has observed that the crops in the area are traditional crops such as maize, corn, vegetables and fruit trees. In the detailed Resettlement Policy Framework a clear discussion of crops compensation will be presented.

3.2 Location and Land Use

Figure 2 shows the pathway of the pipeline start at the Nubaria power station as a source point to a Pressure Reduction Station at the North Giza power station, and continuing to join the Metnama pipeline at an area called Nawa or Ezbet Swelem.

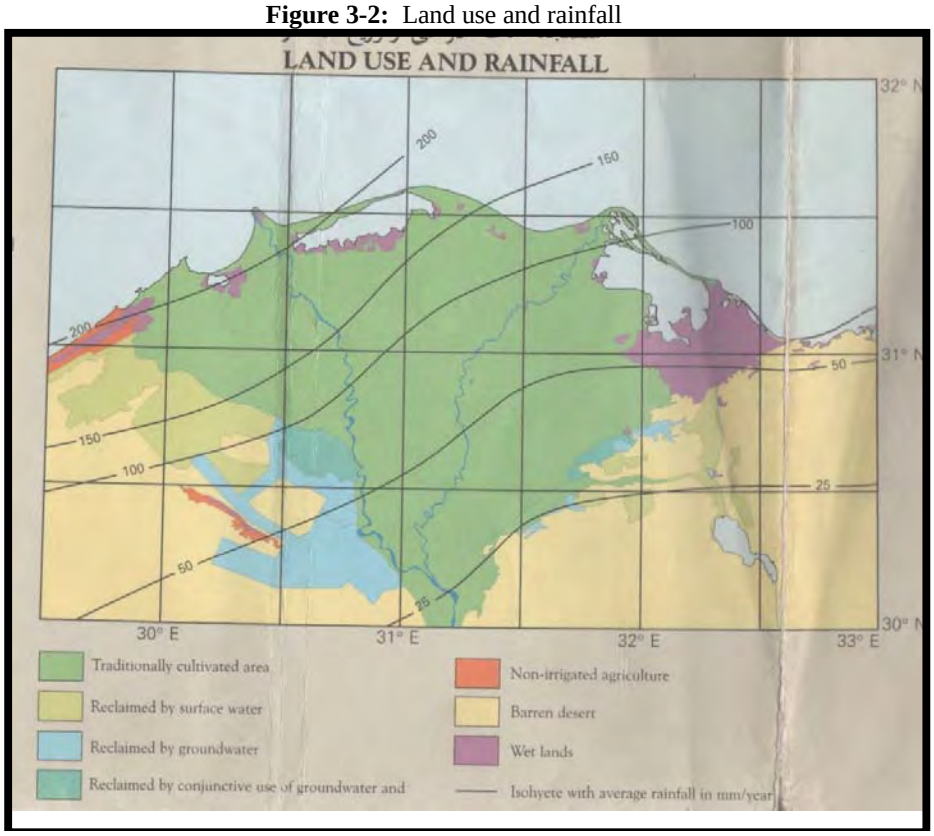
The planned path of the pipeline runs through agricultural lands and inhabited areas, crosses several major transportation routes and waterways (including the Nile) where the pipes will pass through tunnels under the bottom of the waterway.

Figure 3-1: Nubaria-Metnama pipeline area

3.3 Climate

The pipeline route is in a subtropical climatic region of Northeast Africa, generally arid and characterized by a warm winter and hot summer, low rainfall and high evaporation intensity. The relative humidity is moderate and active winds of intermediate speed is recorded, rainfall range between 25 to 100 mm/year as shown in figure 3. The annual minimum and maximum air temperature in this region vary from about 13^0C to about 28^0C, respectively. However the temperature frequently rises to about 35^0C during the summer season.

Figure 3-2: Land use and rainfall



The project area is located in a subtropical climatic region. Among the outstanding weather events are the dust and sandstorms that frequently blow in transitional seasons of spring (March to May) and autumn (September to November). In winter (December to February) the general climate of the area is cold, moist and rainy while during summer (June to August), its climate is hot, dry and rainless.

A phenomenon of Egypt's climate is the hot spring wind that bellows across the country. The winds, known as the Khamasin, usually arrive in April but occasionally occur in March. Unobstructed by geographical features, the winds reach high velocities and carry great quantities of sand and dust from the deserts. These sandstorms, often accompanied by winds of up to 140 kilometers per hour, can cause temperatures to rise as much as 20^{o}C in two hours. The winds blow intermittently and may continue for days. The Khamasin winds cause illness in people and animals, harm crops, and occasionally damage houses and infrastructure.

Winds are mostly northerly, with the direction ranging from NW to NE throughout the year. These directions of the wind could cause rapid transportation of pollutants and other urbanized effects from the industrial complex areas in the north.

Table 3-2: Mean monthly values of metrological parameters recorded in Giza Metrological Station between 1990 and 2004

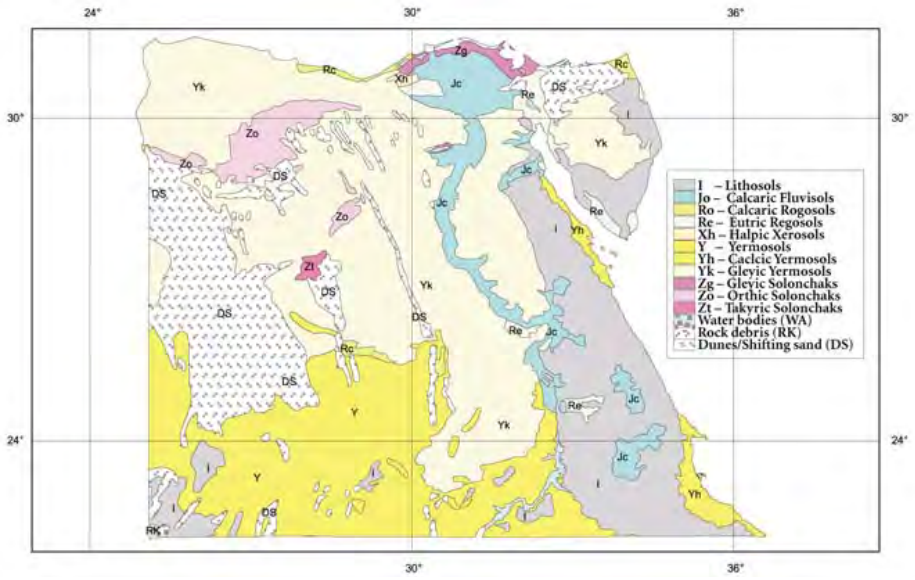
Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Temperature (C◦)	13.9	14.8	17.5	21.7	25.3	28.0	29.1	28.9	27.4	24.6	19.9	15.2
Relative humidity (%)	68.1	63.8	60.3	53.4	51.5	54.5	59.6	62.3	61.3	63.5	66.7	68.9
Accumulation of Rain Quantity (mm/month)	2.9	3.1	2.2	0.1	0.2	0	0	0	0	0.04	3	2.8
Rain-days (day/month)	2.6	1.5	1.7	0.1	0.4	0	0	0	0	0.3	1.2	1.8
Wind speed (knot)	66.4	69.2	58.8	63.0	47.1	44.1	57.3	57.7	58.5	47.6	37.5	63.9

3.4 Soil

Only one type of soil characterize the region through the pathway of the pipeline which is the *Calcaric fluvisols*, relatively young soils (clay to loam) developed on recently deposited colluvial, fluviatile, lacustrine, or marine sediments in the Nile Valley and Delta as shown in figure 4.(sky blue color)

Figure 3-3: Soil map of Egypt



Fluvisols still show some sedimentary stratification. Organic matter content decreases irregularly with depth (although it remains above 0.35 percent in the upper 1.25m) and the soils have sulphide-rich material within 125cm of the surface. Generally fluvisols exhibit little horizonation, except for a weakly developed A-horizon and peaty horizons. Calcaric fluvisols, however, are strongly calcareous, having significant amounts of free calcium carbonate at depths of 20-50 cm and pH 7. These are the most intensively farmed soils in Egypt and have a high development potential due to the ease of irrigation low water erosion potential, and their ability to be double- cropped. They do not, however, have very high nutrient levels, so the maintenance of fertility by traditional manuring practices or by high rates of fertilizer application is of particular importance in crop

production. There are also potential wind erosion problems in silt - rich areas if the topsoil is allowed to dry out. The major management task is to control water supply and conserve soil moisture.

The Nile fluvisols are extensively irrigated and the management of irrigation scheduling and drainage is time- consuming. In addition, in areas with a high clay content, poor irrigation practices often lead to subsoil compaction and pan formation, secondary salinization, and gleying.

3.5 Geology

3.5.1 General outlines

The surface exposures of the area belong almost totally to the Quaternary and to the Late Tertiary and are essentially developed into clastic facies. Eocene and Upper Cretaceous carbonate rocks are locally exposed and are principally associated with fold-faulted structures. Oligo-Miocene basalt exists in the southern portion and also recorded in the subsurface. Figure 6 and 7 represent the geologic map of the area and legen associated and as well as table 1 gives an idea about the Stratigrphic correlation of the area.

- Quaternary:
  - Holocene: occupies the present floodplain the Nile River, composed of silty layers and act as semi-confining stratum in the Nile Delta.
  - Pleistocene: Thick succession of deposits of graded sand and gravels intercalated with clay lenses, the thickness reach about 100 m near Cairo, this unit act as the main aquifer of the area.
- Tertiary:
  - Miocene: occupies the southern portion of the area, composed mainly of sand and gravel and local intercalation of limestone or shale.
- Mesozoic:
  - Upper Cretaceous: present in southern portion of the area with a thickness up to 1000 m, and composed mainly of limestone and dolomite.

Figure 3-4: General geologic map of the area (Egy.Geol.Surv., 1981), scale 1:2,000,000

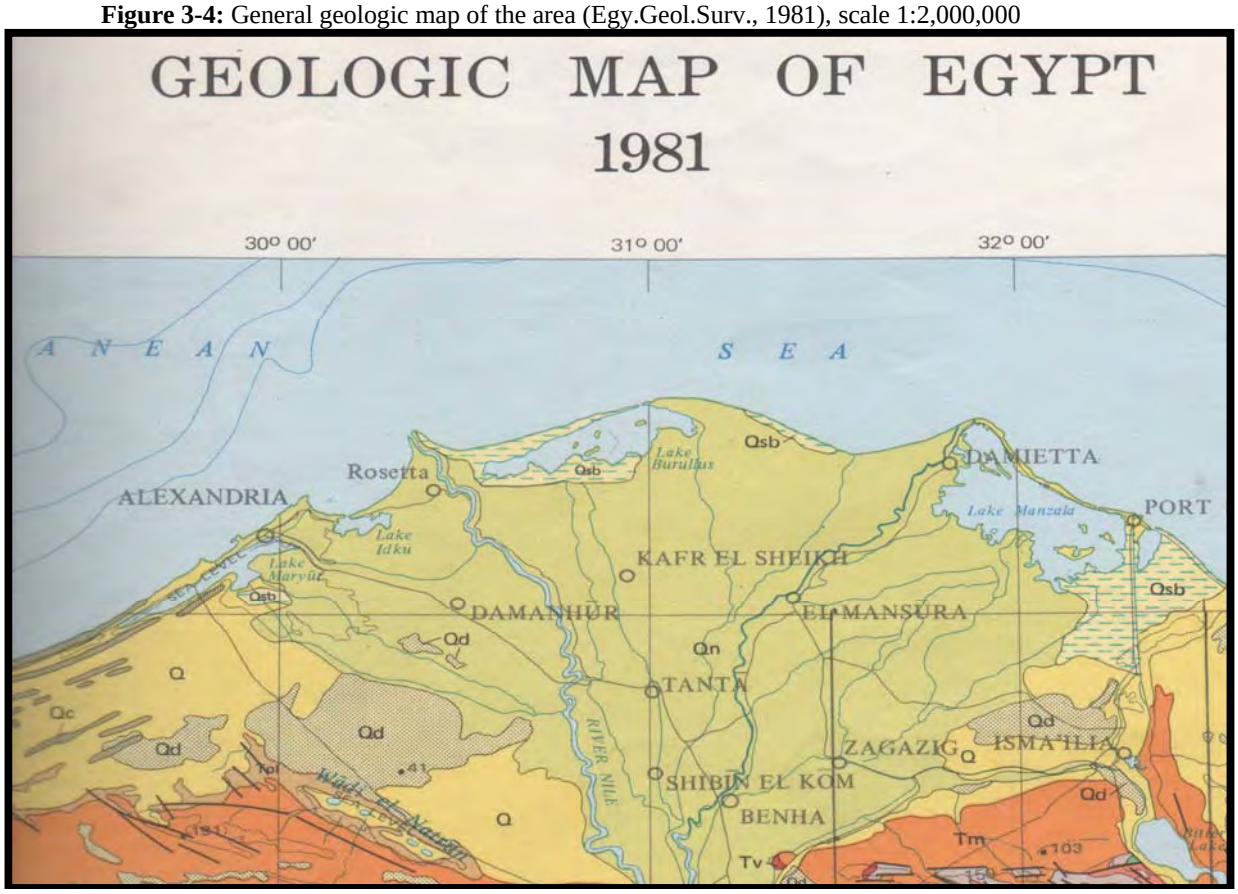


Figure 3-5: Legend of the geologic map

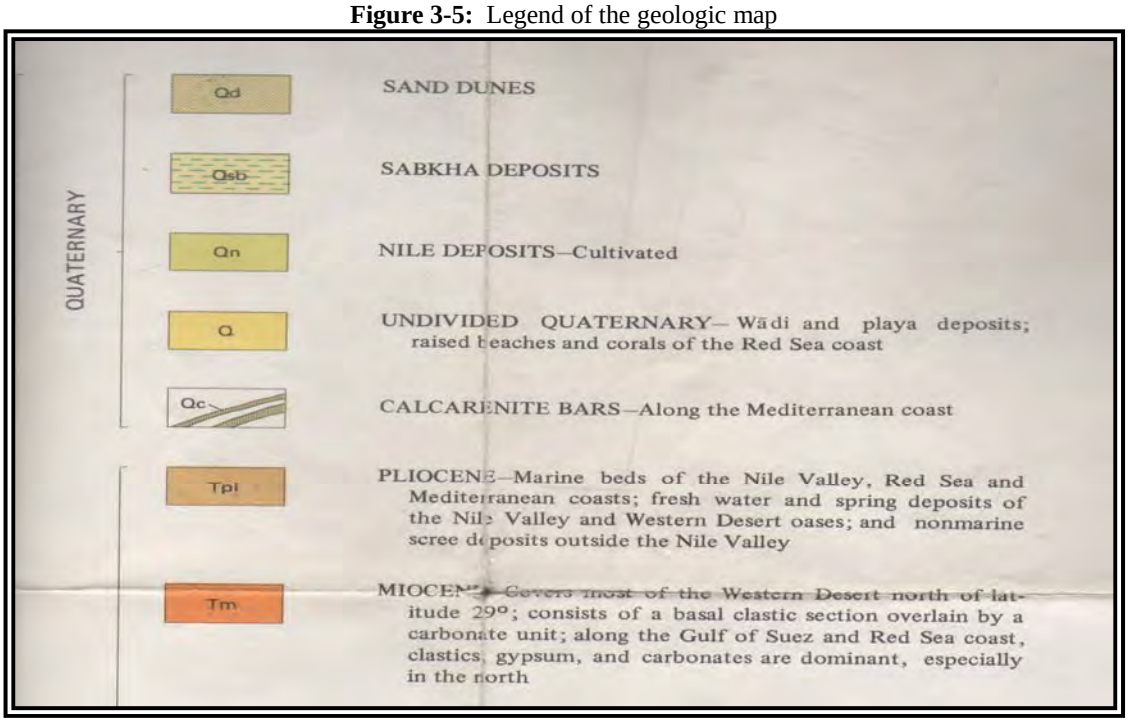


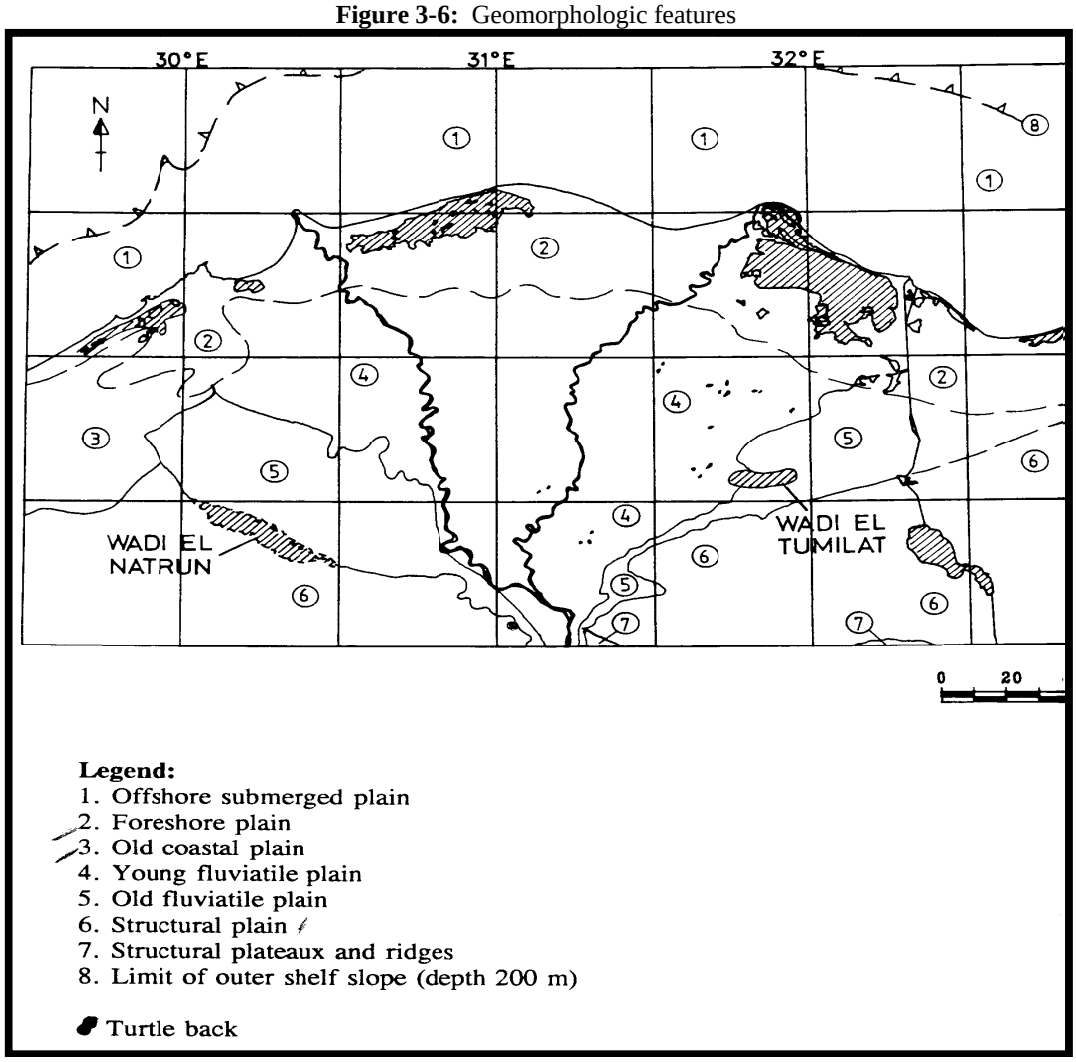
Table 3-2: Stratigraphic correlation or the area (Said, 1990)
a=age (millions of years) b=thickness (meters)

Age				Nile Delta			
Era	Period		a	Nile phase	Formation	lithology	b
Quaternary	Holocene		0.02	Neonile	Belqas	silty clay	50
	Pleistocene			Prenile	Mit Ghamr	gravel, sand	700
				Protonile	El Wastani	sand, clay	300
Neogene		u,m	2.8	Paleonile			
				marine gulf	Kafr el Sheikh	clay	1750
		lower	4.2		Abu Madi	sandy dpts.	250
					Rosetta	evaporites	50
		upper	5.2	Eonile	Qawasim	silt, sand	700
		middle	11.2				
		lower	16.5		Sidi Salem	clay	1800
Paleogene	Oligocene		24		Abu Zabal	basalt	50
					Dab'a-Shushan	shale sand	150
	upper Eocene						

3.5.2 Geomorphology

The pipeline route lies entirely on one main geomorphologic unit - the Young Alluvial Plain (Unit 4 in figure 5) - which occupies the banks of the river Nile. The surface of this flood plain consists of a top layer of clay-silt and underlain by sand and gravels which is water bearing formation of the alluvial aquifer. The Nile floodplain has an elevation of about 21m (amsl), to the east side of the flood plain, the ground surface rises towards El Mokatam to reach about 150m (amsl), to the west side, the surface rises 100m (amsl) at the Pyramid plateau.

Figure 3-6: Geomorphologic features

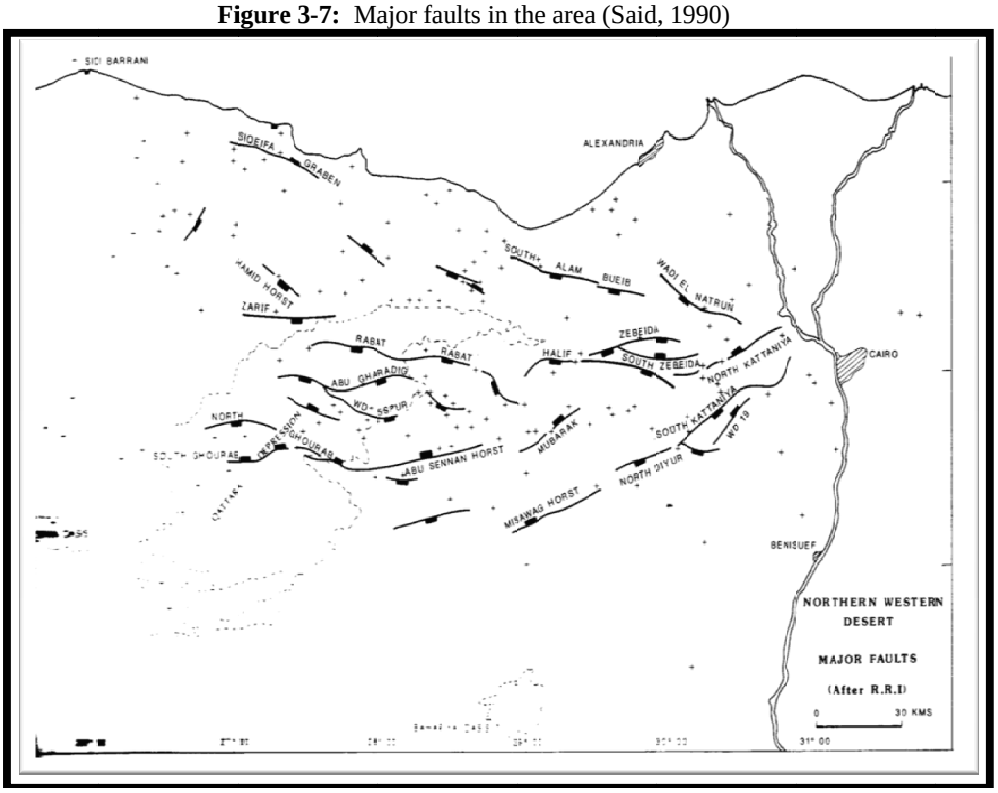


3.5.3 Tectonic Frameworks

3.5.3.1 Structure Geology:

The selected area for the project implementation is characterized by almost featureless plain with the exception of the small folded and faulted Abu Roach complex which offers a few prominent topographical or geologic features. Figure 3-7 shows major faults in the area, the majority of these faults are steep normal faults and most have a long history of growth.

Figure 3-7: Major faults in the area (Said, 1990)



The most famous fault in the area is the Abu Roash fold which owes its origin to compressional movement which affected the area during the late Cretaceous-early Tertiary tectonic event, this fold have a northeast-southwest trend.

3.5.3.2 Seismicity

Seismicity in the area is characterized by the occurrence of small, moderate and large earthquakes which has increased in recent years but they are limited within the crust, only micro-earthquakes were frequently observed. Figure 3-8 shows the intensity distribution of earthquakes in Egypt, and Figure 3-9 shows epicenters of recent medium to large earthquakes (A) and the epicenter of small earthquakes.

Figure 3-8: Intensity distribution of earthquakes in Egypt

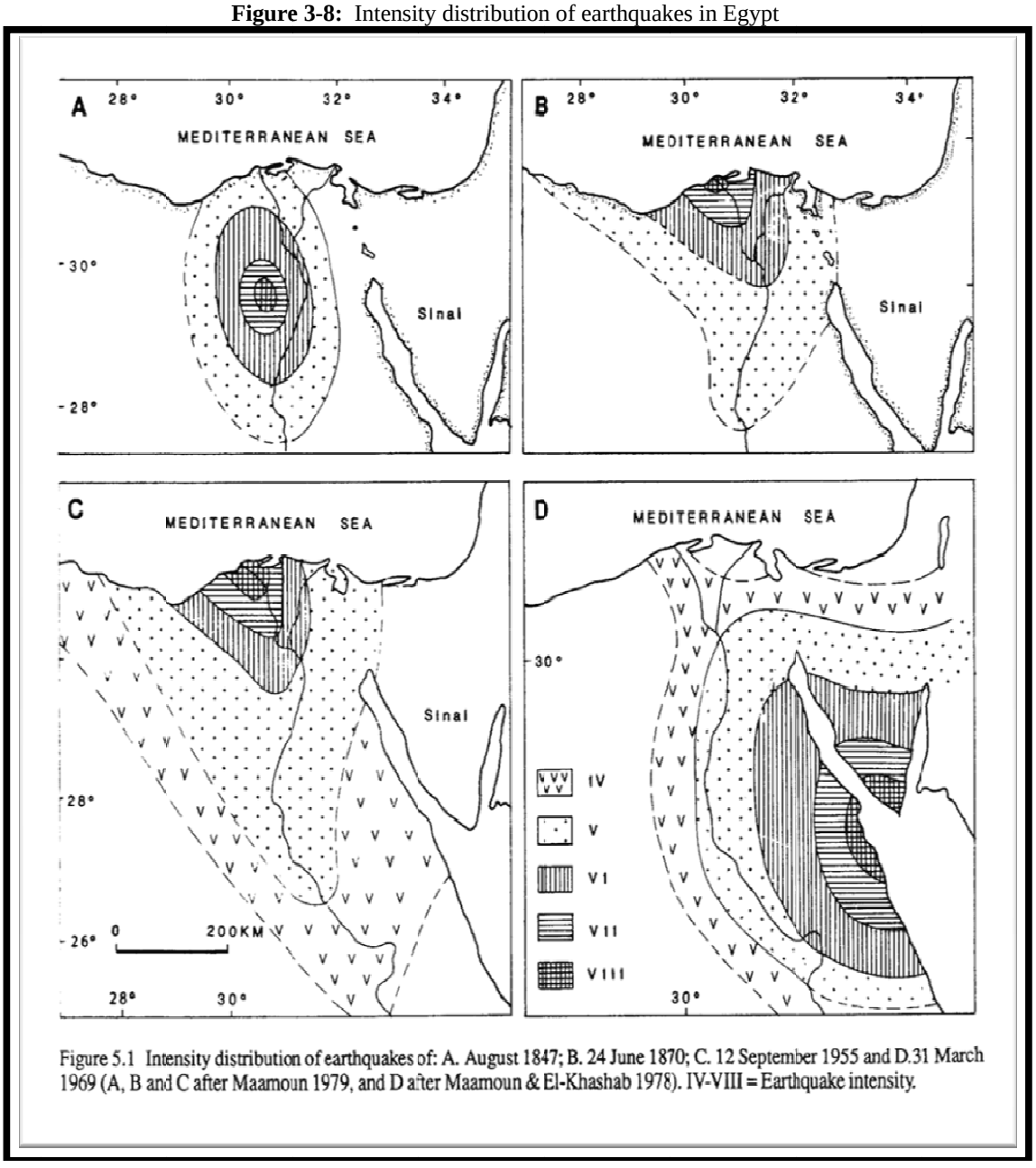


Figure 5.1 Intensity distribution of earthquakes of: A. August 1847; B. 24 June 1870; C. 12 September 1955 and D.31 March 1969 (A, B and C after Maamoun 1979, and D after Maamoun & El-Khashab 1978). IV-VIII = Earthquake intensity.

Figure 3-9 A shows the locations of earthquakes recording stations in the delta area. Figure 3-9 B shows the epicenter of Earthquakes recorded throughout the geologic history which range from large earthquakes in old geologic time to low earthquakes intensity at present time. Recently no earthquakes even of low intensity were recorded throughout the pathway of the pipeline.

Figure 3-9 A, B: Earthquakes throughout the geologic history (Said, 1992)

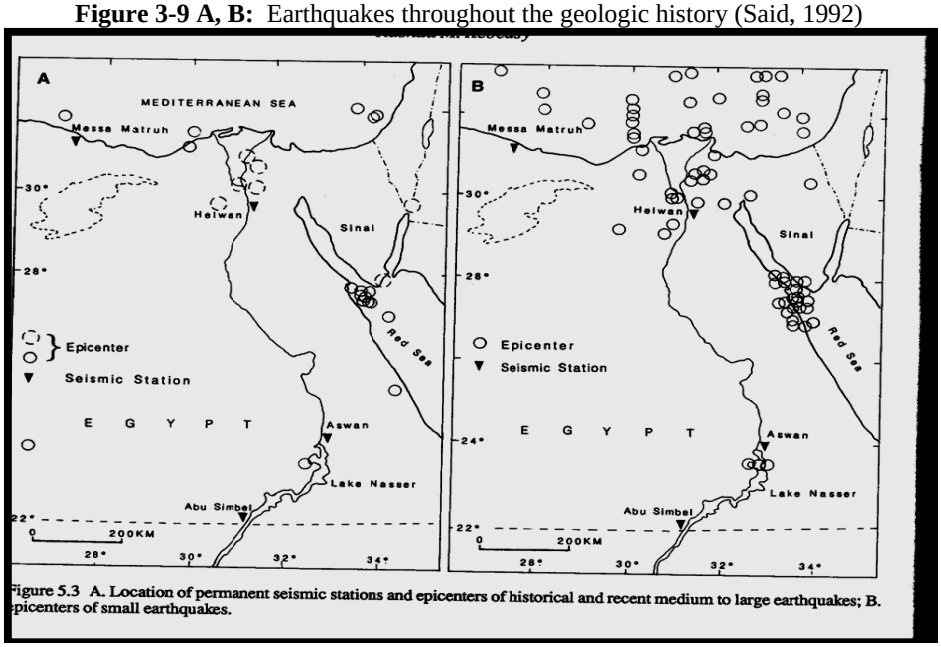


Figure 5.3 A. Location of permanent seismic stations and epicenters of historical and recent medium to large earthquakes; B. Epicenters of small earthquakes.

The region has faced a number of earthquakes in recent geologic history. The following is a brief description of recorded major earthquakes:

- In 1847, an earthquakes of magnitude 8 degree was felt, 100 dead, thousands injured and thousands of houses were destroyed.
- In 1870, very wide earthquakes, was felt all over Egypt, Greece, Turkey and Palestine, and has a magnitude of 6 degree.
- In 1955 several earthquakes occurred and were strongly felt all over Egypt of magnitude ranging between 6-7 degree.
- In 1969, another earthquake of magnitude 6.3.
- In 1974, and 1984, small earthquakes of magnitude 4.5 were felt in Cairo.
- In 1992 moderate earthquake, 5.8 degree but caused large damage in greater Cairo.

3.6 Groundwater

In greater Cairo, the coarse massive sand and gravel Unit, belonging to the late Pleistocene is considered the main aquifer system with a maximum thickness of about 70 m and occupies almost all the area of the flood plain and parts of the adjacent elevated plains. The groundwater exists under semi-confined condition as well as phereatic condition.

3.6.1 Groundwater Hydrology

The pathway of the pipeline runs through Nile Delta Aquifer which consist the main aquifer (Semi-Confined aquifer) in the area, consists of Pleistocene graded sands and gravels, changing to fine sand and clayey facies in the northern part and is overlain by Holocene silty and sandy clay. The thickness of the semi confined layer ranges between 0

to 20 m and occupies almost all the area of the flood plain and a parts of the adjacent elevated plains. The groundwater exists under semi-confined condition as well as phereatic condition. The saturated thickness of the aquifer ranges between 0 to 800 m , the permeability ranges between 35 and 75 m/day, and transmissivity range between 500 to 25000 m^2/day. Figure 3-10 shows the Hydrogeologic features of the line (RIGW, 1992) and figure 10 represent the legend of the map.

Figure 3-10: Hydrogeologic map of the area (RIGW, 1992)

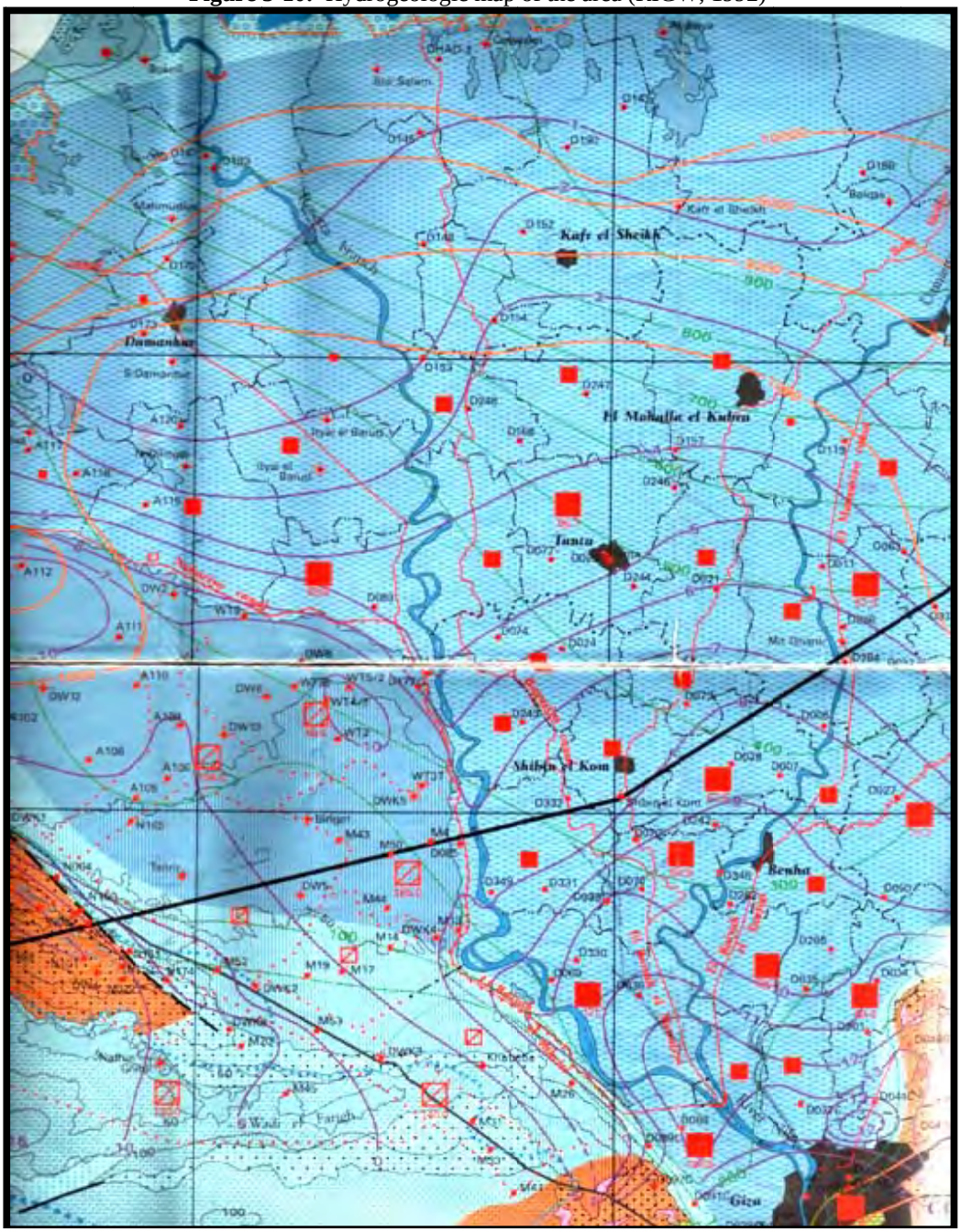
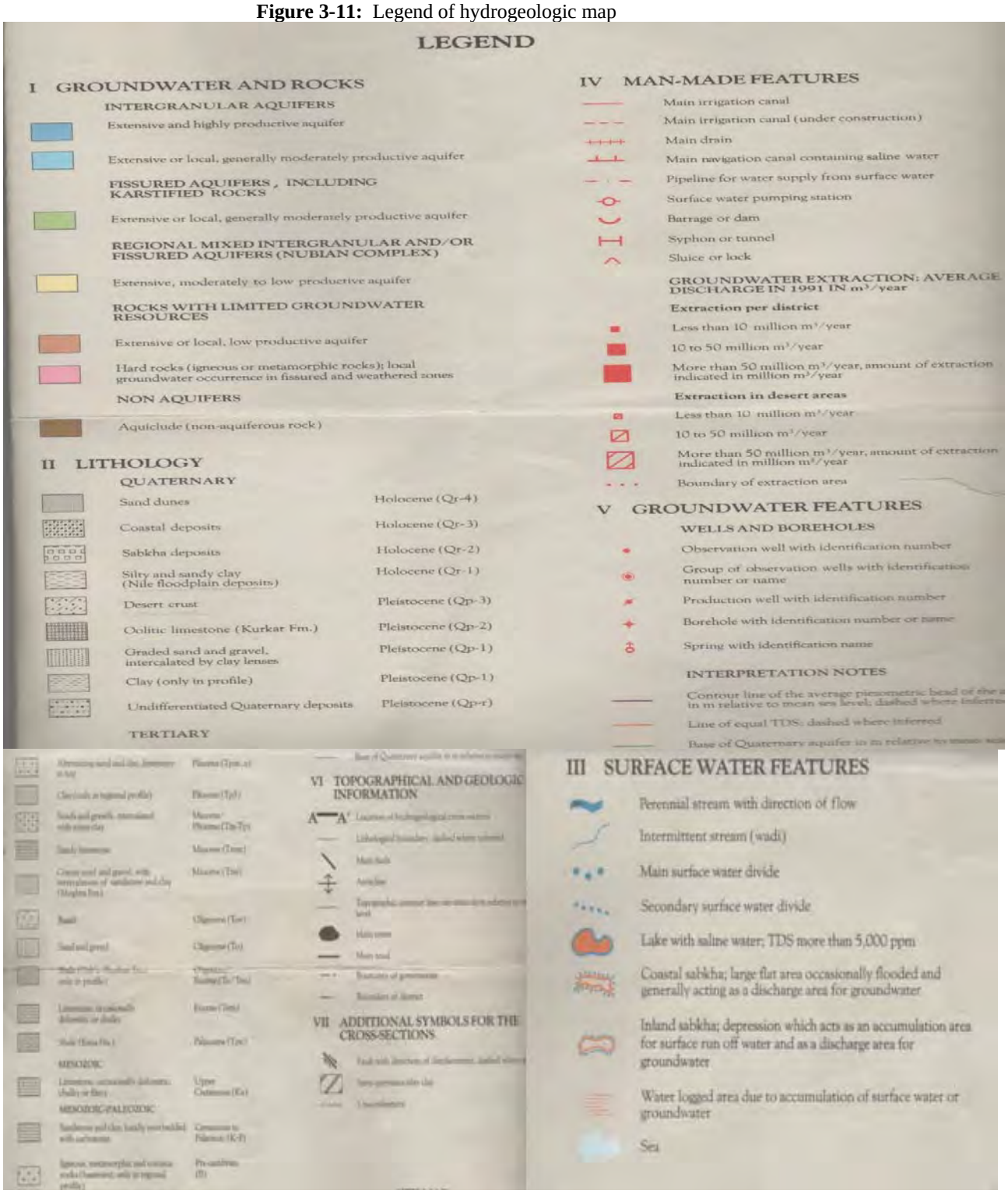


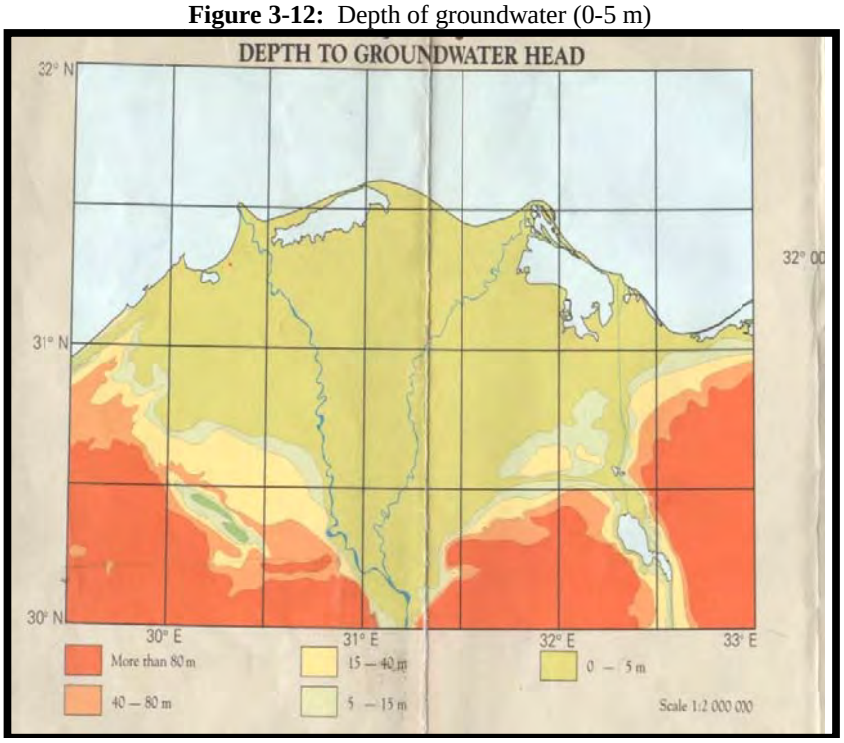
Figure 3-11: Legend of hydrogeologic map



3.6.2 Groundwater Flow

Groundwater flow has been observed by the Research Institute of Ground Water (RIGW) since 1950, so a large amount of data is available. It was observed that the piezometric level decreased gradually from more than 15 m+msl in the southern portion to >5 m+msl in the north as shown in Figure 3-12. The average piezometric gradient is about 11 cm/km. Groundwater flow direction is by definition perpendicular to the piezometric contour lines and therefore the flow direction is from south to north.

Figure 3-12: Depth of groundwater (0-5 m)



3.6.3 Hydraulic Parameters:

The hydraulic parameters of the groundwater aquifer are as follows

- Vertical permeability of the top layer varies from 35 to 75 m/day
- Aquifer Hydraulic conductivity varies from 50 to 70 m/day.
- Transmissivity varies from 5000 to 25000 m2/day, and,
- Aquifer Storativity varies from 0.0005 to 0.01.

3.6.4 Recharge and Discharge:

Recharge sources are:

- Seepage from the river and main canals
- Deep percolation from irrigation of cultivated lands
- Seepage from drinking water supply networks
- Infiltration/seepage from the sewage trenches.

Discharge occurs as:

- Groundwater return-flow to the Nile.
- Interception by sewage system.
- Groundwater extraction.

3.6.5 Hydrochemistry

Many authors, institutes and researchers studied the groundwater quality of the area for the purpose of different projects and/or studies, however, the groundwater quality could be summarized in the following main points:

- Groundwater type is bicarbonates, indicating that the source of recharge is surface water.
- Sodium Chloride and Sodium Sulfate are also present in the deep aquifer which may indicate fossil water and/or recharge from domestic sources.
- TDS generally range between 1000 and 2000 ppm.

3.6.6 Groundwater Fluctuation and Rising Problems

Groundwater table in most of Greater Cairo regions ranges between 1-5 meters in most areas. Many places suffer from the problem of groundwater rising especially along the eastern bank of the river Nile. In the old Cairo district the increase of groundwater varies between 1 – 3 m during the last 20 years due to absence of groundwater extraction, in the north western part of greater Cairo a decrease in groundwater heads occurs in the range of 1.75 - 2 m due to due to the extension in building area, also in the south western portion of Greater Cairo a decrease in groundwater of about 0.7 m due to the excess of groundwater extraction for drinking purposes.

3.7 Surface Water

River Nile passes through central Egypt, before it reaches the Nile Barrage north of Greater Cairo, where it starts branching to Dammietta Branch and Rosetta Branch forming the Nile Delta. Besides the River Nile, the Ismaileya Canal is a major freshwater canal that supplies Suez Canal cities and passes through Greater Cairo. The Canal starts in Greater Cairo at Shobra district (north of Cairo) and passes through Shobra, Matareya, and Mostorod districts before it continue to the east.

There are many irrigation canals which penetrate Greater Cairo, especially at Giza Governorate, such as Zenine Drain, Mariouteya Canal and Mansoureya Canal passing through El Haram, Saft El Laban, and Embaba districts. Water quality in the three latter water courses are relatively lower than corresponding quality of River Nile and Ismaileya Canal, at its upstream reaches in Greater Cairo. They receive effluents from two major sewage treatment facilities (Zenine and Abou Rawash) in addition to receiving solid wastes from urban areas overlooking theses water courses.

3.8 Flora and Fauna

3.8.1 Flora

The following habitats can be distinguished along the pipeline route:

- Farmland (field plots and orchards)
- Hydrophytic and Canal banks Habitats
- Roadsides habitats

3.8.1.1 Farmland

Fruit trees grown in orchards included mango, date palms, olives, oranges, poems, grapes, and guava. The field plots were cultivated by winter crops; wheat, broad beans and clover, as well as vegetables including tomatoes and onion. The summer crops are maize and melons. Most common winter weeds included *Bidens pilosa, Stellaria palida, Chenopodium murale Brassica nigra, Vicia stativa, Urtica urens, Euphorbia peplus, Melilotus indicus, Emex spinosa,* etc. Summer weeds included *Portulaca oleracea, Echinochlod colona, Cyperus rotundus, Amaranths viridis,* etc. All year weeds were represented by *Cynodon dactylon, Convolvlus arvensis, Plantago majo,r Solanum nigrum, Dichanthium annulatum* etc.

Figure 3-13: Orchard field showing dense growth of *Bidens pilosa* and *Euphorbia prostratea*

Figure 3-14: Mango *(Mangifera indica)* growing in the site of the project

3.8.1.2 Hydrophytic and Canal bank Habitats

Irrigation water flows rapidly in the major irrigation canals and branches of the Nile where submerged and floating water plants were formed close to the banks of these canals. e.g. *potamogeton nodosun, ceratophyllum demersum* and water hyacinth, *Eichhornia crassipes.* The muddy and moist banks of the Nile and irrigation canals support the growth of populations of hydrophilic species including tall reeds, shrubs, undershrubs or herbs.

Zahran and Willis (1992- 333- 34), categorized the plants of the canal banks habitat into: Bank retainers, aggressive species and soil (sand) controllers.

The bank retainers are plants having bankholding qualities to the fact that their roots bind the soil, they shade other species which may be harmful. Bank retainers include trees such as *Acaia nilotica, Ficus sycomorus, Salix subserrata, Tamarix nilotica, and Ziziphus*

spina – christi or undershrubs such as *Alhagi graecorum, Chenopodium ambrosides* or *Pluchea dioscorides.*

Aggressive species are those who make such rapid or robust growth that they prevent many smaller or slow growing plants from establishment. To this category belongs herbaceous species, e.g. *Cyperus laevigatus, Trifolium resupinatum or phyla nodiflora* which form mats that soon cover patches of bare soil; or tall reeds including *Arundo donax, cyperus alopecuroides, C. articulatus or Saccharum spontaneum.*

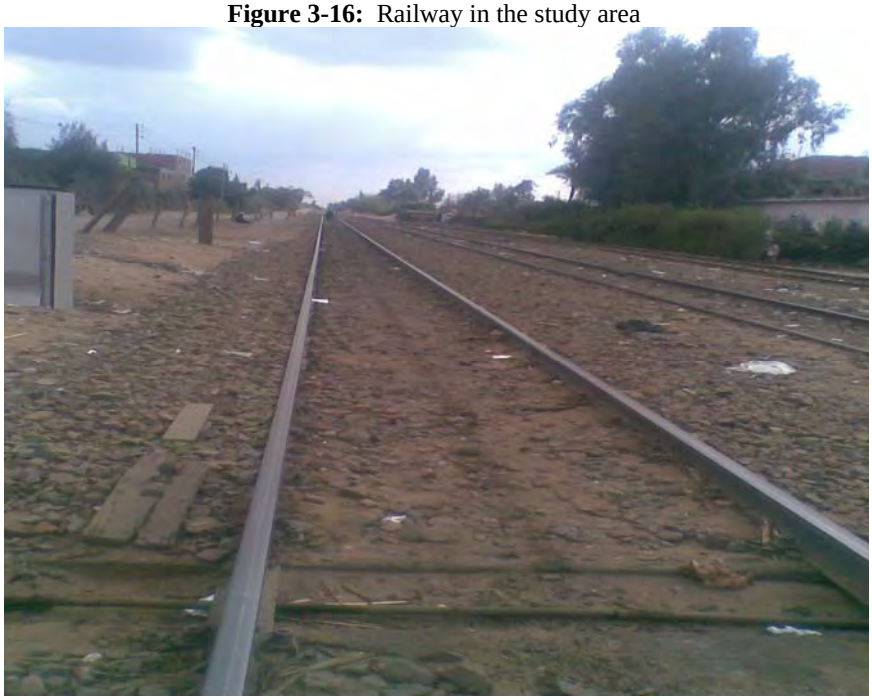
Soil and controllers are plants that can tolerate or at least partly stabilize drift sand. Wind-break or fence plants belonging to this category include the cultivated trees*: Casuarina cunninghamiana, Eucalyptus camaldulensis, Dalbergia sisso or salix babylonica.*

Figure 3-15: EL Rayah EL Behieri, the main irrigation canal showing canal bank vegetation

3.8.1.3 Roadsides

This included unpaved roads, and motorways, which cut through the cultivated land. Among the plant communities recognized along the roadsides are dominated by *phragmitis austrails, Imprata cylindrica, Desmostachya bipinnata* and *Alhagi graecorum*

Figure 3-16: Railway in the study area



3.8.1.4 Rare and Endangered Species

The landfill site is not listened under law 102-1983 as a Protected Area, and of the high number of species observed and recorded at the project site these is no globally or locally threatened or endangered species.

3.8.2 Fauna

The main habitat that represents the majority of all crossed areas by the pipeline pathway is the artificial-terrestrial habitats including arable land, plantations, rural gardens, cultivated agricultural lands and urban areas. Other habitats such as wetlands which represented by the main two branches of the River Nile as well as other Nile branches and irrigation canals are well represented, also inhabited areas, asphalt roads and railways are represented. These habitats can be categorized under two broad ecosystems one being the artificial-terrestrial, and the other is the aquatic (lotic) ecosystem of the River Nile.

The following narrative is for the recorded species from the ecosystems that planned to be crossed by the pipeline pathway either from the most recent literature about the fauna of Egypt and/or the already recorded during the field visits of the conducted study. The pipeline pathway crosses the previously mentioned ecosystems which provide habitats for several species of vertebrate fauna, also for several of other invertebrate species, such as snails, worms, ants, Dragon flies, Damselflies, spiders, beetles and other insects. One common invertebrate species were recorded form the exact pipeline-route during the study is the Vagrant Emperor *Anax ephippiger*. The River Nile represents the aquatic (freshwater) ecosystem with many fish species such as *Tilapia zilli, Oreohromis niloticus*

and *Clarias gariepinus* in addition to other native invertebrates such as *Valvata nilotica* or invasive species such as the crayfish *Procambarus clarkia.*

According to the most recent published literature about the herpetofauna of Egypt (Baha El Din S., 2006), potentially occurred reptiles and amphibians (up to 53 species in some areas) are prominent components of the ecosystems that would be crossed by the pipeline pathway. The highest concentration and greatest species richness is near the margins of Delta with number of recorded species ranges from 32 to 53 species and this is a considerable proportion of the total herpetofauna of Egypt (112 species). Characteristic species of these habitats are *Bufo regularis, Ptychdena mascarenensis, Natrix tessellate, Chamaeleo africanus, psammophis sibilans, Malpolon monspessulanu*s, *Hemidactylus tursicus, Tarentola annularis, Trachylepis quenquetaeniata* and *Naja haje*. No records for any species form the exact pipeline-route during the study.

There are many bird species potentially occurred in the ecosystems that planned to be crossed by the pipeline pathway. The majority of these birds are common species, also the pipeline pathway doesn't occur in any of the 34 IBAs (Important Bird Areas) of Egypt. All recorded bird species during the study are common ones; except one uncommon record for the Great Cormorant *Phalacrocorax carbo* and one fairly common record Little Bittern *Ixobrychus minutus*, see the following tables. No records for any nesting sites for any species form the exact pipeline-route during the study.

STATUS		**RELATIVE ABUNDANCE (RA)**	
RB	**Resident Breeder**	**C**	**Common**
IB	**Introduced Breeder**	**F**	**Fairly Common**
MB	**Migrant Breeder**	**UC**	**Uncommon**
WV	**Winter Visitor**	**R**	**Rare**
PV	**Passage Visitor**		
V	**Vagrant**		

Table 3-3: Bird species in project area

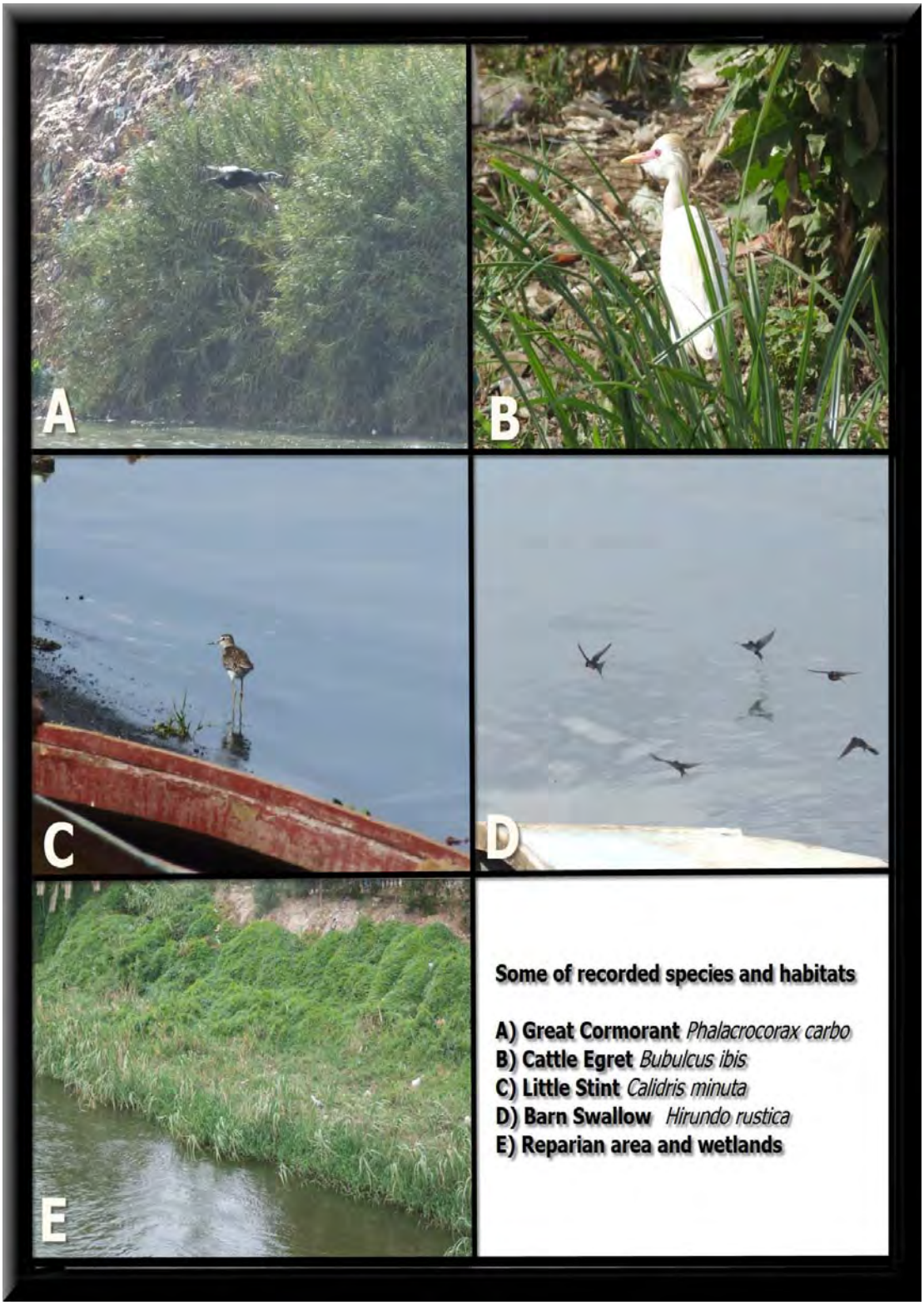
Common Name	Scientific Name	Arabic name	Status	RA
Barn Swallow	*Hirundo rustica*	عصفور الجنة	RB, PV,WV	C
Cattle Egret	*Bubulcus ibis*	أبوقردان	RB,PV,WV	C
Common Bulbul	*Pycnonotus barbatus*	بلبل	RB	C
Common Chiffchaff	*Phylloscopus collybita*	سكسكة	PV, WV	C
Common Moorhen	*Gallinula chloropus*	دجاجة الماء	RB, PV,WV	C
Eurasian Hoopoe	*Upupa epops*	هدهد	RB, PV	C
Graceful Prinia	*Prinia gracilis*	فصية	RB	C
Gray Heron	*Ardea cinerea*	رمادي بلشون	PV,WV	C
Green Bee-eater	*Merops orientalis*	الخضير	RB	C
Great Cormorant	*Phalacrocorax carbo*	غراب البحر	PV, WV	UC
Hooded Crow	*Corvus cornix*	غراب بلدى	RB	C
House Sparrow	*Passer domesticus*	عصفور دورى	RB	C
Kestrel	*Falco tinnunculus*	الجراد صقر	RB, PV,WV	C

Little Bittern	*Ixobrychus minutus*	واق صغير	RB,PV,WV	FC
Little Egret	*Egretta garzetta*	أبيض بلشون	RB, PV,WV	C
Little Stint	*Calidris minuta*	فطيرة	PV, WV	C
Palm Dove	*Streptopelia senegalensis*	يمام مصري	RB	C
Pied Kingfisher	*Ceryle rudis*	صياد السمك الأبقع	RB	C
Spur-winged Plover	*Vanellus spinosus*	زقزاق بلدى	RB, PV,WV	C
Squacco Heron	*Ardeola ralloides*	واق أبيض	RB,PV,WV	C
White-throated Kingfisher	*Halcyon smyreninsis*	قاوند	BR	C
White Wagtail	*Motacilla alba*	أبوفصادة أبيض	PV, WV	C
Yellow Wagtail	*Motacilla Flava*	أبوفصادة أصفر	PV, WV	C

About 23 mammalian species (a considerable proportion of the total mammalian fauna of Egypt - 110 species) that potentially occurred in the investigated ecosystems based on the most recent published literature, (Basuony M.I. et al, 2010). There are some important mammals that existing in these ecosystems such as the endemic Swamp Cat *Felis chaus nilotica*. Despite of potentiality of occurrence of this endemic species in these ecosystems *Felis chaus nilotica* recorded as common species and LC, Least Concern according to IUCN (International Union for Conservation of Nature) criteria and categories. No recorded species form the exact pipeline-route during the study.

Figure 3-17: view from North Giza Station - A) The railways, B) River Nile branch and C) Asphalt road

Figure 3-18: Recorded species in project area


A
B
C
D
E
Some of recorded species and habitats
A) Great Cormorant Phalacrocorax carbo
B) Cattle Egret Bubulcus ibis
C) Little Stint Calidris minuta
D) Barn Swallow Hirundo rustica
E) Reparian area and wetlands

4. Project Description

The proposed project is as an integral part of the country's energy strategy which calls for greater use of natural gas. This initiative will contribute to achieving the government plan for extending natural gas usage and supporting the national gas grid.

The planned pipeline is a 32" diameter, 105 km long pipeline to transport natural gas from the Nubaria power station to a Pressure Reduction Station (PRS) at the North Giza power station, and continuing to join the Metnama pipeline. The following section will detail the pipeline components, work plan, construction activities, and the patrolling philosophy of the pipeline.

4.1 Pipeline Components

4.1.1 Pipeline Route

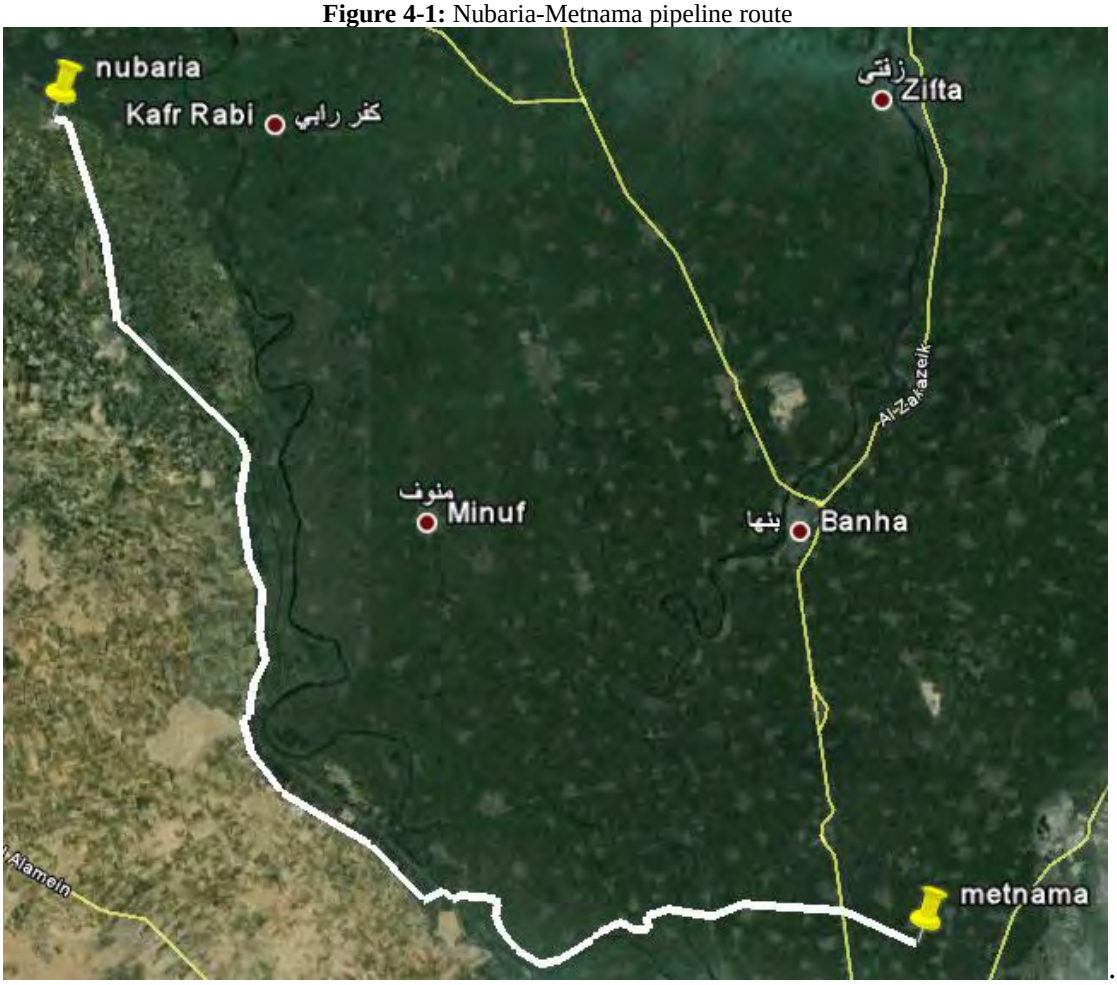
The Nubaria-Metnama gas pipeline starts from the valve room at the end of the Abu Homos-El Nubaria 42"-diameter gas pipeline, near Nubaria Electrical Power Station. Then the pipeline continues south, parallel to El Rayh El Nasry, for approximately 62 km. During the first 45 km, the pipeline runs parallel to EL Rayh EL Nasry. For the last 17 km, the pipeline runs parallel to El Katatba-Borkoash asphalt road (this road is also parallel to El Rayh El Nasry), then runs east to cut across El Rayh El Nasry and the railway and El Rayh El Bahery until the turnoff to North Giza Electrical Power Station.

The pipeline then starts again from the turnoff of North Giza Electrical Power Station and continues east through north part of El Ata City. The pipeline then cuts through the Nile River (Rashed Branch) and continues parallel to the river for about 14 km. Then the pipeline cuts through El Rayh El Monofy and continues through the Nile Delta heading east until it reaches the existing Tena-Metnama pipeline in an area called Nawa or Ezbet Swelem.

The major features that the proposed pipeline route must cross are as follows:

- El Rayah El Nasry conduit
- El Rayah El Nasry Railway
- El Rayah El Bahry
- Nile River (Rashid Branch)
- El Rayah El Monofy Conduit
- Sheben El Kom Railway
- Nile River (Damieta Branch)
- El Rayah El Tawfeky Conduit
- El Basosya Conduit
- Cairo Alexandria Agriculture Road
- Cairo Alexandria Railway
- Sheben El Kantar Road and Railway

Figure 4-1: Nubaria-Metnama pipeline route



4.1.2 Valve Room Locations

Eleven (11) valve rooms will be constructed along the pipeline, in the following locations:

- valve room (1) at zero km (Nubaria power station)
- valve room (2) at 13 km
- valve room (3) at 21 km
- valve room (4) at 29 km
- valve room (5) at 37 km
- valve room (6) at 45 km
- valve room (7) at 61 km
- valve room (8) at 74 km
- valve room (9) at 85.2 km
- valve room (10) at 93.5 km
- valve room (11) at 105 km

Valve room dimensions are 25m x 45m.

4.1.3 Pressure Reduction Station

The PRS is present inside the North Giza Power Station. Its main function is to deliver 425,000 m^3/hour, at an output pressure of 27 bar and an output temperature of 7° C. The station consists of 3 filtering lines (to clean the gas from any particles), 5 reduction lines (to reduce the gas pressure to the desired value), and 3 measurement lines. Additionally 3 heaters will be used.

4.2 Design Gas Composition and Flow Rate

The main stream of natural gas will come from the national network once the pipeline has been filtered. The pipeline is designed to transport the gas at a pressure of 70 bar. The compositions of the gas coming from the national network are indicated in the table below.

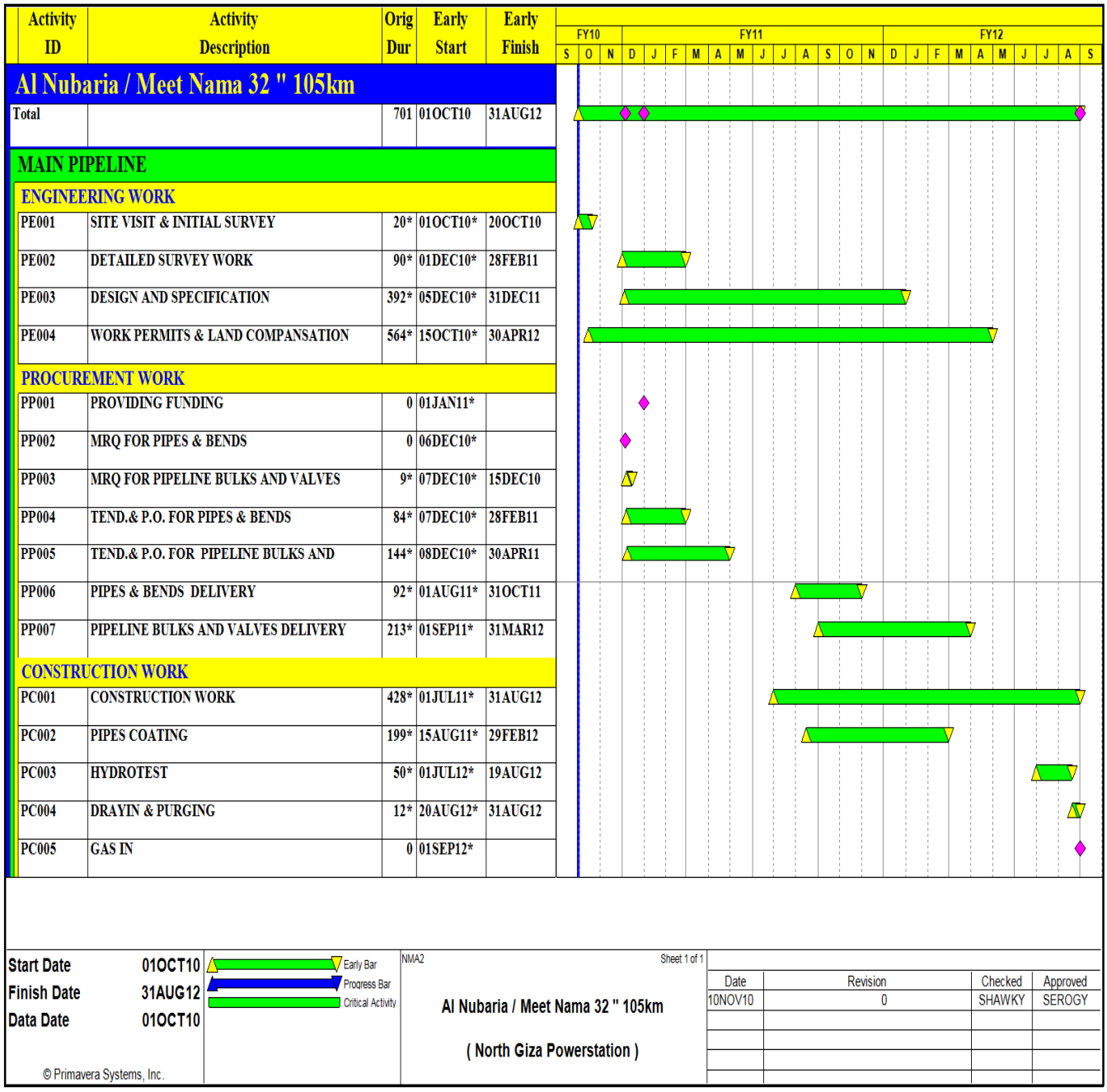
Table 4-1: National Network Gas Composition. Reference: GASCO

Contaminants		Lean Gas Composition	Rich Gas Composition
Carbon Dioxide	CO_2	0.150	3.990
Nitrogen	N_2	0.760	0.050
Oxygen	O_2	0.000	0.000
Hydrogen	H_2	0.000	0.000
Methane	CH_4	97.313	80.224
Ethane	C_2H_6	1.710	10.069
Propane	C_3H_8	0.040	3.880
iso-Butane	i-C_4.	0.020	0.570
n-Butane	n-C_4.	0.000	0.6899
iso-Pentane	i-C_5	0.000	0.2100
n-Pentane	n-C_5	0.000	0.1200
n-Hexane	n-C_6	0.000	0.1200
n-Heptane	n-C_7	0.000	0.0700
n-Octane	n-C_8	0.000	0.00
n-Nonane	n-C_9	0.000	0.000
Total		100.000	100.000
Gas delivered will be commercially free of materials and dust or other solid or liquid matter which may interfere with the operation of lines.			

4.3 Work Schedule

The time schedule for the pipeline construction is detailed in the following table:

Figure 4-2: Work Schedule. Reference: GASCO



Activity ID	Activity Description	Orig Dur	Early Start	Early Finish
Al Nubaria / Meet Nama 32 " 105km				
Total		701	01OCT10	31AUG12
MAIN PIPELINE				
ENGINEERING WORK				
PE001	SITE VISIT & INITIAL SURVEY	20*	01OCT10*	20OCT10
PE002	DETAILED SURVEY WORK	90*	01DEC10*	28FEB11
PE003	DESIGN AND SPECIFICATION	392*	05DEC10*	31DEC11
PE004	WORK PERMITS & LAND COMPANSATION	564*	15OCT10*	30APR12
PROCUREMENT WORK				
PP001	PROVIDING FUNDING	0	01JAN11*	
PP002	MRQ FOR PIPES & BENDS	0	06DEC10*	
PP003	MRQ FOR PIPELINE BULKS AND VALVES	9*	07DEC10*	15DEC10
PP004	TEND.& P.O. FOR PIPES & BENDS	84*	07DEC10*	28FEB11
PP005	TEND.& P.O. FOR PIPELINE BULKS AND	144*	08DEC10*	30APR11
PP006	PIPES & BENDS DELIVERY	92*	01AUG11*	31OCT11
PP007	PIPELINE BULKS AND VALVES DELIVERY	213*	01SEP11*	31MAR12
CONSTRUCTION WORK				
PC001	CONSTRUCTION WORK	428*	01JUL11*	31AUG12
PC002	PIPES COATING	199*	15AUG11*	29FEB12
PC003	HYDROTEST	50*	01JUL12*	19AUG12
PC004	DRAYIN & PURGING	12*	20AUG12*	31AUG12
PC005	GAS IN	0	01SEP12*	

Generally, working hours will be restricted to the daylight hours.

4.4 Equipment Used During the Construction Phase

Table 4-2: Types and Quantity of Equipment Used During Construction Phase. Reference: GASCO

	Equipment	Quantity
1	Double Cabin Car	8
2	Double Cabin Car 4*4	8
3	Pick Up	8
4	Bus (26 Persons)	20
5	Puller	4
6	Generator 200-250 K.V	6
7	Crane 50 Ton.	4
8	Side Boom D8	15
9	Pipe Welder	4
10	Pipe Carrier	2
11	Welding Machine	20
12	Low Bed	2
13	Water Tank Car	10
14	Solar Tank Car	2
15	Agriculture Excavator	12
16	Truck	2
17	Excavator	4
18	Loader	2
19	Bulldozer D8	2
20	Trailer	6
21	Compressor	5
22	Sand Plaster	5
23	Cement Mixer	4
24	Boom Excavator	4
25	Ambulance	2
26	Equipment carrier	2

4.5 Construction Activities and Methodologies

Qualified and approved contractors under the supervisions and monitoring of GASCO personnel will carry out construction. Brief descriptions of the key activities during the pre-construction and construction phases are provided in the following sections.

4.5.1 Planning and system design

Accurate maps of project areas shall be obtained in order to collect sufficient information for reaching optimum design for the system, surveying works may be carried out at few locations where maps are outdated or do not include recent developments. Routes and depths of existing underground infrastructure shall be obtained from different authorities (water lines, sewage lines, telecommunication lines, and electric cables). However, in some cases no accurate mapping is available for underground infrastructure. In such cases a trial pit shall be manually excavated to locate underground pipes.

4.5.2 Mobilization of equipment, materials, and workers

According to the approved phased implementation plan, the contractor mobilizes the required construction equipment, materials, and labor. The contractor normally occupies a location for storing materials and equipment in the project area. This location should be approved by the local authority. These storage locations shall include:

- Excavation machinery, such as trenchers, backhoe excavators, jack hammers, loaders, cranes, manual tools …etc.
- Piping materials, such as pipes, valves, elbows, coating materials
- Stockpiles of sand and filling materials
- Repair machinery, such as compaction machinery, asphalt laying, concrete mixers … etc.
- Management caravan for the site engineers and staff

4.5.3 Site preparation and excavation

Prior to excavation works, pipeline routes shall be identified and marked in the field. Excavation works start by removing the asphalt layer using either mechanical trencher or jack hammer. The mechanical trencher also removes broken asphalt and base stones layer, in case the jack hammer is used, road layers are then removed by excavator.

The road base soil, underneath asphalt and stones, is then excavated either by a backhoe excavator or by manual excavation. The advantage of manual excavation is that it reduces the risks of breaking water, sewerage, electric or telecommunication lines which are unmapped. Typically the trench for PE pipes is 0.4-0.6 meter wide, and about 1.5-meter deep, depending on pipe diameter[4]. For steel pipes the trench width is 0.6-0.8 meters with the same depth, also depending on diameter.

Excavated soils, broken asphalt and other wasted materials during excavation are then loaded to trucks, which transfer it to disposal areas. Loading waste trucks shall be done upon excavation, whenever possible, in order to avoid stockpiling waste on site.

In some cases, where groundwater table is shallow, the trench should be dewatered before pipe lying. Dewatering pumps discharge sucked water into a drain or sewer manhole, according to area circumstances.

4.5.4 Pipe Storage

The project management selected the needed sites for storing the pipes and other installations in an area selected carefully for such purpose. The Contractor will pay great attention in adapting appropriate procedures (approved by GASCO) during transporting, handling, and stacking pipes and installations to ensure that no damage whatsoever results to the pipe or coating.

[4] These should be 1 meter sand cover above the pipe

Piping material must be stored by type, size and material specification. Materials will be supplied color marked, to differentiate types/services of materials. Care must be taken to select and utilize special material such as that manufactured to NACE Std., ASME code and alloys for their required services only. Materials must be checked for their color-coding. For protection of all piping materials, when stored outdoors they shall be supported off the ground.

4.5.5 Foundations Structural Work or Civil Work

At this stage, the site is ready for the commencement of starting the construction of the plant structure. Through the construction of the various components of the plant structure a lot but similar activities take place which follow the pattern for the preparation for pouring concrete. The pattern is as follow:

- Concrete shuttering: which involves the use of shuttering materials mainly plywood for forming the required shape and size of the component being constructed.
- Reinforced steel preparation: which involves the sizing , cutting, and shaping of the reinforced steel bars to the required shapes and sizes, as well as the laying of these bars in the shuttering a specified in the structural design.
- Concrete pouring inside the formed shuttering (form work) so as to form the required skeleton of the structure. This is done through the use of a concrete batch plant which mixes the concrete components (cement, gravel, sand, and water) internally in batch amounts which is then transported to pouring site through the aid of concrete trans-mixers and poured through the use of concrete pumps and cranes.
- The installations of the concrete works subject to exposure with the surrounding ground water table.

Aggregates with different sizes and with an estimated sum total of 10,000 m^3 for the use with different types of a concrete mixes to yield different required concrete strengths.

4.5.6 Trenching Lowering and Laying

A trench will be dug from the running track to allow the pipeline to be buried. The width of the trench will be the width of the pipe plus 0.4 m. Sub-soil from the trench will be stored in loose piles on the opposite side of the working width to prevent mixing with top soil. The minimum cover on top of the pipeline will be 1.5 m. The bottom of the trench will be uniformly graded and covered with sieved sand to prevent any damage to the pipe coating. The pipeline trench will be a minimum of 2 m from any existing pipeline. The trench will be left open for as short a time as possible before the pipeline is lowered into the trench.

During the excavation works, some welding works are taking place above-ground. Once the trench is excavated, the available pipe stretch shall be laid down. The pipeline will be lowered into the trench using wide, non-abrasive belts, and care will be exercised to avoid causing damage to the pipeline coating. In marshy areas, negative buoyancy will be

created using a concrete coating. Warning tapes will be installed 30 cm below ground level. Remaining welding works then take place, to connect the laid pipe with the previous stretch.

The buried metallic structures (pipelines, valves) are coated and cathodically protected according to BS, 739, part 1.

4.5.7 Backfilling

The trench will be backfilled with layers of the original stored sub-soil. Once the trench is filled, the reinstatement of the whole working width begins. This involves ripping the sub-soil to rectify any compaction that may have occurred during construction and grading to the original contours. Topsoil will then be replaced across the working width to its original depth, will be graded carefully, and clean up operations will need to be completed within one week of backfilling.

4.5.8 Welding and Weld Inspection

The following welding processes are acceptable:

- Shielded Metal Arc Welding (SMAW)
- Gas Tungsten Arc Welding (GTAW)
- Gas Metal Arc Welding (GMAW)
- Flux Cored Arc Welding (FCAW)
- Submerged Arc Welding (SAW)
  (Automatic or Semi-automatic)

All welding and tacking must be performed by welders who are currently qualified to applicable codes, and to specific variables and materials of the procedure. Welders and welding operators must be currently qualified as required by the applicable ANST/ASME Code.

The procedure for welding must conform to the current applicable ASME Code. ASME Section IX forms QW-482 and QW-483 or their equivalent must be used.

The following weld inspection methods are applicable:

a) Non destructive tests
   - Radiographic test (R.T. 100%)
   - Ultrasonic test (U.T. 10%)
   - Die penetrate test for weld let, sweepolet and nippolet (½", 1")

b) Destructive tests (Mechanical Test)
   - Tensile test
   - Bending test
   - Macro etching test
   - Impact test
   - Nick break test
   - Hardness test

Every 200-weld joint we made this test (0.5% of all welds) in the laboratory of the faculty of engineering.

4.5.9 Valves and Tie-ins

- Valves requiring frequent operation, and located more than 2 meters (6 feet - 9 inches) above the operating level require extension stems
- Valves should not be installed with stems below the horizontal position, unless otherwise approved by Client.
- Impact type hand wheels or handles may be installed on extended stems if the stem is independently.

4.5.10 Pipe Cleaning

- Materials - Cleaning solutions used shall be compatible with piping materials, valve trim, gaskets, and all other components in the piping. Chemical cleaning shall not exceed 0.2 mils metal penetration. Solutions and water used for detergent flushing of stainless steel piping shall not exceed 50-PPM chloride content.
- Acceptance - The cleaning contractor shall make a record of all lines cleaned. For carbon, steel piping the record shall include the degreasing, pickling, and end of cleaning examinations and type of passivator used. For stainless steel, piping the record shall include the degreasing and end of cleaning examinations.
- Drying - The cleaning contractor shall drain and dry the cleaned piping. Carbon steel shall be dried to -40 degree F dew point Stainless steel shall be blown out with dry air.
- Rust Prevention - The cleaning contractor shall apply a rust preventative on the internal surface of cleaned carbon steel piping immediately after drying. Lube oil and seal oil piping shall be coated with a rust preventative approved by the equipment manufacturer

4.5.11 Disposal of Chemicals

All chemical streams, rinses and drains shall be contained or shall be collected in suitable vats or tanks. No streams shall be allowed to drain upon the ground. Approval must be obtained prior to start draining any material to an existing sewer system.

4.5.12 Special Crossings

Vertical excavation described in could not be practiced when the natural gas line intersects with a waterway, a railway or a major road. When applicable, a special crossing for such obstacles has to be made. Waterways and roadways will be crossed using the Horizontal Directional Drilling (HDD) technique, described in Section 4.6.12.1. Other special crossings may be made using suitable techniques such as Tunnel Boring

Machines (TBM) and micro tunneling. Critical crossings of waterways, railways, and main roads along the route are indicated in Section 4.2.1.

In special crossings, the line starts gradual descending below the obstacle by enough horizontal distance to avoid steep connections. This allows easier access for repairing different parts of the line.

Excavation waste management shall be practiced in a similar way described in Section 4.6.3. However, crossing waterways shall result on relatively large amounts of water discharge out of the tunnel, which makes it necessary to preplan for drainage works.

Sometimes special crossings are done through existing bridges, which will only require fixing the line on the existing bridge.

4.5.12.1 Horizontal Direction Drilling

Crossing of water bodies and main canals, as well as large roads and railways shall not be done by the traditional open-cut method. It shall be done using a new technology named Horizontal Directional Drilling (HDD). HDD is a trenchless methodology that provides an installation alternative that can offer a number of benefits over traditional open-cut. HDD can be implemented with very little disruption to surface activities, requires less working space, and may be performed more quickly than open-cut methods. Also, it can simplify or eliminate certain permitting processes. This type of installation which was applied in municipal underground infrastructure systems and petroleum products pipelines has seen a dramatic increase in recent years. Although there are currently no national standards regarding HDD installations for any pipe material, HDD pipeline installations are becoming more and more common and may be the fastest growing trenchless construction method today. They can be used to install new pipelines or replace existing ones. The technique stages outlined and illustrated below.

Stage 1

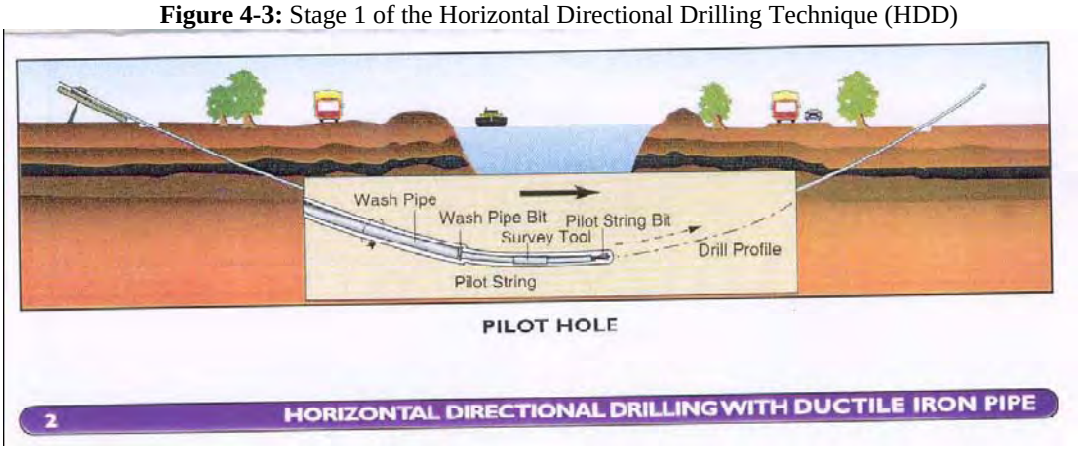
The drilling rig and its associated equipment is set up and positioned on one side of the crossing. The carriage framework is inclined to the desired entry angle, which can be between 5° and 30°. Typically the entry angle is set between 10° and 14° to the horizontal. An 80mm dia. pilot hole is drilled using either a mud motor or a jet bit, attached to 73mm dia. pilot drill pipe. The steering mechanism is provided by means of a small bend or bent sub, usually less than 1° and situated behind the drill. Changes in direction are achieved by partial rotations of the bent sub, as the pilot string proceeds forward. Figure 4-3 gives a detail of the downhole drilling assemblies with mud motor and jet bit. The progress of the pilot hole is monitored by a directional survey steering tool package. A survey probe is positioned just behind the drill head, which is linked by a hard wire up the center of the drill pipe to a computer and printer located in the control cab. The probe contains fluxgates and transducers which measure data in a three-dimensional plan by vector measurement, enabling the course of the pilot hole to be plotted joint by joint. Continuous read outs give the following information:

- Inclination relative to the vertical plane.

- Direction of hole relative to magnetic north, and.
- The orientation of the steering mechanism or bent sub relative to the high side of the hole.

The drilled distance is measured at the drilling rig by physically monitoring the down hole pipe lengths. The readily available survey information, combined with the ability to steer and drill, allow the pilot hole to be drilled along the planned profile. Progress or drilling speed depends on the suitability of the drilling medium. As the pilot hole progresses the frictional force gradually increases on the 73mm dia. Pilot string and it then becomes necessary to wash-over the pilot string with 127mm dia. wash pipe. The front of the wash pipe is fitted with a cutting bit, typically 300mm dia., and fitted with round 20 kenna metal cutting teeth. Unlike the pilot string, the entire wash pipe rotates in moving forward. In addition to reducing frictional forces the wash-over pipe increases the diameter of the drilled hole. It also serves to smooth the curve and to eliminate any irregularities which may have occurred by use of the steering mechanism.

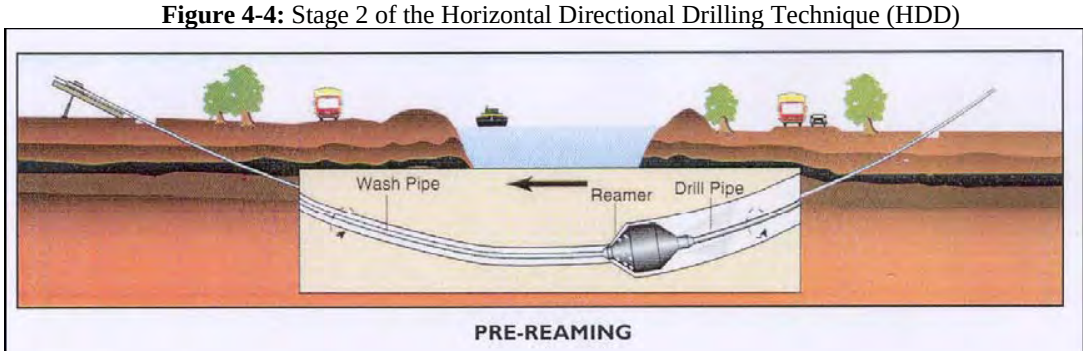
Figure 4-3: Stage 1 of the Horizontal Directional Drilling Technique (HDD)



Stage 2

Drilling progresses with alternate drilling of pilot drill pipe followed by wash-pipe. The distance between the wash-over pipe cutting bit and the pilot drill bit will be in the range of 25.0 m to 80.0 m. It is not advisable to have wash-over pipe closer than 25.0 m as the proximity may adversely affect the accuracy of the survey tool. Alternate drilling continues until both the pilot string and wash-over pipe exit in the target area. The pilot string is now removed from the system by pulling back to the drill rig, leaving the wash pipe in places as a drawstring for the pre-ream operation. For the pre-ream operation a barrel reamer, fitted with jets and cutting teeth, is attached to the end of the wash pipe. The diameter of the pipe to be installed dictates the diameter of the barred reamer. Typically the diameter of the chosen reamer will be twice the diameter of the pipe to be installed. The barred reamer is rotated along the drilled path enlarging the formed annulus. As the reamer is pulled back, additional lengths of 127mm drill pipe are added on behind, to ensure that a complete drill string remains in the hole for the next operation.

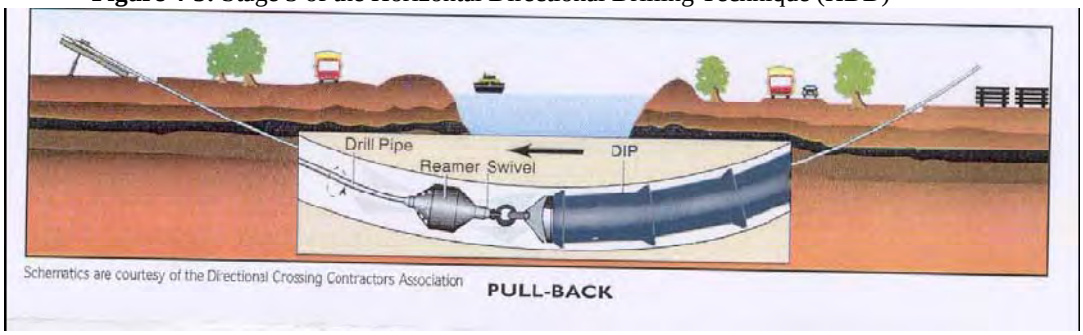
Figure 4-4: Stage 2 of the Horizontal Directional Drilling Technique (HDD)



Stage 3

Either before or during the drilling operation, the pipeline has been fabricated on the target side of the crossing. On completion of hydrostatic testing, the pipeline fabrication is raised onto conveyors. A pulling head is welded onto the front end of the fabrication. The reamer is then transported to the target area, i.e. the opposite side of the crossing. On completion of the pre-ream operation, the reamer is disconnected. The assembly for the pipeline insertion consists of the barrel reamer, followed by a universal joint, and a swivel to prevent rotation of the pipeline being installed. The reamer and pull head assembly are rotated and pulled back from the drill rig using the wash-over pipe. Accordingly a further reaming of the hole takes place as the pipeline is being inserted into the reamed hole.

Figure 4-5: Stage 3 of the Horizontal Directional Drilling Technique (HDD)



4.5.12.2 Testing

After the line construction it should be tested to locate possible leaks in the line. The testing could be done either through hydrostatic testing, or through pneumatic (air/gas) testing.

The first process is normally more complicated than the second, because it needs highly efficient water drainage using the pigging process, which forcing an object through the pipe by liquid or air pressure.

4.5.12.3 Hydrostatic Testing

Water shall be clean fresh water and free from any substance, which may be harmful to pipe material. A fitter of sufficient capacity to accommodate the filling capacity of the pumps shall be installed between the water source and the suction flange of the pump and shall be kept in good order all the time of the operations (mesh 20). The lines will maintain static pressure for 24 hours with no unexplainable drop in pressure for test to be acceptable. A pressure-recording instrument shall be connected to the pipeline for the duration of the test. Hydrostatic testing must be followed by dewatering and gauging, the pipeline must not be left with water in it. The pipeline will be tested in two sections; the water used in the first section will be tested to show the possibility of using it in the second section.

The steps of the hydrostatic test are as following:

- A 'by direction' is placed in the beginning of the pipeline before water flushing.
- The pipeline is filled with fresh clean water by use of pumps. Filters are placed between the pumps and the pipeline to remove any contaminants to enter to the pipeline.
- The by direction is moving in the entering water inside the pipeline to guarantee the emptiness of the pipeline from air.
- The by direction comes out from the receiver trap.
- Assure that there are no 'air pockets' inside the valve rooms.
- The pressure is raised inside the pipeline till reaching 50% of the required pressure for the test; for example: if the required pressure is 105 bar, then the pressure is raised to 52.5 bar.
- The pressure is stopped for 12 hours. Patrolling on the pipeline and the valve rooms to ensure the absence of any leakage.
- After 12 hours, the pressure is raised again till reaching to 105 bar.
- The pressure is for 24 hours observed and recorded on a chart recorded.
- After checking and being sure that the pressure is stable for 24 hours, the pressure is lowered to 0 bars.
- The receiver trap is opened again and the 'by direction' is placed for sweeping the water.

There is no need for using corrosion inhibitor in the hydrostatic test for the following reasons:

- The water used in the test is clean freshwater (NaCl=3%) not sea water.
- The pipes are internally coated with anti-corrosion substances that don't be affected by the pigging.
- The test duration is short; 24 hours, then the pipelines is emptied of the water after.

The water used for this test will be drawn from El Rayh El Bahery conduit and will be discharged in El Rayh El Tawfeky after examination to be sure no harmful material are present. The discharged amount will be approximately 10,000 m^3.

4.5.12.4 Pneumatic Testing

Utility air or nitrogen can be used as the test medium. The air used for blowing and testing shall be clean, dry and oil free. All instrument air system shall be service tested with its own medium when this is not available, a utility air source supplied by a non-lubricated compressor may be used

Air piping receiving a pneumatic test shall be tested at service pressure. Piping receiving a pneumatic test shall be tested at 110 percent of the design pressure, or to the maximum upset pressure, whichever is greater. The pneumatic test pressure shall be continuously maintained for a minimum time of 10 minutes.

Records shall be made of each system tested, which shall include:

- Date of test.
- Identification of piping tested.
- Test medium.
- Test pressure
- Approval by the Inspector

4.5.13 Dewatering

Dewatering will follow immediately upon completion of a satisfactory hydrostatic test. The pipeline must not be left with water in it. As a minimum this procedure will be based upon the use of foam bodied pigs or rubber cupped bi-direction pigs. Pigs will be run until there is no evidence of water in the pipeline as determined by the company. The test for water shall include assessment of the gain in weight of any foam pig or measuring of the dew point of the compressed air into and out of the pipe line. Measurement will take place before dewatering to complete arrangement with the responsible authorities. Dewatering will continue until the company's engineer is satisfied that pipeline is free from water within acceptance limit.

4.5.14 Magnetic Cleaning and Geometric Pigging

A series of magnetic cleaning pigs will be run until the pipeline is judged by the company to be free of magnetic debris. After the pipeline has been cleaned by the magnetic cleaning pig the contractor will run a geometric pig. Acceptance of the pipeline will be based upon a successful report by this pig. Following a successful run by the geometric pig the pipeline will be left with positive pressure in it of at least 2 bar. The medium be with either dry air or dry nitrogen as determined by the company. The discharge will be some metallic components and will be disposed to industrial dump.

4.5.15 Drying and Commissioning

The pipeline will be dried by the application of either vacuum drying or by flashing with dry nitrogen at ambient temperature to ensure that no operational problems arise from water left in the pipeline

4.5.16 Breaking of infrastructure pipes

Most of underground infrastructure in the region has been established long time ago, without accurate documentation for its routes and depths. Therefore, usually the excavation contractor is not aware of the exact locations of such pipes, and accordingly the risk of breaking infrastructure lines is relatively high. Normally the contractor takes caution by applying manual excavation to avoid such situations where he is obliged to pay for the damage.

If a line break occurs, site manager gives immediate notification to the Police Department and the correspondent authority (according to the type of broken pipe). The authority then starts repairing the line as soon as possible, they claim repair costs back from the contractor later.

4.5.17 Records and Operating Manuals

The constructing contractor will be responsible for the production of all kinds of records relating to the whole construction job. These records include but are not limited to:

- Materials records that contain identification number, inspection certificates, test certificates, etc.
- Welding records (e.g. welder qualifications, welding procedure, etc.).
- Protective coating records that contain date, method of cleaning, material used, repairs, etc.
- Painting records (e.g. paint type, grade of paint, paint batch number, etc.)
- Mechanical installation records (e.g. testing procedure, insulation procedure, pipe alignment, etc.)
- Structural steel work records (e.g. line, level, plumbness, tightness of bolts, etc.)

In addition, the contractor shall supply all necessary maintenances manuals and training in their application.

4.6 Pipeline Surveillance

GASCO has ensured that it will take all reasonable precautions to safeguard its pipeline and to protect the people living in the vicinity of its pipelines. GASCO will be fully responsible for monitoring and securing the entire length of the pipeline outside of the power stations, but it should be noted that it is the responsibility of the electricity authority to monitor any components inside the power stations.

4.6.1 Pipeline Patrolling

Pipeline patrolling shall be carried out in order to identify activities or actions that could damage the pipeline. Patrolling will also identify areas of concern, such as land erosion in the general vicinity of the pipeline and the subsequent risks it poses. The frequency of the patrol will vary for differing areas. In desert regions, minimal work is conducted around

the pipeline. In urban areas where there is a lot of excavation activity on water mains and sewers, the frequency of inspection shall be the highest.

The pipeline patrolmen will carry out vehicle and walking surveys along the pipeline route, at the following frequencies:

Table 4-3: Frequency of Patrol. Reference: GASCO

PIPELINE LOCATION		VEHICULAR	WALKING
Location Class	1	6 Months	No survey
Location Class	2	1 Month Vehicular accessible areas inc canal and river crossings	6 Months Arable land, AGIs, valve rooms, crossings, sleeves
Location Class	3		2 Weeks Survey all areas
Location Class	4		2 Weeks Survey all areas

The patrol will observe and report findings to the Sector Office on a daily basis and where the safety of the pipeline is at risk, notification will be as soon as possible. The patrol will be issued with written authorization to instruct other people affecting and the safety of GASCO property, to stop their work or actions immediately. The patrolman will need to complete a written daily report. These will be logged again on a daily basis, in the Area Office. These daily reports will be audited on a random basis by the patrol's supervisor. The survey diary, issued to each Patrolman, will also be completed by the end of each day. The survey diary will contain all observations along the pipeline route for a particular day. This diary will be used as a check by the patrol supervisor.

All necessary permits or permission will be obtained from landowners, farmers, railways, etc. prior to starting work. The patrol will ensure that he holds a valid identity card or letter of authorization. In addition to watching and reporting on the PPC pipelines, the patrol will establish a good liaison with farmers and landowners along the pipeline route.

It is not the intent to specifically test for the presence of leakage with gas detection equipment during this survey.

4.6.2 Leakage Survey

The leakage survey shall be conducted to protect the population and staff against the effects of escaping gas and to detect damage to the pipeline. The survey shall therefore be conducted where the pipeline runs close to buildings and where staff work.

These surveillance methods will be supported by two report sheets: one for each day of the survey for patrolling duties, and one for leakage survey duties. These two sheets are designed to be the only documentation the operative needs to perform the task. The locations for both surveys and the frequency of the leakage survey must be determined in advance by a qualified engineer and reviewed at least annually. The engineer must also fully classify all pipeline routes according to ASME 31.8 within 6 months of

implementation of these surveillance methods. Where the two surveys coincide in terms of frequency they can be combined into a Patrol and Leakage survey.

It is essential to take all reasonable precautions to reduce the risk of pipelines being struck or damaged. The inspection and surveillance, applied to a particular section of a pipeline, should reflect the likelihood of such damage at that location and the type of frequency levels should be regularly reviewed at intervals not exceeding two years. All staff undertaking the patrol duties and the leakage surveys must be fully trained before carrying out these duties.

4.7 Description of Operation Phase

4.7.1 Normal operation

Normal operation will include routine audits on pressures and condition of the network. Normal maintenance and monitoring works for the network include:

- Monitoring valves and some selected points on the pipeline. Gas leaks are routinely detected using gas detection sensors
- Maintenance of valve boxes and raise of its level whenever needed
- Checking cathode protection on "Flange Adaptors" by taking voltage readings and change anodes whenever needed

The Pressure Reducing Stations are also routinely tested against leaks and safety issues.

4.7.2 Repairs and replacement

In case of leak detection, or damage of part of the pipeline, the damaged pipe is replaced. The following procedures are usually followed:

- Stopping leaking line
- Excavating above the effected part (in case of distribution main or underground installation line)
- Venting the line
- Removing affected pipe
- Replacing effecting part and welding it with the two ends
- Filling and road repair

5. Analysis of Alternatives

Alternatives are explored in the following areas: construction technologies (particularly in crossing roads, railways and waterways), routing options, and locations of associated facilities. The "No Action" alternative is also considered in order to demonstrate potential environmental benefits or detriments that would occur if none of the project activities were carried out.

5.1 The "No Action" Alternative

The primary purpose of the proposed project is to supply natural gas to the North Giza Power Station, which will generate electricity for end user consumption. Without the project activities, there are two possible scenarios:

1. Fuel is provided to the station using different means of transportation, and potentially a different fuel
2. Operation of the power station is abandoned

Without the pipeline, fuel could be transported over land. However, regardless of fuel choice, this situation is likely to be extremely uneconomical and carries increased risk of dangerous accidents occurring, as well as a negative impact on traffic in the area. This scenario would not require any new construction activities, but the continual operation of transport vehicles generate emissions to the air as well as other waste, and is in general not sustainable. Construction of an alternative pipeline is possible, but this would likely originate at a more distant source, thus increasing the scope of the potentially negative impacts of such a project.

Without the additional generation capacity of the North Giza station the supply of electricity may become insufficient, creating shortages in the area that would negatively affect people's living conditions and quality of life, and the local economy. Additional generation capacity is badly needed, and while there may be more environmentally friendly options such as renewable energy facilities, these require significant capital investment and under current conditions it is not considered feasible for these technologies to completely replace combined cycle power plants.

5.2 Construction Alternatives

Horizontal Directional Drilling (HDD):
HDD is a trenchless construction technique, which uses guided drilling for creating an arc profile. This technique is used for long distances such as under rivers, lagoons, or highly

urbanized areas. The process involves three main stages: drilling of a pilot hole, pilot hole enlargement, and pullback installation of the carrier pipe.

HDD offers several advantages when compared to other trench-less or open-cut construction methods:

- Complicated crossings can be quickly and economically accomplished with a great degree of accuracy since it is possible to monitor and control the drilling operation.
- Sufficient depth can be accomplished to avoid other utilities such as power and telephone cables.
- In river crossing applications, danger of river bed erosion and possible damage from river traffic is eliminated.
- Requires only a small construction footprint.
- The volume of drilled fluids will be estimated only during the start of HDD by a short time.

Open-Cut Method:
If a trenchless technology were not employed, the pipeline would have to be laid using open-cut excavation along the entire route. This would have a number of major negative impacts at points where the pipeline crosses roads, railways, and waterways. Main roads would have to be partially or completely obstructed for a significant period of time to allow for excavation and laying of the pipeline, amplifying any negative impacts on traffic discussed in Section 6.2.2. Furthermore, obstruction of main roads and railways would disrupt the flow of people and goods along those routes, which would have a negative effect socially and economically, not only in the project area, but in the larger region linked with the transport routes that were disrupted. This technique would also require partial dismantling/destruction and then reconstruction of the existing infrastructure of roads and railways, thus complicating and expanding the required construction activities of the project.

Crossing waterways without using a trenchless technology would require construction activities that directly affected important sources of water, increasing the risk of contamination during both the construction and operation phases. These activities would also disrupt the natural marine environment. It is likely that the pipeline would not be buried in these situations, so it would also be at an increased risk of damage. These impacts could affect the entire downstream portion of the respective waterways.

5.3 Routing Alternatives

Choosing the pipeline route involves selecting paths that, when possible, follow a logical course along existing transportation ways, cross these transportation ways at opportune

locations, and avoid populated areas and other sensitive receptors. These efforts must be balanced with efficient use of resources and the desire to minimize the overall length of the pipeline.

The first section of the pipeline, before it reaches the North Giza Power Station, runs along the El Rayh El Nasry drain and parallel roads, on the edge of the Nile Delta region. The land in this area is in general less populated and less intensively used for agricultural purposed than the middle of the delta. Though this route still intersects some agricultural lands, unutilized desert land is too distant for a viable alternative to be considered in which this does not occur. The other conceivable alternative is that the pipeline immediately cuts into the heart of the delta region, and then down towards the power station. However there are not any major roads that would lead directly from the desired start to the desired finish, and the pipeline would inevitable be closer to more populated areas and disrupt more agricultural land.

After the pipeline reaches the North Giza station, it must cut across part of the delta to join the existing Metnama pipeline. Virtually all conceivable paths will intersect the same major transport routes and waterways, and all will require the disruption of agricultural land. The path selected by GASCO is sufficiently short and well chosen for its navigation of the critical crossing points and populated areas. GASCO has an unwritten strategy that thoroughly avoids any construction buildings including: houses, graveyards, religious buildings and historical areas.

6. Assessment of Main Environmental and Social Impacts

6.1 Positive Impacts

Achieving the project objectives shall yield many social and economic benefits, and will help meeting the targets of the overall Energy Strategy for the country and national development plans formulated by the Egyptian oil/gas sector.

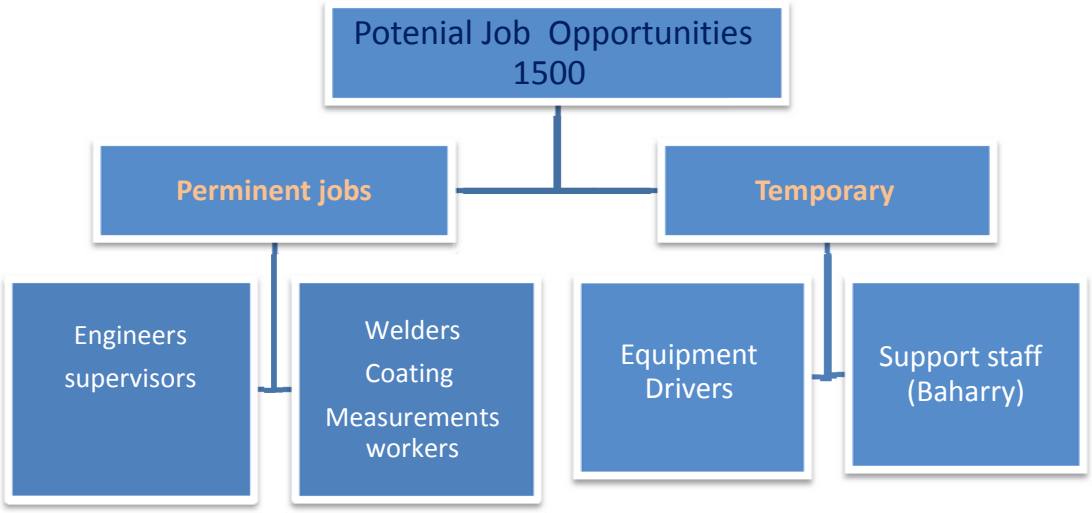
Job opportunities will be provided for both skilled and unskilled laborers in the selected governorates. These job opportunities can be divided into two main categories:

- The first category encompasses the jobs directly affiliated with the project implementers namely GASCO staff and the contractor's staff.
- The second category encompasses job opportunities to be provided to the following community groups:
    - Support staff for the welders, coaters, measurement workers
    - Restaurant and cafes workers in the area,
    - Ferry workers (helping people cross the river Nile),
    - People who work in construction materials business in the area,
    - Owners of small markets and supermarkets in the area,
    - Drivers of large vehicles and small vehicles that can transport the workers around the area.

“A new project means 200-400 people live in the area for 24 months, they have full eating, purchasing, living…they will flourish the economic status of the area for two years" reported an engineer from GASCO.

These jobs are likely to directly benefit many poor community members who suffer from substandard living conditions. The project could be of a major importance to them as it could represent a main source of income during the construction phase potentially lasting for 24 months. Based on the interview conducted with GASCO team, the following are the potential job opportunities to be provided during the construction phase directly on the level of GASCO and the contractor. The total job opportunities to be provided will be around 1,500 jobs, among which 20% are welders, 20% work in coating, 30% support staff "*bahary*" drivers for heavy equipment about 10.0% and the supervisors and engineers.

Figure 6-1: Job opportunities to be provided during the construction phase



Among the other social benefits that could be achieved by the project are:

- Benefit owners of cafés and small restaurants in the project areas through providing services to the construction workers.
- Increase the rental of local buses and vehicles to move the workers and the equipment to and from the construction sites.
- Rent apartments near the pipeline sites for the housing of the workers from outside the governorates.
- Provide jobs primarily for community members, simultaneously saving on the cost of employing people from outside the governorates and encouraging community acceptance of the project.
- Diversification of skill base within the existing workforce.
- Engender feelings of wellbeing and pride within different communities as new developmental projects are being implemented in order to enhance the living conditions of community members. Such feelings are important for the communities.

The project shall also result on some environmental benefits, such as:

- Natural gas offers substantial environmental benefits over oil and coal as a source of fuel:
- Natural gas contains less carbon and more hydrogen than oil and coal and so results in the generation of lower amounts of carbon dioxide per unit of energy output. Compared to other fossil fuels, it also produces lower emissions of nitrogen oxides when burned.
- Natural gas contains no solid particulates or inorganic compounds that may give rise to particulate emissions or ash production.
- Natural gas produced from indigenous sources can be made available at costs, which are significantly lower than the cost of importing oil or gas and, in many cases, lower than costs of importing coal.

- Whilst some of the NGLs will substitute or replace other less environmentally friendly fuel sources, some will represent new or additional consumption. The balance between replacement and new consumption is beyond the scope of this EIA and has therefore not been considered.

6.2 Potentially Negative Impacts During Construction

By analyzing project activities during the construction phase, the most significant negative impacts that may be encountered are:

- Waste disposal
- Reduction of traffic flow
- Air emissions
- Noise
- Soil quality
- Risk to infrastructure
- Stability of existing structures
- Effects on culturally valuable sites

An environmental and social management and monitoring plan has been formulated to mitigate these impacts. The plan is detailed in Section 7.

6.2.1 Waste Generation

The amount of daily domestic rubbish that will be generated during construction is approximately 100 kg. It will be transported off-site by trucks to the general authorized landfill. Wastes that are generated during the construction phase include:

- Excavated soil and excess sand
- Concrete and bricks waste
- Demolished asphalt
- Containers of chemicals and lubricant oils used for construction machinery
- Discharge of dewatered water from trenches and tunnels

Excavated soil and concrete/bricks waste are inert materials. Improper disposal of such wastes will only have aesthetic effects in the disposal site. The legal standards of Law 4/1994 for the Environment and Law 38/1967, discussed in Section 2, stipulate that these wastes should be disposed in licensed sites by the local authority, which minimizes any aesthetic effects of such waste.

The asphalt waste could have some hazardous components, such as tar, lubricating oils, some heavy metals, etc. However, its solid nature minimizes transport of such components to the environment. Disposal of asphalt waste to construction waste disposal site is the common practice in Egypt, which is normally not associated with significant environmental risks because of the dry weather nature of the country. However, it would be a more acceptable environmental practice is to transport asphalt waste to one of asphalt mixing stations for recycling.

Empty containers of chemicals and lubricating oils, are considered hazardous waste. They should be disposed of in an approved hazardous waste treatment facility for proper treatment/disposal.

The water used for this project will be drawn from El Rayh El Bahery conduit, and will be discharged in El Rayh El Tawfeky canal after being examined to be sure no harmful materials are present. The amount will be approximately of 10,000 m^3.

Improper drainage of dewatering water may result in forming stagnant water ponds around construction site, which can develop, if not drained, infiltrated or evaporated, to form nuisance and an environment for breeding of insects.

Normally dewatered water are relatively clean water, which could be drained to a public sewer or even discharged at a watercourse, which may be applied during tunneling a special crossing under a water course. However, there can be exceptions to that, when dewatering is performed from a contaminated trench or near source of pollution seepage to groundwater. This could apply during trenching besides, or under, fuel service station, any UST or AST system, where groundwater could contain hydrocarbons or chemicals. Although such cases could be rare, its occurrence would require collection of contaminated water and special treatment/disposal. Discharging contaminated water with significant amounts of chemicals and hydrocarbons is not legally acceptable neither to sewers nor to fresh watercourses according to Laws 93/1962 and 48/1982 respectively.

6.2.2 Reduction of Traffic Flow

The installation of the natural gas pipeline is bound to affect traffic conditions during construction. However, the significance of the effect of the activities on traffic flow in the region will be limited to the construction phase. Construction of the pipeline and facilities will require a large-scale transport operation in order to deliver equipment to the work site. In addition, the pipeline route runs alongside and at times crosses multiple roadways, which potentially entails narrowing major roads, lateral excavation, and temporary blockage of the road.

It is recommended that a specific transport/journey management plan be drawn up by the contractor and approved by GASCO prior to works commencing. This should address the need to minimize environmental impacts from traffic and the proposed mitigation approach.

6.2.2.1 Impact on Main Roads

The primary road network carries the highest traffic volume, and vehicles generally move at higher speed. While complete obstruction of main roads will be avoided by the use of the HDD technique described above, traffic on these roads will still be affected by temporary restructuring/narrowing of the lanes as a result of construction activities taking place nearby.

The narrowing of the road will reduce the number of traffic lanes available for traffic movement and will also entail the prohibition of on-street parking along the length of the road works. The narrowing may reduce the right-lane either partially or totally. In either case, traffic will shy away from the construction side and encroach with traffic in the adjacent lanes. A direct result of the construction works would be the reduction in the average travel speed on these roads. Although it is difficult to quantify such an effect without a detailed study, the general conclusion is that the level of service would be reduced one level as a minimum.

Lateral excavation is bound to produce similar effect as other roadside work in terms of flow reduction, however this will only occur at one section of the road. This method of construction entails the closure of a lane or more at a point along the road. As such, this type of work can take place during off peak periods, preferably during night-time when traffic volumes are the lowest. The road cross section at the site can then be reinstated during daytimes to resume normal traffic conditions. Therefore, the reduction in the number of lanes will have its minimum effect.

In addition, as drivers approach such a construction site, they would tend to change their lanes prior to site and adjust their speed to that of the traffic in the adjacent lanes. These maneuvers will be easier to carry out when traffic volumes are low during night time. The selected times could be from midnight to 6:00 am.

6.2.2.2 Impact on Secondary Roads

The local street network carries the lowest traffic volume. Disruptions to traffic due to the construction would be different from those for main roads. The local streets are narrow in width, so lateral excavation would mean almost blocking a direction. Therefore, traffic in both directions would be using one lane only. Opposing traffic (although little) can block the street if they reach at the same time. Therefore, the level of service in this case will depend primarily on the judgment of each driver on the best way to avoid blocking the street.

In order to traverse the smaller secondary roads that pass into private farms, the pipeline will be laid using the open cut method. This will require temporary blocking of all or part of the roads. For roads that will be crossed via open cut technique, GASCO will develop alternative roads for entrance to the farms and the crossing will be done after arrangement with the owners of these farms. In addition, GASCO will choose an appropriate day like Friday when there is not high traffic movement on the road.

In any case, lesser impact is envisaged on the local road network since they are considered low volume roads that are expected to use these streets with low speed.

6.2.3 Air Emissions

Air emissions during construction shall arise primarily from exhaust from excavation vehicles (excavators, trenchers, loaders, trucks) containing SO_x, NO_x, CO, VOCs … etc.

Dust generated during construction of the new pipeline will result from clearing and earthworks, including excavation, trenching, levelling, and reinstatement operations. Another major dust sources will be from the movement of vehicles transporting pipes and equipment to the work areas.

The effects of such impacts are expected to be local and short term; however the dust and suspended particles problem could cause health problems to inhabitants of affected areas.

The occurrence and significance of the dust generation will depend upon meteorological and ground conditions at the time and location of activities. However, under normal meteorological conditions, dust impacts will be limited to within several meters of the construction area(s).

Dust generation can affect the ability of nearby vegetation to survive and maintain effective evapo-transpiration. It is also a potential nuisance to workers and employees in the area during the construction activities.

It may also pose health risks and irritation to humans, but typically where working in uncontaminated soils, wind-blown dust is normally only considered a nuisance to those exposed. The proposed route for the pipeline is away from residential areas, public gardens and other social activities and there are no sensitive receptors like schools, hospitals, natural protectorates, etc. along the pipeline route.

Law 4/1994 has very strict standards to preserve the air quality. As previously indicated in Section 2, the law has identified certain measures to control excavation, soil stockpiling, soil haulage and exhaust from vehicles. These measures have been considered in the recommended environmental management practices in Section 7.

Another indirect source of air emissions is the traffic congestions that may happen. Air emissions from vehicles usually are effected by different modes of traffic, including traffic congestions.

6.2.4 Noise

Construction activities shall increase noise levels caused by excavation machinery. The noise levels would be similar to those associated with typical construction sites, with activities such as clearing, ditch digging, drilling, sand blasting, facilities handling, and vehicle movements. Construction noise in a particular location will be temporary, and the levels will vary from increase of noise intensity due to engine operation, and intermittent impacts which may take place during demolition of asphalt, either by a trencher or by a jack hammer.

Law 4/1994 has defined certain standards, discussed in Section 2, for noise intensity and exposure period in work place, in addition to certain limits for ambient noise levels for different types of urban and rural areas.

The effects on construction labor are considered more significant, because they are exposed to high levels of noise for relatively longer periods. Residents of neighboring areas are the second level recipients of elevated noise levels, as the noise intensity will be relatively dissipated at their locations.

Noise can also have social impacts among the neighboring areas. The noise produced as a result of GASCO operations, which affects the surrounding area, is defined as Environmental Noise, it is not likely that the general public will suffer from hearing damage as a result of environmental noise; it is more a nuisance or disturbance. However, it can make life uncomfortable or stressful for those who may be affected, and when it exceeds the standards, can even cause psychological effects among exposed persons.

Traffic congestions, which could be caused by excavation works, may increase ambient average noise intensity levels, but this will not be an issue for most of the smaller roads in the area.

6.2.5 Soil Quality

The construction and laying activities will result in direct disturbance of soil and specific geological features. This disturbance includes localized alteration of the soil profile within the trench footprint, and soil compaction in the immediate vicinity because of vehicle and construction equipment operations. However, excavation will only occur to a depth of 1-2 meters along the path of the pipeline, with most of the excavated material being replaced, so the impact of these activities on soil profile will be relatively minor. Compaction is not considered to pose a serious environmental risk.

Potential soil contamination may result from improper waste storage, handling, and disposal practices, as well as and potential spillage and/or leaks during the course of the construction activities. The potential of this impact is local in nature and considered minor, but there is the risk of it spreading beyond the project site as a result of nearby ground or surface water contamination, thus becoming a significant environmental risk.

6.2.6 Flora and Fauna

6.2.6.1 Flora

Although the number of plant species observed and recorded at the project site appears large, almost all of these species are characteristic of agricultural or cultivated lands (weeds of cultivation) in the region and therefore the risk of disrupting them is not considered important.

6.2.6.2 Fauna

According to the pipeline trenches dimensions as well as the exact trench-line route, there is a very low impact on the fauna as most of pipeline pathway occurs in insensitive areas, represented by artificial-terrestrial habitats including plantations, rural gardens, cultivated agricultural lands and urban areas as well as asphalt roads and railways. No records of species from the exact trench-line route and few records around. The adequate depth of the pipeline underground leaves adequate amount of soil (the same soil that resulted from the digging process not from another different habitat) on the pipeline to be used by fauna and that helps to mitigate the impact of changing habitat for most of recorded or potentially occurring species in these ecosystems. As the dug trench-line will be re-filled at the same level of the surface, that will help to mitigate the impact of making barriers which affecting both habitat utilization and distribution of the fauna. Finally, all previously mentioned reasons indicate that in general the pipeline pathway has no passive effect on the fauna which may potentially occur in these ecosystems.

6.2.7 Damage to Infrastructure

Most of the underground infrastructure pipelines (such as water, sewerage and telecommunication) have been established a long time ago, without accurate documentation for its routes and depths. Therefore, the risk of breaking infrastructure lines is relatively high. Normally the contractor takes caution by applying manual excavation to avoid such situations where he is obliged to pay for the damage.

The most important environmental impact will arise in case a sewerage pipe is broken, and wastewaters accumulate in the trench and, possibly, over flood to the streets causing significant nuisance to the surrounding environment.

Breaking a water supply pipe may result in cutting the supply to a number of residential units, which may, if it takes place for a long period, direct residents to use other sources of water which may be either expensive or unsafe.

The effects of cutting telecommunication cables during excavation are mainly socioeconomic, due to cutting possible personal and business communications.

6.2.8 Stability of Existing Structures

Weak and old structures are very sensitive to differential settlements, which could be caused by different factors. Among the construction activities that could have impacts on structures are:

- Dewatering from regular trenches
- Tunneling and horizontal drilling

Excavation for natural gas pipelines is usually shallow and does not exceed a depth of 1.0 meter. In the project region, there are very few areas which have ground water depth less than that. If groundwater was not encountered during excavation of normal trenches there shall be no effects. In case if groundwater is encountered and dewatering is applied, there might be effects if the dewatering occurs for a long duration. Dewatering in silty and

sandy soils can move fine soil particles and wash them away through the surface pump, which creates voids and spaces in the soil surrounding the excavation and the nearby buildings.

The effect of the tunneling process has several folds, but mainly settlement, which can be due to:

- Excavation of jacking and receiving shafts in case of micro-tunneling
- Dewatering if needed for the shafts and/or the tunnel in case of open face machine
- The tunneling process itself

Another, relatively minor, risk which could be encountered is weakening the structural system during drilling holes in the walls for house connections. Usually, wall drilling in load bearing masonry walls does not have an effect on inherited the structural system. The walls with their long sections provide large carrying capacity. The hole for the pipe usually is very small compared to the wall section. Moreover, the beams of the flooring system are small and can easily be avoided by the level of the drill with respect to the ceiling. For skeleton type buildings, although drilling in columns or beams could have significant effect on the structure, it is believed that this risk is well understood among connection workers and could be avoided.

6.3 Potential Negative Impacts During Operation

6.3.1 Air Emissions

Emission sources during operation will be associated with fugitive emissions from pipeline relief valves, flanges, etc. Such events may happen during planned preventive maintenance or unplanned venting of the pipeline.

6.3.2 Impacts of Excavation Works

The negative impacts discussed earlier in the construction phase, will also apply to the operational phase, but to lesser extent, in case of repairs and maintenance of the network.

6.4 Potential Social Impacts

The project will most likely not result in negative social changes like migration or change the demographical or the traditional lifestyle of area communities. Nevertheless, given the uncertainty, a Resettlement Policy Framework has been prepared. The framework has defined methods for valuation and compensation of affected people. The asset valuation will depend on market value of the asset and replacement costs. For intangible losses that cannot easily be valued in monetary terms (i.e. access to employment opportunities, public services, natural resources, social capital), access to equivalent resources and earning opportunities would be established. Compensation will be provided to all individuals whose assets or access to assets is severely affected or damaged, as a consequence of land acquisition or any other activities undertaken by the project.

6.4.1 Negative Social Impacts During Construction

During construction phase, there are a number of impacts with possible negative social implications that need to be considered, namely:

- An effect on the socioeconomic conditions of the community people due to the expropriation of their crops that represent the main source of income to them. The implementation of the project will necessitate to expropriate a plot of land about 150 Feddans (that was a calculation of the agricultural lands facing the line.) during the construction. It was very difficult to estimate the numbers of potentially affected people due to the limitation of information about them
- Reduction of traffic flow due to the construction materials and dust that will result from digging. We don't discuss this impact as an environmental one, but the traffic congestion might affect the income of microbuses, small vehicles and taxi drivers. Thus, that should be mitigated
- Air emissions, especially dust, which might trigger some allergic reactions within the communities located near the construction sites. That might result a financial burden for community people in order to pay for the health cost, medication. Putting into consideration that the majority of peasants has no health insurance coverage (Ministry of Health- 2010).
- Risks to existing infrastructure, especially water pipes that are not mapped and must be identified through excavation holes. It is crucial to have updated maps of these lines and pipes in order to avoid damaging them. If such maps are not available, excavation holes must be dug before any construction,
- Effects on houses and other constructions as it was notable that during the observation of the line sites in some areas the streets were narrow. Consequently, the project implementation might affect the houses. People will not be able financially to rebuild the affected houses.
- Effects on culturally valuable sites (mosques, churches, historical sites, graveyards) is one of the main worries reported by community people.
- Accumulation of wastes in the construction areas might make community people suffer from insects and unfavorable smells is one of the potential unfavorable impacts.

6.4.2 Negative Social Impacts During Operation

Some of the negative social impacts that might occur during the operation phase are:

- The possibility of some leakage in the sites might affect the agricultural lands in the areas or causing fires. That will result losing of assets or income.
- Potential damage in crops due to any needed works in the site during operation phase
- Temporary workers may cause problems at the end of the project when they are no longer needed.
- The possibility of gas leakage and fire, bearing in mind that the fire departments does not have the necessary equipment to put out gas fires.

6.4.3 Affected parties

The affected parties or people affected by the project should be discussed in order to try to minimize any hardships they face due to project implementation.

- It is foreseen that the affected parties will be mainly among the peasants. They will lose their income due to the expropriation of crop land.
- Based on interviews conducted in the area with GASCO engineers and some community members who were compensated during the implementation of another pipelines, it was discovered that only 1.0% of those who were compensated brought up disputes. The disputes were settled when compensation documents were revised indicating that the current system used by GASCO is acceptable to the community.
- The second main potential affected parties are the construction workers who might be injured at the site. However, after visiting one of the sites, safety measures were seen to be applied.

6.4.4 Key Issues for Consideration

The study team has identified the following key social issues that need special consideration during the project implementation:

6.4.4.1 Problems Related to Valuation of Compensations

The valuation of the vegetation is one of the main obstacles that might face this type of project. However, GASCO have a clear valuation system that was primarily based on the Ministerial Decree 347/2007 that declared the necessity of valuing the vegetation is the responsibility of each governorate. In case of any related issues, the Ministry of Agriculture will be the reference to settle such problems.

The valuation should be based on the type of crop (trees – other crops). Valuation for trees should be based on the productivity of the trees and their age. The majority of the areas (65.0%) are empty desert lands which will not necessitate a detailed valuation system.

6.4.4.2 Problems Related to the Community

Though community members might not be willing to relinquish their lands temporarily for the project, GASCO does have a decree for temporary acquisition of lands. This decree is issued prior to the implementation of the project. Moreover, during the implementation (after payment of compensation to the affected parties), the contractor should follow the maximum relief behaviors and this should not conflict with the implementation plan. *"When we notice that a crop will be harvested in days, the contractor does his best to avoid working in the plot before the harvest of the crops unless it will affect the time plan,"* reported an engineer at GASCO.

6.4.4.3 Challenges facing Community Participation

According to the various groups of the interviewed stakeholders, community participation in developmental projects is quite limited in Egypt and in particular, within such projects. Many people noted that their voices are not heard and that they cannot raise any of their concerns through any channels. This is a serious fear that affects local people's willingness to contribute to these projects

However, GASCO staff reported that the following measures are usually considered in order to ensure adopting a participatory and transparent approach with the local hsting communities:

- Providing information about the project to the community in a timely manner
- Provision of a clear valuation strategy in order to settle any potential disputes with the project affected people
- Provision of information about the owners of the crops in areas
- Working to mediate between the owners of crops and the Compensation Committee from GASCO in order to facilitate their work
- Monitoring of any unfavorable attitudes during the implementation and report the complaints to the monitoring department of the project
- Gasco participatory approach stresses on involving influential stakeholders in the process. This include natural leaders like mayors of the villages and their deputies, religious leaders, youth center managers, ….etc. The Agriculture Association is also a crucial party that they engage in the process of valuation, paying compensations and channeling complaints.

The NGOs located within the project localities should also play a major role in providing clear information about the routes of the project and any further information needed. In addition, NGOs can help in documenting the community grievances and conveying them to the project management unit.

7. Environmental and Social Management Plan (ESMP)

7.1 Objectives of the ESMP

The objective of this Environmental Management Plan is to propose mitigation measures for expected negative impacts and to monitor the efficiency of these mitigation measures on relevant environmental indicators. Similarly, the goal of the Social Management Plan, as represented by the Resettlement Policy Framework, is to construct guidelines for the avoidance of expected negative social impacts, and initiate a mechanism for implementing these guidelines when issue arise. The respective plans identify certain roles and responsibilities for different stakeholders for implementation, supervision and monitoring.

Also in this Section is an assessment for the capacity of the implementing agency, GASCO, for implementing the ESMP, along with recommendations for improving their capacity and resources for implementing the ESMP.

7.2 Management and Monitoring Activities During Construction Phase

7.2.1 Management of Traffic

The mitigation measures are proposed to maintain the existing level of service and to minimize disruptions to vehicular movements:

1. Construction during Off-peak Periods: It is essential to plan for the construction works outside the peak periods of the main arterial road network. The works would be scheduled during off-peak periods, mostly during night time. During peak periods, work will be stopped and the road space is re-instated for use by traffic. Also during Ramadan month, all occupations of most streets should be stopped. Although this procedure will provide the minimum impact on the traffic flow, the construction program of work may be extended for longer periods of time.
2. Signage and markings: Construction works require proper information disseminated to motorists. This can be done by provision of informational and directional signs posted prior to the construction zone so that drivers can react in due time and maintain safe driving. The Egyptian Road Code of Practice (Ministry of Housing, 1998) provides standard arrangements of construction zones. Markings, in the form of lane lines and directional arrows are also needed to guide the drivers to the proper lane changes and turning. Pedestrian crossings can be also provided at proper locations as dictated by each site.
3. Traffic Detour: In some important roads, and based on recommendations of the Traffic Department, it would be required to maintain the movements of traffic at a reasonable level of service. Therefore the Traffic Department may request detouring, which has proved to be a potential solution. A traffic study will be required to produce a traffic circulation plan during the construction period. The traffic study will include an area wide analysis of the road system coupled with

traffic counts. Alternatives of the circulation plan will be produced and evaluated in terms of level of service, driving convenience, access to adjacent land uses and pedestrian mobility.

4. Re-structuring the Road Right-of-way: Again this shall be based on recommendation from the Traffic Department in order to keep traffic flow at adequate levels in some roads. The Right-of-way for roads in the project area typically does not include sidewalks or medians, as it is not an urban setting. If the normal excavation construction procedure is adopted, it would be possible to re-structure the road's cross section to accommodate the construction works and maintain traffic movements along the road. A traffic study will be required to produce the optimum roads' cross section during the construction period. The traffic study will include road inventory coupled with traffic and pedestrian counts. Alternatives of the cross section, public transport services and pedestrian crossing will be produced and evaluated in terms of level of service, driving convenience, access to adjacent land uses and pedestrian mobility.

All above mitigation measures should be implemented in coordination with Traffic Departments of the appropriate governorate. Traffic studies recommended in mitigation measures 3 and 4 should be also done based on request from the Traffic Departments and in coordination with them.

In case the Traffic Department has requested traffic studies, as mentioned in mitigation measures 3 and 4, to maintain traffic flow in some roads, these traffic studies shall monitor the efficiency of detouring or re-structuring of road, by undertaking traffic and pedestrian counts. These counts should be compared with the expected results from detouring and/or re-structuring in order to take corrective actions if needed.

7.2.2 Management of Air Emissions

Mitigation measures for reducing air emissions are mainly stipulated by Law 4/1994, as indicated in Section 2. The following mitigation measures are considered minimum standards:

1. Apply water spraying to the soil before excavation, which shall suppress dust emissions during excavation
2. Excavated soil stockpiles and stored sand should be located in sheltered areas, sprayed with water and covered with appropriate covering material, such as polyethylene or textile sheets to avoid soil dispersion
3. Transportation of excavation/construction waste should be through licensed and sufficiently equipped vehicles with suitable special box or an air-tight cover to prevent loose particles of waste and debris from escaping into the air or dropping on the road
4. Disposal of excavation/construction waste should be in licensed locations by the local authority.
5. Air emissions of excavation machinery should be within the standards of the executive regulations of Law 4/1994, which are presented in Table 2-5

6. If the Traffic Department classified some roads for being major roads that would need detouring or restructuring, as indicated in the previous section, it will be recommended to avoid or minimize traffic congestions in these roads during periods of air quality crises, such as during autumn (the black cloud) and during spring (Khamasin winds). Minimization of traffic congestions shall be though following mitigation measures mentioned in the previous section
7. It is recommended that GASCO consider implementing a Mobile Health Care Unit in potentially affected areas in order to provide the needed treatment to the people in those communities which may experience some negative health impacts due to the dispersion of air emissions and fugitive dust.

Because dust emissions from construction works are a non point source, it will not be possible to monitor direct emission levels. On the other hand monitoring ambient total suspended particles or PM_{10} could be misleading because of the interference of other pollution sources. Therefore monitoring activities shall focus on making sure that point sources from the exhaust of excavation machinery are within law standards, and that mitigation measures are well documented.

7.2.3 Management of Noise

Mitigation measures for avoiding unacceptable, and illegal, noise levels include:

1. Prevent exposure of construction workers to different noise levels and noise impacts according the Law standards mentioned in Tables 2-1 and 2-2 in Section 2
2. Provide construction workers with ear muffs
3. Minimize construction through nighttime whenever possible, while working in populated areas. Implementing this measure should be balanced with avoiding peak hours of heavy traffic. If construction works are to take place in important traffic roads, avoiding traffic disturbance in day time may overweigh reducing noise levels in afternoon or night times and vice versa.

Monitoring of noise levels during construction shall include

1. Measurements of noise intensity at the locations of construction, where workers are exposed to the noise
2. At locations where mechanical hammers are used, measurements of noise intensity of impacts, and the correspondent number of impacts at the construction location
3. Recording of the reaction and complaints of the neighboring areas about the noise levels. Monitoring ambient noise levels at locations of residential areas may be misleading because of the interference of other factors.

7.2.4 Management of Excavation Activities Posing Risk on Infrastructure

Mitigation measures for avoiding breaking infrastructure pipes:

1. Collecting most accurate maps for infrastructure routes, whenever available and making such data available to the contractor prior to commencing the works

2. Excavating manual trial pits in each street to allocated the pipes before using mechanical excavation
3. In case an infrastructure pipe has damaged, a documentation report shall be prepared for the accident, including:
    a. Time and place of accident
    b. Name of contractor
    c. Type of infrastructure line
    d. Description of accident circumstances and causes
    e. Actions taken and responses of different parties, such as infrastructure company
    f. Duration of fixing the damage
    g. Damage caused (description shall be according to observation, expertise judgment, reports of infrastructure company)
4. Analysis and statistics should be undertaken periodically for the accidents taken place, with recommendations to reduce such risks in consequent excavation activities

Monitoring activities for such risk, is basically documenting, analyzing reasons that led to the accident and updating procedures to avoid future accidents. Monitoring environmental consequences of such accident, such as depth of effected soils, volumes of effected groundwater, and other social effects are believed to be unnecessary action by the implementing company, though it might be recommended for the authority owning the infrastructure line (Water and Sewage Authority or Telecommunication Authority) for their research activities.

7.2.5 Management of Dewatering and Tunneling Activities Posing Risk to Structural Stability

Mitigation measures during dewatering and tunneling activities:

1. For areas screened as including buildings with potential structural problems, in which dewatering (in case groundwater table is high) or tunneling works (in special crossings) will take place, a survey of building status should be undertaken. A list of structures with damage potential should be prepared
2. Undertake soil investigation program using representative bore holes for soil classification and identification of groundwater depth.
3. Implement tight excavation/dewatering schedule through preplanning and supervision on implementation to avoid elongated dewatering activities
4. In case well point system and/or deep/shallow wells are inevitably used, proper execution of the wells is very important in reducing the movement of fine particles.
5. For tunneling process, choosing the location of the jacking and receiving shafts as well as the path of the tunnel, the type of support and the type of tunneling machine should consider the status of surrounding buildings and soil type. Precautions for launching the tunneling machine and recovering it should be clearly stated and submitted showing the steps taken to prevent soil from entering the shaft.

The following monitoring activities for dewatering/tunneling works and structures at risk shall be only undertaken based on recommendation of structural consultant in area status report, mentioned in mitigation measure 1. These monitoring activities shall be, most probably[5], through:

1. Performing Elevation Reference Points (ERP) test for identified structures. The test should be undertaken 2 or three times in the two weeks preceding start of works. During the excavation process the test should be undertaken daily. The test has to continue for 2-4 weeks after excavation process.
2. Continuous monitoring of the tunneling process by observing the amount of soil excavated versus the advance of the tunneling machine and continuous monitoring of the line and level of the tunneling machine.

Survey of structural status of buildings, performing soil investigations, performing ERP tests shall be undertaken under the supervision of a structural consultancy firm. The remaining mitigation and monitoring measures should be undertaken by the contractor and should be reflected in the successful tender for establishing the network in such problematic areas.

7.2.6 Management of Waste Disposal

The following mitigation measures are recommended for waste management:

1. Allocating certain areas, in each Sector, for stockpiling waste soil and construction waste, in coordination with the local authority. These areas should be selected so as not to cause significant obstruction to traffic and the waste should be covered to prevent dust dispersion. The waste should be hauled at the end of each working day to the allocated disposal site, taking into consideration covering of the hauling vehicle, as indicated earlier. No soil stockpiling is allowed on banks of waterways
2. Normally asphalt waste could be disposed with construction waste according the previous procedures. However, it is recommended as a best environmental practice to segregate asphalt waste and to send it to an asphalt mixing plant for recycling. Because recycling of asphalt is not a common practice in Egypt, there are doubts that an asphalt plant will accept the waste. For such circumstances this recommendation should not be compulsory
3. As an important pollution prevention measure, fueling, lubricating or adding chemicals for excavation should not take place at the construction site except in necessary situations. In such situations, empty containers of chemicals and lubricating oils should be collected and disposed in an approved hazardous waste facility. The contractor is required, according to the stipulations of Law 4/1994, to keep records and manifests for his management practices of such waste.
4. Preplanning of mains of drainage of dewatering water and taking necessary permits from sewage authority, or irrigation authority. If dewatering is taking place from a contaminated trench, or contains hydrocarbons that could be

[5] The survey reports of areas under potential risk shall have more detailed description of these monitoring activities

observed or smelled, contaminated water should be collected in barrels and transported for a wastewater treatment facility for special treatment.

Monitoring activities for ensuring sound waste management practices shall depend mainly upon observation of waste stockpiles of soil and construction waste to ensure how often they are removed from site, and whether they contain hazardous components. For contaminated water produced during the dewatering process, also field observation of oily appearance and possibly smell would indicate whether to classify this water as hazardous waste.

7.2.7 Management of Social Impacts

Mitigation measures are crucial in order to reduce the worries and disputes among community people. The following are the proposed measures needed to mitigate the unfavorable social impacts. Before the discussion of mitigation measures it is crucial to differentiate between the ones mitigated under social budget and the ones lying under environmental mitigations that have a social effect. That will be useful in budgeting and identifying the responsibility.

Compensation should be provided for the peasants in the area for their lands and crops loss. Luckily due to the extensive experience GASCO has with such projects, the company has a clear mitigation strategy for the community members that were discussed in detail in the section about vulnerable groups and those affected by the project. The following are some recommendations about the strategy of compensation:

1. The compensation should be provided to the owner of the crop regardless of his legal status,
2. A clear screening of different areas should be carried out prior to the implementation of the project in order to identify the possibility of arousing disputes regarding compensations,
3. It is the Agricultural Association and the community members in addition to the existence of administrative papers (if available) that provide information about the Project Affected People,
4. Any compensation received should be clearly documented.
5. The person who receives the compensation stipulates that he will be legally responsible for any disputes resulting from receipt of the compensation.

The following list provides explanations of the social aspects of some of the environmental impacts detailed above:

- Regarding the mitigation of reduction of traffic flow due to the construction materials and dust that will result from digging. It is recommended that dust be removed and construction materials be stored in big storage areas close to the construction sites,
- In addition, there must be precautions to ensure that drivers approaching such a construction site change their lane prior to the site and adjust their speed to that of the traffic in the adjacent lanes. These precautions will be easier to carry out when traffic volumes are low during night time, i.e. from midnight to 6:00 am.

- For the mitigation of affecting the health of allergic people who might be affected due to dust and emissions, it is recommended to follow the environmental safety measures needed to reduce the emission of dust.
- Risks to existing infrastructure, especially water pipes that are not mapped and must be identified through excavation holes. It is crucial to have updated maps of these lines and pipes in order to avoid damaging them. If such maps are not available, excavation holes must be dug before any construction,
- For the mitigation of affecting houses and other constructions, it is recommended to reduce the possibility of affecting such buildings, the maximum safety measures must be followed,
- In order to be able to reduce the unfavorable impacts on culturally valuable sites. GASCO fully intends to avoid the cultural areas, mosques, churches, and graveyards. The company got accustomed to avoiding any cultural areas. Based on the analysis of other projects implemented by GASCO, no damage to any houses or cultural areas were reported.
- Waste disposal in the construction areas, necessitating a clear strategy to remove waste on daily basis in order to reduce the potential unfavorable waste accumulation in the construction site

7.2.7.1 Social Monitoring Guidelines

It was notable that the main activities that should be monitored are those related to expropriation of lands and valuation of crops. Moreover, the grievances should be also highlighted and reported.

This monitoring process necessitates some forms in order to be able to process the management and monitoring system appropriately:

1- Registration of the affected plot of land that contains the following information:
   a. Serial Number
   b. Place of the plot
   c. Governorate
   d. Agriculture valuation
   e. The total area of the land to be expropriated
   f. Name of crop owner
   g. His ID
   h. The value of the crops
   i. Duration of expropriation
   j. Signature and stamp of the owner of crops
   k. Witness from community
   l. Prepared by (Name of the employee)

2- Grievance form that includes:
   a. Serial Number
   b. Governorate
   c. Education of the person reporting a grievance
   d. Age of the person reporting a grievance

e. Gender of the person reporting a grievance
f. Topic of grievance
g. Actions to be taken

The results of the monitoring and management system should be reported quarterly to the Headquarter of GASCO and the World Bank. The monitoring and management will be implemented by the branches of GASCO in each governorate and monitored by the headquarter staff.

In order to achieve this monitoring system the following personnel are needed. However, it is worth mentioning that the majority of recommended staff is already part of GASCO. Regarding the compensation committee that is responsible for the valuation of the compensations are a manager, an accountant and a lawyer. The Supreme compensation Committee that tackle the responsibly of settling disputes regarding temporarily expropriation of lands are also from GASCO staff headed by a councilor from the Supreme Court.

The Compensation Committee should be assessed by the Agricultural Association during the process of compensation.

In addition to that, a social officer should be hired in order to do the following tasks as part of the monitoring system:

1- Provision of detailed list about the potential community stakeholders and the NGOs representatives
2- Provision of clear information about the project to the community members
3- Having a clear list of project affected people with the help of community people and the Agricultural Association
4- Conducting regular meetings with stakeholders in order to discuss the information needed and any potential complains and grievances
5- Informing the affected groups with the potential expropriation activities with the help of community people
6- Identify the compensations needed and accompany the compensation committee in order to document their work
7- Document the grievances , classify them , raise them to the responsible people to response on them, inform the people about the responses and document all the process

7.2.8 Management of Culturally Valuable Sites

The project is not expected to encounter any sites of cultural or historical significance. Nonetheless, management and mitigation guidelines have been established in case of such a situation.

Law 117/1983 for Protection of antiquities has set certain standards that should be followed during excavation works near a registered antiquity site. The Supreme Council for Antiquities emphasizes that collaboration should be established between an archeologist and an infrastructure developer during construction near an antiquity. These standards and requirements are followed among the following proposed mitigation measures:

1. Identifying comprehensive list of all registered antiquities, falling within the domain of the project, and collect their maps and identified buffer zones from the Supreme Council of Antiquities
2. Identifying locations of the network where line will be next to or near, antiquities buffer zones. In such location permission from the Supreme Council of Antiquities on excavation works should be obtained. These locations are expected to be concentrated in Old Cairo district
3. Provide supervision on implementation of construction works at these identified locations
4. No tunneling activities should be allowed under or next to monuments
5. If dewatering activities are to take place, the process should be undertaken under the supervision of foundation engineers who shall perform necessary soil investigations. The process should be tight in time schedule to avoid elongated dewatering, and possibly use under-trench culvert or tunnel to preserve groundwater table under the monument
6. Reduce vibration, in identified locations of antiquities:
    a. using manual tools whenever possible
    b. phasing work to eliminate generation of resultant vibrations from several machinery
    c. Establish cutoff barrier through a vertical trench, whenever needed, to absorb vibrations
7. Identify architecturally valuable sites and implement aesthetic designs of rising connections, choosing back sides to avoid artistic sides and components
8. In case an antiquity is found, excavation works should hold and the Supreme Council of Antiquities should be contacted to handle the site.

Possibly required monitoring activities for some antiquities, which will be based on survey report of archeological constant undertaking mitigation measures 1 and 2, include:

- Perform Elevation Reference Points (ERP) test for identified monuments if dewatering is to take place in identified locations of the network, near antiquity sites, according to the methodology mentioned in the previous section
- Monitor vibration levels at the monument location during excavation
- Undertake geophysical survey for some locations prior to construction, according to the instructions of the Supreme Council for Antiquities

A matrix illustrating management and monitoring activities during construction, proposed responsibilities of different stakeholders and approximate costs are given in Tables 7-1 and 7-2.

Table 7-1: Environmental Management Matrix during construction

Impact	Mitigation measures	Responsibility of mitigation	Responsibility of direct supervision	Means of supervision	Estimated Cost of mitigation / supervision
Reduction of traffic flow	- Construction during peak off periods - Signage and marking	Contractor	GASCO HSE + Traffic Department	Field supervision	- Contractor management costs that shall be included in normal bid price - GASCO management costs
	- Traffic detour	Traffic consultant for design and Traffic Department for implementation	GASCO HSE + Traffic Department	Review consultant reports	- L.E. 2,000 per detour
	- Road restructuring	Traffic consultant for design and contractor for implementation	GASCO HSE + Traffic Department	Review consultant reports and field supervision of execution	- L.E. 2,000 for traffic study per road
Air emissions	- Water spraying - Sound storage, transportation and disposal of stockpiles - Ensure that air emissions within legal standards	Contractor	GASCO HSE supervisor	Field supervision	- Contractor management costs that shall be included in normal bid price - GASCO management costs
	- Schedule excavation works in main roads not in low air quality	GASCO Technical Department	GASCO HSE Manager	Review contractor time schedule	- GASCO management costs

Impact	Mitigation measures	Responsibility of mitigation	Responsibility of direct supervision	Means of supervision	Estimated Cost of mitigation / supervision
	periods				
Noise	- Protect construction workers - Avoid night works whenever possible	Contractor	GASCO HSE supervisor	Field supervision	- Contractor management costs that shall be included in normal bid price - GASCO management costs
Risk of damaging infrastructure	- Collect infrastructure maps - prepare accidents log	GASCO (HSE supervisor)	GASCO HSE Manager	Review HSE site reports	- GASCO management costs
	- Use trial pits	Contractor	GASCO HSE Supervisor	Field supervision	- Contractor costs in normal bid price - GASCO management costs
	- Analyze accidents log	GASCO HSE Research	GASCO HSE Manager	Review periodic HSE reports	- GASCO management costs
Effect on structures by dewatering/tunneling activities	- Investigate buildings status - Undertake soil investigations	Structural consultant	GASCO (Technical Manager + HSE Manager)	Review consultants reports + random site inspections	- L.E. 5000/borehole - L.E. 20,000/ status report/area - GASCO management costs
	- Tight dewatering schedule - Proper well insertion - control tunneling process	Contractor	Structural consultant	Field supervision	- Structure consultant supervision: L.E. 15,000 /month - Contractor responsibility: Included in normal contractor bid
Waste disposal	- Control over construction waste	Contractor	GASCO HSE supervisor	Field supervision	- Contractor responsibility: Included in normal contractor bid

Impact	Mitigation measures	Responsibility of mitigation	Responsibility of direct supervision	Means of supervision	Estimated Cost of mitigation / supervision
	- Arrange effective drainage during dewatering				
	Arrange for asphalt recycling (not compulsory)	Contractor	GASCO HSE Manager	Review contractor contract with asphalt factory	- L.E. 100 / ton additional, transportation costs of asphalt, to contractor bid price[6] - GASCO management costs
	- Adequate handling of chemical containers	Contractor	GASCO HSE Supervisor + HSE Manager	Field supervision + review of contractor manifests	- L.E. 500 / ton additional, transportation costs of hazardous waste, to contractor bid price - GASCO management costs
Expropriation of Land	Providing compensation to the land owners	GASCO (Compensation Committee)	GASCO Headquarter and Regional branches	List of affected parties Documentation Report Receipts for the provided compensation	GASCO management staff 80,000 EGP Estimated compensations 1,000,000 EGP
Damage of crops	Compensation for the crops	GASCO (Compensation Committee)	GASCO Headquarter and Regional branches	List of affected parties Documentation Report Receipts for the provided compensation	GASCO management staff No cost Estimated compensations 2,000,000 EGP

[6] Assuming that asphalt plant is taking the asphalt free of charge

Table 7-2: Environmental Monitoring Matrix during construction

Impact	Monitoring indicators	Responsibility of monitoring	Duration of monitoring	Methods of monitoring	Estimated Cost of monitoring
Reduction of traffic flow	Traffic counts	Traffic consultant	During construction	Field count of traffic volume	L.E. 1000 point
Air emissions	HC, CO% and opacity	Contractor	Before construction	Measuring exhaust emissions in an authorized institution	L.E 200 / Vehicle
Noise	Noise intensity, exposure durations and noise impacts	GASCO HSE Department	Once quarterly during construction, with at least one measurement per contractor per sector	Noise meter	GASCO management costs
	Complaints from residents	GASCO HSE Supervisor	Continuous during construction	Documentation in HSE monthly reports	GASCO management costs
Risk of damaging infrastructure	Accidents documentation	GASCO HSE Department	During construction	Documentation in HSE monthly reports	GASCO management costs
Effect on structures by dewatering/tunnelin g activities	Deferential settlements of buildings	Structural consultant	- 2 to 3 times in the 2 weeks preceding works - Daily during works - 2 to 3 times during the four weeks following works	ERP tests	L.E. 3000/house
Waste Management	Accumulation of waste in site for long time	GASCO HSE Supervisor	Continuous during construction	Observation and documentation	GASCO management costs
	Existence of hazardous	GASCO HSE	Continuous during	Observation and	GASCO

Impact	Monitoring indicators	Responsibility of monitoring	Duration of monitoring	Methods of monitoring	Estimated Cost of monitoring
	waste in waste piles or at site	Supervisor	construction	documentation	management costs
	Existence of water ponds from dewatering	GASCO HSE Supervisor	Continuous during construction	Observation and documentation	GASCO management costs
	Smell, color or appearance of dewatering waste	GASCO HSE Supervisor	Continuous during construction	Observation and documentation	GASCO management costs

7.3 Management and Monitoring Activities During Operation Phase

7.3.1 Management of Repairs and Maintenance

The same mitigation and monitoring measures discussed for the construction phase shall also apply to repair and maintenance works that will require excavation.

7.3.2 Mitigation Measures for PRS Safety Aspects

Although a detailed Quantitative Risk Assessment for PRS operation was performed and provided in a separate report, this study includes some recommended risk reduction measures have been proposed as points of improvement in order to enhance the PRS safety standards. It should be noted that the PRS will be constructed inside the Atfeeh power station, and management of the PRS operation will be the responsibility of the Ministry of Electricity. The risk reduction measures (recommendations) include the following:

1. There is a need to develop a safe system of work, based on risk assessment for dealing with potential gas leaks.
2. Consideration should be given to the remote actuation of isolation and slam-shut valves by GASCO for different PRS's as well as the transmission and distribution pipelines.
3. There is a need to produce Hazardous Area Classification drawings for all Pressure Reduction Stations.
4. Planned preventive maintenance policy should be in place for the new PRSs.
5. There is a need to produce a 'Station Manual' for each PRS. This manual should include formalized procedures, including precautions and a site scenario specific emergency plan.
6. Site emergency plans must take into account wind direction and stability and should consider interfaces with others, e.g. GASCO as well as the public living nearby.
7. GASCO needs to consider the security arrangements for all un-manned stations.
8. There is a need that GASCO should apply risk assessment to all activities and to formalize procedures and permit-to-work systems.
9. The control room inlet door should be located in the upwind direction away from the PRS station (Inlet door should not face the PRS station).
10. Alternatively, the control room should be provided by a secondary means of escape at the back side of the room, which shall be used in case of blockage of the main escape route by jet fires.
11. It is recommended that a jet fire rated passive fire protection system to be applied to all safety critical shutdown valves ESDVs or Solenoid valves in order to maintain small isolatable inventories. (As applicable)
12. It is recommended to have pipeline marking signs indicating in Arabic and in English "Do Not Dig" and "High Pressure Pipeline Underneath" in order to prevent such extreme hazardous situation.
13. It is recommended to include the prevailing wind direction on the PRS site plan.

14. It is recommended to have an elevated wind sock installed in the PRS site, which can be seen from distance and from outside the fence to determine the direction of gas migration in case of major gas leak.
15. It is recommended to have a gas detection system within the PRS area to automatically sense the released gases as a percentage of LFL, in order to provide early warnings of gas release.
16. Also, it is recommended to have point gas detectors at the room HVAC intake (if provided) to automatically sense the released gases as a percentage of LFL, in order to provide early warnings of gas release.
17. Investigate a strategy to inform the residential area beside the PRS and the associated pipeline with the risk involved in such accidents as well as the methods required for annunciating if any leak occurs.
18. The design should fully comply with IGE TD/3 code requirements.

7.3.3 Mitigation Measures for Social Impacts during operation

The main major unfavorable impacts during the operation phase will be mitigated as follows:

1. To mitigate the leakage in the sites that might affect the agricultural lands in the areas or causing fires. That will result losing of assets or income. This necessitates compliance with maximum safety measures and close monitoring of the site.
2. For the mitigation of any crops damage in the areas due to monitoring work should be compensated according to the rules and regulations of the Egyptian Laws, the World Bank safeguards and the strategy of GASCO. Damage to agricultural lands will be compensated only for the affected crops. During the operation phase, any construction or building must be as least six meter away from the pipeline. This might result in a loss of plots of land and the community members would be very negatively affected. GASCO has already faced this problem before and have therefore developed an entity, named the Supreme Committee for Compensation, responsible for handling problems associated with compensation.
3. A clear eligibility and compensation plan should be developed to compensate the identified project affected people according to severity of impact.
4. Raising the level of awareness of the people in the project areas through different media channels and with the help of local NGOs.
5. Local Community Councils should ensure that the roads are paved immediately after finishing the installation to avoid any further congestion and disturbances.

During the operation phase, it is recommended to monitor the line, especially to make sure that no one tries to build on the routes of the line. Moreover, in case of changing the farm land into construction land, the appropriate compensation should be applied by the Supreme Committee for Compensation in order to limit the unfavorable impacts of the project.

A matrix illustrating management and monitoring activities during operation, proposed responsibilities of different stakeholders and approximate costs are given in Tables 7-3 and 7-4.

Table 7-3: Environmental Management Matrix during operation

Impact	Mitigation measures	Responsibility of mitigation	Responsibility of direct supervision	Means of supervision	Estimated Cost of mitigation / supervision
Potential safety risks due to PRS Operation	- Develop a safe system of work, based on risk assessment for dealing with potential gas leaks. - Produce Hazardous Area Classification drawings, 'Station Manual', and planned preventive maintenance policy and for all PRSs.	Safety consultant	Ministry of Electricity	Review of consultants report	- L.E. 20,000 per PRS (to be confirmed in final report)
	- Point gas detectors at the room HVAC intake (if provided) to automatically sense the released gases as a percentage of LFL, in order to provide early warnings of gas release.	PRS Staff	Ministry of Electricity	Quarterly auditing for each PRS	- MoE management costs
Expropriation of Land	Providing compensation to the land owners	GASCO (Compensation Committee)	GASCO Headquarter and Regional branches	List of affected parties, Documentation Report, Receipts for the provided compensation	GASCO management staff No cost (permanent GASCO Staff) Estimated compensations 150.000EGP
Damage of crops	Compensation for the crops	GASCO (Compensation Committee)	GASCO Headquarter and Regional branches	List of affected parties, Documentation Report, Receipts for the provided compensation	GASCO management staff No cost (permanent GASCO Staff) Estimated compensations 5.000 EGP Annually

Table 7-4: Environmental Monitoring Matrix during operation

Impact	Monitoring indicators	Responsibility of monitoring	Duration of monitoring	Methods of monitoring	Estimated Cost of monitoring
Safety aspects of PRS operation	- Installation of point gas detectors at the room HVAC intake (if provided)	Ministry of Electricity	Quarterly for each PRS	Reviewing Environmental Register, observation of site	MoE management costs

7.4 Criteria for Environmental and Social Screening the Activities of the Project

According to the environmental impacts and their correspondent mitigation measures which have been presented, criteria has been formulated for screening project activities that would trigger negative environmental impacts. These criteria and the required input from the implementing agency (GASCO) are illustrated in Table 7-5.

Table 7-5: Screening Criteria for Project Activities and Proposed Input from Implementing Agency

Likely impact	Criteria for triggering impact	Actions required by Implementing Agency (Direct implementation by GASCO and Supervision by EGAS)			
		Design phase	Tender phase	Construction phase	Operation phase
Reduction of traffic flow	- Traffic department requiring traffic solutions for some roads - General occupation of parts of road width	- Ask for the review of network route by Traffic Department - Assign traffic consultant to design detouring or restructuring of some roads based on request from Traffic Department	Ensure that contractor include mitigation measures in his tender	- take excavation permits from Traffic Department - Supervise contractor implementing mitigation measures - Supervise consultant monitoring of some roads based on request of traffic department	- Apply mitigation measures mentioned during construction in case of line repair
Air emissions	Excavation / backfilling works	n/a	Ensure that contractor have vehicles complying with emission standards	- Supervise mitigation measures by contractor	- Apply mitigation measures mentioned during construction in case of line repair
Noise	Excavation / backfilling works	n/a	n/a	- Supervise mitigation measures by contractor - Monitor noise levels	- Monitor noise levels in PRSs - Apply mitigation measures mentioned during construction in case of line repair
Risk of damaging infrastructure	Occurrence of accidents during	Collecting available infrastructure maps	n/a	- Supervise contractor	Apply mitigation measures mentioned

Likely impact	Criteria for triggering impact	Actions required by Implementing Agency (Direct implementation by GASCO and Supervision by EGAS)			
		Design phase	Tender phase	Construction phase	Operation phase
	implementation			- Documentation of accidents	during construction in case of line repair
Effect on structures by dewatering/tunneling activities	Implementation in areas having weak structures associated with tunneling or dewatering activities	- Decide areas where the impact is triggered	- Assign construction consultant to ensure that contractor technical proposal should include mitigation measures 3-6	- Assign construction consultant for evaluating the situation and to supervise the contractor - Supervise work of consultant and contractor	Apply mitigation measures mentioned during construction in case of dewatering for line maintenance
Improper management of construction waste	Construction activities	n/a	Ensure contractor's commitment for sound waste disposal	Supervise contractor	- Apply mitigation measures mentioned during construction in case of line repair
Improper management of chemicals barrels	Using excavation chemicals, lubricant oil, fuel, or hazardous material on site	n/a	Ensure that contractor has considered such situations in his bid	Supervise contractor	- Apply mitigation measures mentioned during construction in case of line repair
Improper disposal of contaminated water	Dewatering from contaminate trench, beside UST or AST system	Determine likely problematic locations	Ensure that contractor has considered such situations in his bid	Supervise contractor	- Apply mitigation measures mentioned during construction in case of line repair

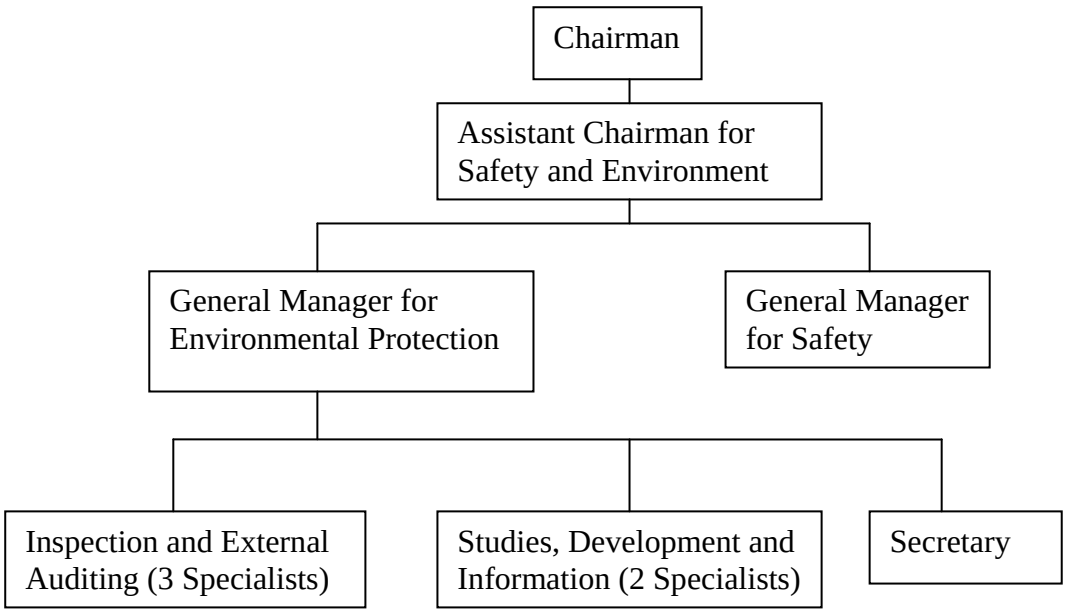
7.5 Institutional Framework for Implementation

7.5.1 Environmental Management Structure of the Implementing Agency

The project shall be implemented by the Egyptian Natural Gas Company (GASCO), an affiliate of the Egyptian Natural Gas Holding Company (EGAS), which owns a majority share. EGAS was established in 2001 as an entity focusing on developing Natural Gas business including upstream and downstream operations. EGAS has number of affiliate companies with different specialties in natural gas business chain.

The organizational chart, Figure 7-1, of EGAS indicates that the responsibility of environmental management falls under the responsibility of Assistant Chairman for Safety and Environment, who supervise the General Manager for Environmental Protection and five environmental specialists.

Figure 7-1: Organizational Chart for Environmental Protection Department in EGAS



Being certified for ISO 14001:2004, EGAS has a well defined Environmental Management System in place and running. The Environmental Policy of EGAS mentions that the company and its affiliates are committed to:

- Comply with legislation relevant to their nature of activity
- Provide training and awareness for their staff in order to carry out their work safely
- Achieve continual improvement in the fields of safety, health and environment
- Investigate and analyze incidents to prevent its recurrence
- Follow-up companies and contractors compliance and implementation of health, safety and environment rules, regulations and provisions
- Provide necessary information and data on health, safety and environment
- Ensure execution of the policy through setting objectives, targets and an action plan. The policy shall be reviewed whenever needed

Staff members of EGAS carry out audits and inspections on affiliate companies, of which GASCO is one, to make sure the EMS is being implemented according to set objectives and targets. As part of the EMS procedures, GASCO presents monthly and quarterly reports about its environmental performance. EGAS reviews these reports, and makes occasional site inspections to compare these reports with field conditions.

GASCO has direct involvement of the environmental management and monitoring of the natural gas network. The Environmental Department of GASCO includes 5 specialists who are responsible for carrying over this task.

One of the standard tasks of the Environmental Department of GASCO, which is followed up by EGAS, is establishing Environmental Register for PRSs and buildings, and frequent auditing of this register. For PRSs, the Environmental Register is audited by the Environmental Department has of GASCO. The HSE Department audits each PRS twice annually on the average, in addition to infrequent and emergency inspections. The routine monitoring activities performed for each PRS include:

- Visual inspection of solid waste and scrap, and disposal methods
- Visual inspection of existence of liquid waste such as leaked condensate hydrocarbons or chemicals used in the heaters
- Checking that handling of hazardous waste is according to the approved procedures, which are described below
- Use gas analyzers to measure SO_2, CO, CH_4 and O_2 in ambient air, and detect possible leaks
- Measure noise at different locations of the PRS

GASCO HSE personnel have received training on environmental auditing, environmental impact assessments for industrial establishments, and environmental legislation.

The Environmental Department of GASCO has been less involved on design, planning, tendering and construction procedures of natural gas connection projects. Their role has been more effective in the operational phase according to the described procedures above. However, the Safety Department in GASCO usually reviews designs, and assigns full time staff member to supervise the construction contractor, making sure that adequate safety measures are considered during design and implemented during construction.

7.5.2 Required Resources

It has been concluded from the assessment of the existing practices of the GASCO Environmental Department that they are following sound environmental standards in the operation phase. However, the involvement of the department should be emphasized during the design, tendering and construction phases according to the screening criteria illustrated in Table 7-3.

GASCO management should take procedures to involve the HSE department in the approval and clearance steps of project designs, tenders evaluation, phasing of implementation and construction. The involvement of GASCO HSE Department should be reported in their monthly and annual reports submitted to EGAS, who should make sure that the integration of environmental aspects is adequately addressed during design, tendering and construction.

The required additional resources for EGAS are considered suitable for their role in reviewing monthly and quarterly reports produced by GASCO. However it is recommended to improve the human resources of GASCO through recruiting additional personnel and training the existing and new personnel on environmental management issues.

The estimated human resources for the new project are:

- About 300 total workers, including 40-60 workers for each construction phase.

8. Public Consultation

The preparation of the ESIA of Nubaria-Metnama ESIA in January - February 2011 coincided with 25th January Revolution in Egypt. This time involved major changes and instabilities driven by the popular protests and strikes which prevailed across the country. Under theses instable conditions of the country, the ESIA team strived to ensure that the ESIA is prepared and results are reviewed with the highest level possible of participation from various stakeholders. Several participatory consultation activities have been conducted during the scoping phase, and the disclosure of the ESIA results is explained in more detail below.

8.1 Scoping Phase

As explained in Section 1.3.3, the scoping phase of the ESIA preparation involved carrying out consultative interviews with relevant stakeholders across the line according to the list shown under Annex C. The findings from this phase are incorporated into the ESIA. In particular these interviews were successful in:

- Familiarizing the ESIA team with GASCO compensation policy and identifying the main common principles between this policy and WB OP 4.12.
- Giving information on the nature of farming, crops, and land shares within the project area.
- Introducing the project to a number of stakeholders, including farmers, who will be the key affected groups of the project.
- Assuring the potentially affected groups that compensation schemes are in place and that actual inventory/survey of the affected lands and crops will be prepared as part of the project in order to provide fair compensation to the affected farmers.

8.2 Public Consultation

In order to review the findings of the draft ESIA, a collective public consultation workshop was organized to allow the various groups of stakeholders to come together and provide comments on the drafted ESIA. To announce for the event and invite stakeholders the following activities have been carried out:

An announcement for a “Public Invitation” has been published in Al Akhbar newspaper. An official letter has been directed to the Secretary General (SG) of Menofia Governorate[7] stating the workshop objectives, time and venue. A list of relevant stakeholders that should participate in the workshop has also been prepared and attached to the letter. The letter asked the SG to direct official invitation to representatives from the relevant affiliations (the list is included in Annex C). Despite the daily strikes across the Governorate and the close of several governmental offices, Menofia Governorate helped in directing personal invitations to the nominated stakeholders. Menofia EMU also provided the ESIA team with contact details for the nominated stakeholders, and invitations have been directed through phone calls from EcoConServ.

[7] Menofia Governorate has been selected as an intermediate Governorate located on the project geographic range.

Figure 8-1: Presentations during the public consultation- February 17th, 2011

Figure 8-2: Public consultation participants- February 17th, 2011

Table 8-1: Key comments and responses raised during the public consultation of February 17th, 2011

Questions/Recommendations	Responses
Dr. Ayman Fathy **(a)** Sometimes the incoming labor might be a burden in the hosting areas as they will for example need food or bread that is not so easy to get. **(b)** We should take into consideration any affect on the infrastructure, especially water supply. **(c)**Any potential plan to secure the line outside the electricity station and inside it should be clarified.	***GASCO Responsible (Mostafa Abu El Makarem)*** **(a)** We try to benefit the areas where the project will pass near to, but in case of limited area resources, we will provide our workers with their needs from another area. **(b)** We have a clear monitoring plan in the Environmental & Social Management Plan. **(c)** In the full report, it is crystal clear that the line will be monitored and secured by GASCO outside the electricity station, but it is the responsibility of the electricity authority to monitor the line inside the station. ***Eng. Hany, GASCO*** I would like also to add that we have already implemented some projects in 15 Governorates. No problems has occurred in any areas
Mr. Emad, NGO Representative Will the compensations be paid before or after the starting of work?	***Eng. Gaber, GASCO*** All compensations should be paid to the farmers before putting any equipment in the land. We inform the farmers 45 days before starting the work in order to pay their compensation. Then we inform them that we will start the work 24 hours before starting working
Ms. Mervat, NGO representative Will the compensation be paid for the total area of the lands, or only for the areas where you will dig for your project?	***Eng. Gaber, GASCO*** We have two types of lands: Agricultural, and Potential Residential (this is the land that might be part of the urban areas)

Questions/Recommendations	Responses
	The potential residential should be compensated for 7 meters wide and whatever length needed to protect our line. This is the responsibility of the Supreme Committee for Compensation headed by a counselor from the Supreme Court. The whole potential expropriated lands should be compensated for according to the market price. This is the Egyptian and World Bank rules and regulations Regarding the agricultural lands it will be temporarily expropriated and we will pay for the crops. If there is no crops we will pay for the renting
Eng. Tawfic, Manager of Maintenance Department **(a)** Almost 90% of the line is located in Menofia Governorate, My Department is responsible for providing the allowance and permission for the construction of new houses I would like to know about the safety areas needed for the line in order not to allow anyone to build in. In addition we need the final maps for the line. **(b)** Also we don't have a clear description for the horizontal drilling	***Eng. Gaber, GASCO*** **(a)** The safe area needed between the line and any residential area should be during digging about 20 meter. **(b)** The infrastructure should not be touched, therefore we apply the horizontal drilling in order not to affect the infrastructure. So we go along El Rayah El Nasry in order to avoid any potential overlapping with the infrastructure I would like also to notify that we have a temporary expropriation decree from the Military and the Local Councils in order to facilitate our work. However, we don't use this type of decree except to make pressure on the farmers in case of no approval ***Eng. Ibraheim, GASCO*** The safety distance is ruled by an Egyptian Law 4/88 that identifies the safe distance with 6 meters away from the line, according to the Law. We have another safety measure that the valves are automatically turned off in case of any problem

Questions/Recommendations	Responses
Mr. Hamdy, Head of Land Protection Authority You should coordinate with different authorities before the implementation. Also I would like to ask about the thickness of lines near to the residential areas.	***Eng. Ibraheim, GASCO*** Of course we arrange with different authorities before the kick off of the implementation Regarding the thickness near to the residential areas. As you know the pipe lines have different thickness measurements, near to the residential areas it is 77% more than the standard. Also each 5 years we scan the pipes in order to check for any potential erosion. Any change of the thickness measurement should be repaired The line is put 1.5-2 metres below the surfaces
Eng. Medhat, an NGO The pressure of the line is how many bar?	***Eng. Ibraheim, GASCO*** It is 70 bar since and will be reduced at the power station to 20 bar.

Questions/Recommendations	Responses
Ms. Amany, Directorate of Irrigation **(a)** We need you to coordinate with the other authorities, especially regarding excavations. **(b)** Will the line provide natural gas to the villages? **(c)** I think that the quantity of water to be used for hydrostatic test is too high that it should cover 105km. From where can you get all of this quantity?	***Eng. Ibraheim, GASCO*** **(a)** Regarding the coordination before starting the project we have already conducted meetings with some authorities and before the implementation we will have another meeting. **(b)** Regarding the connection to the line. We have the capacity to serve all populations and factories in the areas in the 4 Governorates as their potential consumption will not exceed 0.5% of the capacity of the new line The new line is connected to the national Gas net in Nubaria mainly to provide the NG to the electricity station, but in case of any expansion in the usage of gas in the areas it is no problem . The line was designed to cover 180% of the needs of the electricity station indicating that we have sufficient. **(c)** Regarding the static water needed, the it was part of the mitigation measurement to use water slowly in order not to affect the fisheries in addition we will need water to cover around 20km only not 105 km that water will be transferred from valve room to the another one. Also we get permission from the Irrigation Authority regarding the usage of water. ***Eng. Gaber, GASCO*** **(a)** Regarding the coordination with the other authority we had a meeting with General Secretary in the Governorate. Some representatives from Irrigation department have attended. They asked for the maps and designed sector القطاعات التصميمية in order to be provided to the contractor. Also we agreed that the contractor who implemented the covered disposal الصرف المغطي will be responsible for any rehabilitation or re-estate for the damaged part if happened.

Questions/Recommendations	Responses
Eng. Ahmed, Water Company In case of overlapping with water lines, how can you react?	***Eng. Gaber, GASCO*** We have two types of Water connection The main line which lie deep in the ground and we pass our line over it The branches, we detach them and put our lines then we reinstall them ***Eng. Ibraheim, GASCO*** It is a must to respect all lines and all authorities so that they will respect our line. It is for the safety of our project
Mr. Seherif, Civil Protection Authority I checked the line of GASCO from Quesna where I noticed that it passes near to the residential area.	***Eng. Mostafa, GASCO*** This was unused old line that we had to reroute due to safety reasons. But it is very important to have such valuable notice. We have a hotline 149 please in case of you find such thing immediately phone us. It is crucial to report such actions in order to protect our line

Annex A: Baseline Social Data

The following are some tables that describe the three governorates excluding 6th of October due to the limited information provided.

Table (A-1): Administrative Division

Behera	Menoufia	Qalubia	
15	9	7	**No. of Marakz**
15	10	10	**No. of Cities**
0	2	2	**No. of Districts**
84	70	47	**No. of Rural Local Units**
497	315	197	**No. of Villages**
6	0	0	**Villages Outside Local Units**
5737	901	900	**No. of Hamlets**

Source: Description of Egypt by Information 2007 Information and Decision Support Center

Table (A-2): Land Use

Behera	Menoufia	Qalubia	Unit	
9826	2499.0	1124.28	Km2	**Total area**
7093.84	2435.93	1072.72	Km2	**Total populated area**
163.04	103.14	110.13	Km2	**Housing and scattering areas**
129.54	103.39	65.45	Km2	**Facilities and cemetries**
188.54	5.17	1.02	Km2	**Ponds and fallow**
4019.26	1366.76	807.23	Km2	**Agricultural land within agricultural borders**
2593.46	857.47	88.89	Km2	**Agricultural land outside agricultural**
0.67	1.34	3.95	1000 persons/ Km2	**Population density in the populated area**
0.48	1.31	3.77	1000 persons/ Km2	**Population density in the total area**
72.2	97.5	95	%	**Populated area (% of total area)**

Source: Description of Egypt by Information 2007 Information and Decision Support Center

Table (A-3): Population

Beheira	Menoufia	Qalubia	Unit	
4900.9	3374.2	4386.8	Thousand persons	**Total population**
48.7	48.5	48.6	%	**Females (% of total population)**
4.3	4.2	4	Person	**The average of family members**
24.3	24.8	26.1	Live birth/ Thousand persons	**Birth rate**
5.2	6.1	5.4	Dead person/ Thousand persons	**Mortality rate**
19.1	18.7	20.7	Per thousand persons	**Population natural growth rate**
989.3	1085.3	694.3	Contract/ 100 thousand persons	**No. of marriage contracts**
83.2	83.3	98.9	Incident/ 100 thousand persons	**No. of divorce incidents**

*Source: Egyptian Human Development Report 2010
Source: Description of Egypt by Information 2007 Information and Decision Support Center

Table (A-4): Major Crops 2006

Beheira			Menoufia			Qalubia			unit	
Productivity	Production	Area	Productivity	Production	Area	Productivity	Production	Area		
4.1	899.2	217	---	---	---	3.48	112.13	32.20	1000 tons	**Rice**
6.0	873.4	145	5.50	126.28	22.96	5.06	41.24	8.15	1000 quintars	**Cotton**
18.1	9050.8	501.1	19.60	2137.58	109.06	17.90	873.47	48.80	1000 ardabs	**Wheat**
9.5	585.4	61.7	---	---	---	---	---	---	1000 ardabs	**Bean**
---	---	---	8.73	80.48	9.22	---	---	---	1000 tons	**Potatoes**
---	---	---	3.97	1009.66	254.21	3.24	243.70	75.13	1000 tons	**Maize**

Source: Description of Egypt by Information 2007 Information and Decision Support Center

Table (A-5): Agricultural Activity 2006

Beheira	Menoufia	Qalubia	Unit	
1557	356.1	179.2	Thousand feddans	**Total area of cultivated land**
831	351.7	179.2	Thousand feddans	**Total area of old cultivated land**
726	4.4	0	Thousand feddans	**Total area of newly cultivated land**
67	59.8	67	%	**Cultivated area (% of total area)**
2789	686.2	333	Thousand feddans	**Total cropped area**
1.8	1.93	1.86	time	**Cultivated land condensation factor**
6.5	2.2	2.5	Billion m^3	**Amount of water used for agricultural sector**
400	286	193	Association	**No. of agricultural cooperative associations**
48	34	21	Association	**No. of specific associations**
47.1	48.8	92.8	Thousand tons	**Total production of meat**
831	291	161	Thousand tons	**Total production of milk**
1406	972	3091	Farm	**No. of poultry farms**
22	44	29	Slaughterhouse	**No. of cattle slaughterhouses**
4	7	30	Slaughterhouse	**No. of poultry slaughterhouses**

Source: Description of Egypt by Information 2007 Information and Decision Support Center

Table (A-6): The Standard of Living

Beheira	Menoufia	Qalubia	Unit	The Standard of Living
4781.4	4557.5	4616.1	EGP	**Average of annual household expenditure on food & nonalcoholic beverages**
777.1	847.7	875.4	EGP	**Average of annual household expenditure on clothing & foot wear**
1509.7	1689.3	1820.4	EGP	**Average of annual household expenditure on housing, water, gas & others**

Source: Description of Egypt by Information 2007 Information and Decision Support Center

Table (A-7): Income Distribution and Poverty

Behera	Menoufia	Qalubia	Unit	Income Distribution and Poverty
9451.6	9854.0	8134.4	EGP	**GDP per Capita**
3039	3355	3754	EGP	**Expenditure per Capita**
28.2	26.4	25.8	%	**Lowest 40% of people**
2.6	3.1	3.1	%	**Ratio of highest 20% to the lowest 20%**
0.19	0.23	0.23	%	**Gini coefficient**
23.5	17.9	11.3	%	**% Poor of total population**
3.8	3.1	1.8	%	**Ultra poor**
17.8	14.2	9.3	%	**Wages of poor households**

Source: Egyptian Human Development Report 2010

Table (A-8): Labor Force and Unemployment

Beheira	Menoufia	Qalubia	Unit	Income Distribution and Poverty
38.2	35.1	30.5	% of total population	**Labor force (15+)**
30.6	26.1	18.7	%	**% of women in labor force (15+)**
59.3	32.9	15.6	%Agriculture	**% of labor force (15+)**
10.4	18.8	32.6	%Industry	
30.3	48.3	51.8	%Services	
11.4	21.0	20.8		**Professional and technical staff**
36.5	60.3	72.0	%Total	**Wage earners (% of labor force 15+)**
15.5	39.3	53.1	%Female	
18.4	31.1	30.1	%Total	**Employment in governmental public sector**
12.4	32.6	41.1	%Female	
6.8	6.5	8.0	Total	**Unemployment rate (%)**
13.7	13.0	26.2	Female	
11.8	10.0	10.4	Urban	**Unemployment rate (%)**
5.7	5.6	6.6	Rural	
1.9	3.9	2.8	Below secondary	**Unemployment rate by education**
76.9	53.4	59.3	Secondary	
21.2	42.7	37.9	University	
236.8	259.1	304.6		**Future labor force replacement ratio**

Source: Egyptian Human Development Report 2010

Annex B: Compensation and Grievance Forms

Compensation form

_____	**Serial**
_____	**Place of the plot**
_____	**Governorate**
_____	**Agriculture valuation**
_____	**The total area of the land to be expropriated**
_____	**Name of crop owner**
_____	**His ID**
_____	**The value of the crops**
_____	**Duration of expropriation**
_____	**Signature and stamp of the owner of crops**
_____	**Witness from community**
_____	**Prepared by (Name of the employee)**

Grievance form

_____	Serial
_____	Date
_____	Governorate
_____	Education of the person reporting the grievance
_____	Age of the person reporting the grievance
_____	Gender of the person reporting the grievance
_____ _____ _____ _____ _____ _____ _____ _____ _____ _____	Topic of grievance
_____ _____ _____ _____ _____ _____ _____ _____ _____ _____	Actions to be taken
_____ _____ _____ _____ _____ _____ _____ _____ _____ _____	Monitoring of the action

Annex C: Public Consultation Documents

Figure (C-1): Scanned Copy of the Al Ahram Announcement for the Public Consultation (published on 27th January 2011)

Table (C-1): List of stakeholders interviewed during the scoping phase

1	Ahmed Abd El Raouf	Head of Geodesia Department- Gasco
2	Hany El Saed	Lawyer in Gasco
3	Ahmed Galal Khairy	Head of enironmental Department Gasco
4	Magdy Aly Abd Hady	Ferry worker
5	Islam Abd El hady	Farmer
6	Husein Tawfeik	Farmer
7	Amgad Shawqy	Farmer
8	Mostafa Hassan	Head of Security Department in North Giza Electricity Station
9	Ahmed	Operator
10	Attendee refused to give a name	Farmer
11	Attendee refused to give a name	Farmer
12	Attendee refused to give a name	Farmer
13	Attendee refused to give a name	Farmer
14	Attendee refused to give a name	Farmer

Figure (C-2): Scanned Copy of the Al Akhbar Announcement for the Public Consultation (published on 11th February 2011)

Table (C-2): List of Participants in Menoufia Public Consultation for Numbaria-Metnama Gas Pipeline -Thursday 17 February 2011**,** Menoufia University Hotel

No.	Name	Job Title	Phone no.
1	Gihan Rashad Aamer	Director High Institute for Archeology	0121620810
2	Ahmed Ragab Gaafar	Director Environmental Dept of the Governorate	0163327692
3	Said Osman Badr		010769059
4	Heba Mohamed Khodir	Environmental Researchers of the Governorate	0107264840
5	Eng. Ahmed Ibrahim Elaw	Director Drinking Water Sector of the governorate	0120900331
6	Eng. Yahia Ibrahim Taha	Director. Transportation sector	0107742919
7	Eng. Ihab Salah Hassan	Deputy Director Environmental Protection sector.	0108818956
8	Eng. Ahmed Abd El samea		01606010824
9	Eng. Amany Atia Kafafe	Ministry Of Irrigation	0105233944
10	Ibrahim Mohamed El sakaa	Driver	0124917542
11	Colonel. Sherif Mohamed Ali	Civil Society Protection Agency	0167518601
12	Marwa Gaber Tahwn	PhD. Dentist	0105113925
13	Zainab Mohamed Hafez	EcoConServ Social Expert	0166127117
14	Hany Bayoumy Abd El Halim	Environmental Researcher of the Governorate	0162974723
15	Mohamed Reda Shaaban	Environmental Researcher of the Governorate	0107720552
16	Mohamed Fathy Taha	Environmental Sector of the Governorate	0102799807
17	Eng . Tawfik Mohamed Gad	Director of Maintenance Sector of the Governorate	0103718703
18	Mr. Bahgat Hamam	Chairman of Environmental Association.	2320760
19	Dr. Mohamed Abd El fatah Tahwn	General Secretary of Young Generation Club	0109545999

No.	Name	Job Title	Phone no.
20	Hamdy Mohamed El Dib	Director of Land Protection Sector of the Governorate	0124033018
21	Usama Kamal Shafik	Member of the Regional Union of Menoufia	0106202006
22	Mervat Saad Hassan	Goodwill Association	0122504777
23	Emad Abd El Wahab Mogheth	Goodwill Association	0104247726
24	Galal Galal Ibrahim	Goodwill Association	0101639354
25	Said Mohamed Imama	Driver	
26	Abd Alla Abd El Aziz El Shikh	Director of Technical Office of the governorate	0101230598
27	Khaled Mohamed Abd El Fatah	Director Gasco	0111117560
28	Ahmed Aly Ahmed	Chemist	0165516080
29	Hassan Mohamed Fouad	Chemist	0123653335
30	Ibrahim Mahmoud Ahmed	Msc. Environmental Risk Assessment	0106072291
31	Dr. Hany Kamal Wally	Director Environmental Implementation	0101660795
32	Ahmed Sayed Ahmed	Implementation Director	0106677389
33	Gaber Mohamdy Tahwn	General Director	
34	Mohamed Hammad Mousalam	Coordinator	0106072038
35	Ihab Ramdan Gomaa	Unit Head	0111117247
36	Mostafa Abou El Makaram		0124600002

Figure (C-3): Scanned Registration Form for Nubaria-Metnama Gas Pipelines Public Consultation Workshop (17 February 2011)

جلسة الاستماع و مشاركة المجتمع المحلي في إطار إعداد دراسة تقييم الأثر البيئي و الاجتماعي و سياسة إعادة التوطين لمشروع خط أنابيب الغاز النوبارية ميت نما

فندق جامعة المنوفية – محافظة المنوفية

الخميس ١٧ فبراير ٢٠١١

استمارة تسجيل

No.	الاسم	الوظيفة و الجهة التابع لها	الإيميل	تليفون	التوقيع
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EcoConServ

GASCO

جلسة الاستماع و مشاركة المجتمع المحلي في إطار إعداد دراسة تقييم الأثر البيني و الاجتماعي و سياسة إعادة التوطين لمشروع خط أنابيب الغاز النوبارية ميت نما

فندق جامعة المنوفية – محافظة المنوفية

الخميس ١٧ فبراير ٢٠١١

استمارة تسجيل

No.	الاسم	الوظيفة و الجهة التابع لها	الإيميل	تليفون	التوقيع
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GASCO

جلسة الاستماع و مشاركة المجتمع المحلى فى إطار إعداد دراسة تقييم الأثر البيئي و الاجتماعي و سياسة إعادة التوطين لمشروع خط أنابيب الغاز النوبارية ميت نما

فندق جامعة المنوفية – محافظة المنوفية

الخميس ١٧ فبراير ٢٠١١

استمارة تسجيل

No.	الاسم	الوظيفة و الجهة التابع لها	الإيميل	تليفون	التوقيع
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