The Egyptian Natural Gas Company

Atfeh station
Natural Gas Pipeline, Egypt
(modification of old Atfeh station feeding gas pipeline accepted by WB)

ENVIROMENTAL AND SOCIAL IMPACT ASSESSMENT

November 2014
Executive Summary

Introduction

The proposed project is an integral part of Egypt’s strategy which aims to expand the uses of natural gas as a clean source of energy. This project aims to provide natural gas to the Atfeeh power station and to strengthen the national network of gas. The Egyptian Company for Natural Gas (GASCO) is taking the responsibility of the implementation of this project, with funding and assistance from the World Bank.

GASCO has been asked to prepare a modified Environmental and Social Impact Assessment, in compliance with the requirements and regulations of the Egyptian Government and the World Bank.

Approach to Study

- Assessment of the potential environmental and social impacts of the project.
- Comparison of impacts with regard to the requirements and national and international guidelines.
- Assessment of the environmental and safety guidelines which is practiced on an ideal basis through gas delivery activities in Egypt.
- Inclusion of stakeholder concerns at multiple stages through early scoping session and final public consultation.
- Monitoring of the Egyptian laws and the World Bank standards, which might affect the project during implementation.
- Preparation of the environmental management plan and the environmental monitoring plan to mitigate the potential negative impacts and monitor the compliance process of the relevant environmental laws.
- Provision of an integrated plan for monitoring, evaluating and determining compensation strategies for groups likely to be affected as a result of the implementation of the project.
- Evaluation of the institutional capacity of GASCO to implement the project and proposed mitigation measures, and suggestion of institutional capacity raising means if necessary.

Project Description

Pipeline Route

(atfeh station gas pipe line 30" pipeline with length of 1.2 km)

The route starts by making hot-tap on an existing gas pipe line (koraymat – bany swef 30") then it extends toward west intersecting koroymat – bany swef road with length equal to 300 m till it reaches front of hagara youth Centre then extends towards north direction parallel to koraymat-bany swef road for a distance equal to 900 m including 200 m parallel to eastern fence of Atfih power station till it reaches to pressure reduction and metering station inside atfih power station with total length about 1.2 K.M.)
Construction Phase

The project will be carried out under the supervision and control of GASCO. It is anticipated that the construction phase will continue for 6 months, and includes the following activities:

- Leveling and preparing of the temporary roads leading to the work sites
- Storing of pipes
- Trenching
- Welding and checking the seams
- Tweaking the welding joints
- Visual checking of the welding joints
- Inspection
- Air tests
- Laying pipes in the trenches
- Valves installation
- Connection works with valves
- Backfill works
- Cleaning works
- Preparation for tests
- Hydrostatic test
- Additional air test
- Water discharging
- Magnetic cleaning
- Drying and delivery

Operation Phase

Normal operation will include routine audits on pressures and condition of the pipeline. Normal maintenance and monitoring works will also be performed, including a leakage survey and patrolling for encroachment. In case of leak detection, or damage of part of the pipeline, the damaged pipe is replaced. Standard procedures are in place for such incidents.

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.

Luckily, this pipeline is intended to pass though empty desert areas. Moreover, the line will pass by the protected areas of highways. GASCO has an unwritten strategy that thoroughly avoids any construction buildings including: houses, graveyards, religious buildings and historical areas. "It is not allowed for us to pass through houses, mosques, churches, graveyards or any other historical areas. We try to do our best to avoid those areas, therefore the start point of the project and the end points are fixed but their routes might be changeable 10-20 meters right or left to the originally planned line," reported an engineer from GASCO.
The path selected by GASCO is sufficiently short and well-chosen as there are no population of any kind on the path of the line route.

**Positive Environmental and Social Impacts**

Achievement of the previously mentioned project objectives represents many of the social and economic benefits, and will support the achievement of Egypt's strategy for the energy sector. The most significant positive impacts to be achieved are:

- Providing work opportunities for local untrained labor or limited trained labor in construction works. This is a positive social indicator especially if we looked at the unemployment rates, which is about 10% of the total workforce.
- To achieve increased commercial activities (such as restaurants and cafes) at construction sites.
- To stimulate the sale and rental of building materials and construction equipment at the targeted areas, where such projects provide a good marketing opportunity, particularly as a result of distance from the production plants that are buying from them in bulk.
- Increased opportunities for workers in the various means of transportation in the different locations, and in particular light transportation means, such as motorcycle and Tuk Tuk,
- Contribute to improving the opportunities for targeted communities to benefit from the natural gas service, which supports the feeling of citizens that there are someone who cares about them, their living conditions improvement and provision of services for them.
- Utilization of housing units for the project management at site, as well as to accommodate the workers.
- Achievement of sustainability and continuity of the energy source, which is environmentally safer and comes with less economic cost. The life span of the facilities used to generate electricity at power stations that will be supplied by gas will be extended. This will lead to improved continuity of electricity in the targeted governorates of Egypt.
- The ability to make subsidiary gas connections for the various governorates, which could result in delivery of natural gas to houses around the clock.
- Economic benefits as a result of using sustainable local source of energy at the power stations, which will work on the stability of the fuel cost price, unlike other unstable sources such as fuel oil and diesel fuel. This will also reduce the subsidiary cost of petroleum materials which overburden Egypt.
Environmental Impact Rating Summary

<table>
<thead>
<tr>
<th>Phase</th>
<th>Impact Category</th>
<th>Impact Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>Hazardous waste generation</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Risk to infrastructure</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Construction/excavation waste generation</td>
<td>X</td>
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<td></td>
<td>Water use/wastewater generation</td>
<td>X</td>
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<td></td>
<td>Air emissions</td>
<td>X</td>
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<td></td>
<td>Noise production</td>
<td>X</td>
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<td></td>
<td>Soil quality degradation</td>
<td>X</td>
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<td></td>
<td>Biodiversity and habitat destruction</td>
<td>X</td>
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<td>Stability of existing structures</td>
<td>X</td>
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<td>Traffic disruption</td>
<td>X</td>
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<tr>
<td>Operation</td>
<td>Accidents and emergencies</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Repairs and maintenance</td>
<td>X</td>
</tr>
</tbody>
</table>

Main Construction Impacts

Hazardous Waste Generation

The primary sources of hazardous waste are:

- Demolished asphalt
- Containers of chemicals and lubricant oils used for construction machinery

Asphalt waste will come from the open-cut road crossings, while the chemicals and lubricants will result from the use of construction and excavation machinery. Articles 26 through 28 of the Executive Regulations of Law 4 lay down certain steps that must be followed for the granting of handling licenses for the waste.

Improper disposal of the waste can potentially directly affect the health of anyone who comes in contact with them. Potential soil contamination may result from improper hazardous waste storage, handling, and disposal practices, as well as potential spillage and/or leaks during the course of the construction activities. There is a slight risk of a spilled or leaked substance spreading beyond the project site as a result of nearby ground or surface water contamination, thus becoming a more significant environmental risk, but in general the potential of this impact is local in nature.

Damage to Existing Infrastructure

Due to the very small length of the gas pipe line which is 1.2 K.M a great care will be given to all 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.

**Main Operational Impacts**

*Accidents and Emergencies (Quantitative Risk Assessment)*

In order to assess the potential impact of pipeline operation in terms of human health and safety, a Quantitative Risk Assessment (QRA) was performed to determine the threat of injury or fatality to the public in the case of an accident or emergency. The nature of the project is such that an unforeseen failure in the pipeline operation could result in the release of significant amounts of natural gas into the surrounding environment. The possibility of this gas being ignited poses an environmental risk and threatens the safety of individuals and the public. This risk is fully assessed in the accompanying QRA report.

**Social Impacts**

*Social Impacts during Construction*

- No PAP at all in the project area.
- Permanent acquisition of land for the establishment of the only valve room is on the land owned by government.
- Potential traffic congestion due to the accumulation of construction materials and dust that will result from digging. From a social prospective, this impact might affect the income of microbuses, small vehicles and taxi drivers.
- Potential temporary inconvenience as result of the construction activities. This could be in the form of accumulation of wastes (both construction and domestic waste in the construction areas, associated odor, air emissions, especially dust as a result of excavation. These impacts are of temporary nature and will be of very limited level of severity, particularly since the construction activities will be in non-populated areas
- Risks of damaging existing community infrastructure, especially water pipes that are not mapped, can have detrimental social repercussions. Disruption of other utility services such as electricity and communications can also be a nuisance to those affected.

*Social Impacts during Operation*

The possibility of a gas leakage or the occurrence of fires, but likely there are no residents in the area.
# Environmental Management Plan

Environmental mitigation matrix during construction

<table>
<thead>
<tr>
<th>Impact</th>
<th>Mitigation measures</th>
<th>Responsibility of mitigation</th>
<th>Responsibility of direct supervision</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous waste generation</td>
<td>Separation of asphalt waste, arrange for asphalt recycling</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Vehicle repairs and fuelling off site, on appropriate surfaces</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Approved storage and disposal of chemical and lubricant containers</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Risk of damaging infrastructure</td>
<td>Consult maps before excavation work</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Use of trial pits</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Analysis of accident log</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Construction/Excavation waste generation</td>
<td>Identification and use of approved nearby disposal sites through local authority</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Designation and use of appropriate stockpiling locations on site</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Daily hauling of waste to disposal site in covered trucks</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Water use/wastewater generation</td>
<td>Acquire discharge permits from sewage/irrigation authority</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Collection of potentially contaminated streams in separate tanks</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Air emissions</td>
<td>Water spraying before excavation, filling, loading and unloading</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Spraying of stockpiles, storage in covered areas</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td><strong>Noise Production</strong></td>
<td>Implementation of regular maintenance schedule for machinery</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
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<td></td>
<td>Limit exposure time of workers to elevated noise levels</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Use of earmuffs</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td><strong>Effect on structures by dewatering/tunneling activities</strong></td>
<td>Survey of buildings with damage potential</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
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<tr>
<td></td>
<td>Soil investigations</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td><strong>Traffic congestion</strong></td>
<td>Signage and markings to instruct drivers</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
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<tr>
<td></td>
<td>Use of alternative routes when roads are obstructed</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Employment of trained drivers</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
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<tr>
<td><strong>Loss of farmer livelihood due to temporary land acquisition and crop damage</strong></td>
<td>Not applicable (no pap on the path of the line route)</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td><strong>Loss of farmer livelihood due to permanent land acquisition for valve rooms</strong></td>
<td>Not applicable (no pap on the path of the line route)</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
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Environmental monitoring matrix during construction

<table>
<thead>
<tr>
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<th>Monitoring indicators</th>
<th>Responsibility</th>
<th>Frequency/Duration</th>
<th>Location</th>
<th>Methods</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction/</td>
<td>Use of designated stockpile locations</td>
<td>Contractor</td>
<td>Weekly</td>
<td>Construction site</td>
<td>Site observation</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>excavation and hazardous waste generation</td>
<td>Separation of hazardous waste components</td>
<td>Contractor</td>
<td>Weekly</td>
<td>Construction site</td>
<td>Site observation</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Quantity and type of waste generated</td>
<td>Contractor</td>
<td>Daily</td>
<td>Construction site</td>
<td>Recording of daily hauling statistics</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Risk of damaging infrastructure</td>
<td>Frequency and location of damage incidents</td>
<td>Contractor</td>
<td>Monthly</td>
<td>Documentation offices</td>
<td>Documentation in HSE monthly reports</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Water use/</td>
<td>Quantity of wastewater/sewage discharge from administrative</td>
<td>Contractor</td>
<td>Daily</td>
<td>Construction site</td>
<td>Recording of daily discharge amounts</td>
<td>Contractor cost</td>
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<tr>
<td>wastewater generation</td>
<td>camp</td>
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<td></td>
<td>Quantity of water diverted for testing</td>
<td>Contractor</td>
<td>Continuous during testing</td>
<td>Construction site</td>
<td>Flow rate measurements</td>
<td>Contractor cost</td>
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<td></td>
<td>Oily appearance or smell of wastewater stream</td>
<td>Contractor</td>
<td>Continuous during testing</td>
<td>Construction site</td>
<td>Site observation</td>
<td>Contractor cost</td>
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<tr>
<td></td>
<td>Contaminant concentrations in wastewater streams</td>
<td>Contractor</td>
<td>Upon detection of oily appearance or smell</td>
<td>Approved water treatment lab</td>
<td>Chemical analysis</td>
<td>USD 680</td>
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<td>Air emissions</td>
<td>Inspection of vehicle and</td>
<td>Contractor</td>
<td>Quarterly</td>
<td>Documentation offices</td>
<td>Review of schedule</td>
<td>Contractor cost</td>
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</tbody>
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<table>
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<tr>
<th>Impact</th>
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<tr>
<td>Machinery maintenance schedule</td>
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<td>HC, CO% and opacity</td>
<td>Contractor</td>
<td>Once before</td>
<td>Construction site</td>
<td>Emissions testing</td>
<td>Contractor cost</td>
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<td>for each vehicle</td>
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<tr>
<td>Noise production</td>
<td>Noise intensity, exposure durations and noise impacts</td>
<td>Contractor</td>
<td>Quarterly, at least one measurement per contractor per sector</td>
<td>Construction site</td>
<td>Noise recording, reporting in monthly reports</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Complaints from residents</td>
<td>Contractor</td>
<td>Quarterly</td>
<td>Construction site</td>
<td>Inspection of filed complaints</td>
<td>Contractor cost</td>
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<tr>
<td>Use of earmuffs by construction workers</td>
<td>Contractor</td>
<td>Weekly</td>
<td>Construction site</td>
<td>Site observation</td>
<td>Site observation</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Effect on structures by dewatering/ tunneling activities</td>
<td>Amount of soil present in wastewater stream</td>
<td>Contractor</td>
<td>As necessary during dewatering/ tunneling</td>
<td>Inspection of water from dewatering or tunneling</td>
<td>Contractor cost</td>
<td></td>
</tr>
<tr>
<td>Loss of farmer livelihood due to temporary land acquisition and crop damage</td>
<td>Not applicable ( no pap on the path of the line route)</td>
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## Environmental mitigation matrix during operation

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<th>Responsibility of mitigation</th>
<th>Responsibility of direct supervision</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidents and Emergencies</td>
<td>Design to recognized standards, effective inspection, testing, and maintenance plans</td>
<td>GASCO HSE Department</td>
<td>GASCO Headquarters</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td></td>
<td>Rapid isolation of leaks to minimize potential hazards</td>
<td>GASCO HSE Department</td>
<td>GASCO Headquarters</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td></td>
<td>Pipeline patrolling for encroachment and damage risks</td>
<td>GASCO HSE Department</td>
<td>GASCO Headquarters</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td></td>
<td>Pipeline leakage surveys</td>
<td>GASCO HSE Department</td>
<td>GASCO Headquarters</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td>Permanent expropriation of land entering urban zoning</td>
<td>Not applicable (no pap on the path of the line route)</td>
<td>GASCO HSE Department</td>
<td>GASCO Headquarters</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td>Temporary loss of crops during maintenance</td>
<td>Not applicable (no pap on the path of the line route)</td>
<td>GASCO HSE Department</td>
<td>GASCO Headquarters</td>
<td>GASCO regular management cost</td>
</tr>
</tbody>
</table>
## Environmental monitoring matrix during operation

<table>
<thead>
<tr>
<th>Impact</th>
<th>Monitoring Indicators</th>
<th>Responsibility</th>
<th>Frequency/Duration</th>
<th>Location</th>
<th>Methods</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accidents and Emergencies</strong></td>
<td>Performance of regular maintenance</td>
<td>GASCO HSE Department</td>
<td>Quarterly</td>
<td>Documentation offices</td>
<td>Inspection of maintenance schedule</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td></td>
<td>Buildings on RoW, land alterations</td>
<td>GASCO Inspection Department</td>
<td>Twice monthly for populated areas</td>
<td>Pipeline route</td>
<td>Site observation, inspection of permits</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td></td>
<td>Leakage noise, pipeline pressure, etc.</td>
<td>GASCO Inspection Department</td>
<td>Twice monthly for populated areas</td>
<td>Pipeline route</td>
<td>Leakage detection tools</td>
<td>GASCO regular management cost</td>
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<td><strong>Permanent expropriation of land entering urban zoning</strong></td>
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<tr>
<td><strong>Temporary loss of crops during maintenance</strong></td>
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</tbody>
</table>
Public Consultation

as the project will pass in a desert area with no population at all and on a land owned by government no public consultation will be done (there are no public).

Conclusion

The study concluded, after analyzing the various project activities through the phases of construction and operation, and the consequent various environmental impacts, that the basic designs were based on the latest technologies and cleaner production technologies. The study also concluded that the project has many positive impacts on the socio-economic level, in terms of providing several employment opportunities, especially during construction phase, which support the national economy.

As for the negative environmental impacts during construction phase, they are considered to be limited and short-term, and can be reduced to the minimum that could be made these impacts negligible, by applying the proposed environmental monitoring and management plan during the construction phase. With regard to the negative environmental impacts during operational phase, the study concluded that they are insignificant and very limited.

Similarly, the social impacts of the project are mostly of temporary nature. From the foregoing, the study concluded that the project is acceptable in terms of environmental and social aspects, with the following of the proposed social and environmental monitoring and management plan.
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### List of Acronyms and Abbreviations

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<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST</td>
<td>Aboveground Storage Tank</td>
</tr>
<tr>
<td>CAPMAS</td>
<td>Central Agency for Public Mobilization and Statistics</td>
</tr>
<tr>
<td>CBO</td>
<td>Community Based Organization</td>
</tr>
<tr>
<td>EDHS</td>
<td>Egyptian Demographic and Health Survey</td>
</tr>
<tr>
<td>EEAA</td>
<td>Egyptian Environmental Affairs Agency</td>
</tr>
<tr>
<td>EGAS</td>
<td>Egyptian Natural Gas Holding Company</td>
</tr>
<tr>
<td>EHS</td>
<td>Environmental Health and Safety</td>
</tr>
<tr>
<td>ESIA</td>
<td>Environmental and Social Impact Assessment</td>
</tr>
<tr>
<td>ESMP</td>
<td>Environmental and Social Management Plan</td>
</tr>
<tr>
<td>FGD</td>
<td>Focus group discussion</td>
</tr>
<tr>
<td>GASCO</td>
<td>Egyptian Natural Gas Company</td>
</tr>
<tr>
<td>IFC</td>
<td>International Finance Corporation</td>
</tr>
<tr>
<td>LGUs</td>
<td>Local Governorate Unit</td>
</tr>
<tr>
<td>LPG</td>
<td>Liquefied Petroleum Gas</td>
</tr>
<tr>
<td>MOSEA</td>
<td>Ministry of State for Environmental Affairs</td>
</tr>
<tr>
<td>NG</td>
<td>Natural Gas</td>
</tr>
<tr>
<td>NGO</td>
<td>Non Governmental Organization</td>
</tr>
<tr>
<td>PPM</td>
<td>Parts Per Million</td>
</tr>
<tr>
<td>PPAH</td>
<td>Pollution Prevention and Abatement Handbook (WB)</td>
</tr>
<tr>
<td>PRS</td>
<td>Pressure Reduction Station</td>
</tr>
<tr>
<td>RAP</td>
<td>Resettlement Action Plan</td>
</tr>
<tr>
<td>RPF</td>
<td>Resettlement Policy Framework</td>
</tr>
<tr>
<td>UNDP</td>
<td>Human Development Report</td>
</tr>
<tr>
<td>UST</td>
<td>Underground Storage Tank</td>
</tr>
<tr>
<td>WB</td>
<td>World Bank</td>
</tr>
</tbody>
</table>
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 Atfeeh power station. 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 route starts by making hot-tap on an existing gas pipe line (koraymat – bany swef 30") then it extends toward west intersecting koraymat – bany swef road with length equal to 300 m till it reaches front of hagara youth Centre then extends towards north direction parallel to koraymat-bany swef road for a distance equal to 900 m including 200 m parallel to eastern fence of Atfih power station till it reaches to pressure reduction and metering station inside atfih power station with total length about 1.2 K.M.

1.3 Approach and Methodology

1.3.1 Approach to Study

The ESIA adopted an interactive and participatory approach and has been prepared 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.
- 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 project route. In order to do so, the visit was established in a way to trace, to the maximum extent possible, the exact route proposed by GASCO, from the source point to the end point. Many stops occurred during the visit in order to examine fauna, flora, soil type, existence 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 subsurface), 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 KORYMAT – BANY SWEF 30" gas pipe line to the end point of Atfeeh power station. 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 October 2014. This survey relied upon two sources of data, namely secondary and primary data.

The secondary data was collected from previous reports including but not limited to:

- Egyptian Human Development Report (EHDR), 2010,
- The Egyptian Demographic and Health Survey(EDHS), 2008
- Information and census data from the Egyptian Central Agency for Public Mobilization and Statistics (CAPMAS), 2009
- Egypt's Description by Information 2007, Volume 1 & 2 and the 8th edition

The primary data was collected from carrying out several participatory and consultative activities with the following main groups:

- Governmental Executive Officials
- NGOs
- GASCO staff including site engineers, Environmental Protection Engineers, Health and Safety officers, lawyers,

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 and the local communities feedback about the project cycle were also considered in the analysis in order to have a clear idea about the current monitoring and compensation strategy applied. Additionally, practical challenges on the local level were also examined from the various prospective of both GASCO and local communities’ views.
2. Legal and Administrative Framework

2.1 Applicable National Egyptian Legislation

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. Empty containers of lubricating oils and other 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>
<thead>
<tr>
<th>Table 2-1: Noise intensity and maximum exposure periods in working environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise intensity level (LAeq) - Decibel</td>
</tr>
<tr>
<td>Period of exposure - one hour</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2-2: Noise intensity and maximum number of intermitted impacts(^1) from heavy hammers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise intensity level (LAeq) - Decibel</td>
</tr>
<tr>
<td>Number of permissible impacts - impacts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3-3: The maximum permissible limit for noise intensity in the different areas</th>
</tr>
</thead>
</table>

\(^1\) Impact is considered intermittent if the period between impacts is one second or more
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 2-3: Maximum limits for air pollutants in ambient air

<table>
<thead>
<tr>
<th>POLLUTANT</th>
<th>MAXIMUM LIMIT (µ/m³ if otherwise identified)</th>
<th>EXPOSURE PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphur Dioxide</td>
<td>350</td>
<td>1 hr</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>24 hrs</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>1 year</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>30 Milligrams/cubic meter</td>
<td>1 hr</td>
</tr>
<tr>
<td></td>
<td>10 Milligrams/cubic meter</td>
<td>8 hr</td>
</tr>
<tr>
<td>Nitrogen Dioxide</td>
<td>400</td>
<td>1 hr</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>24 hrs</td>
</tr>
<tr>
<td>Ozone</td>
<td>200</td>
<td>1 hr</td>
</tr>
<tr>
<td></td>
<td>120</td>
<td>8 hr</td>
</tr>
<tr>
<td>Suspended Particles Measured as Black Smokes</td>
<td>150</td>
<td>24 hrs</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>1 year</td>
</tr>
<tr>
<td>Total Suspended Particles (TSP)</td>
<td>230</td>
<td>24 hrs</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>1 year</td>
</tr>
</tbody>
</table>
Respirable Particles (PM$_{10}$) | 150 | 24 hrs |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>70</td>
<td>1 year</td>
</tr>
</tbody>
</table>

Lead | 0.5 | 1 year (daily averages) in urban areas |
|     | 1.5 | 6 months (daily averages) in industrial areas |

<table>
<thead>
<tr>
<th>Type of vehicle</th>
<th>Pollutants</th>
<th>Vehicles manufactured before 2003</th>
<th>Vehicles manufactured starting 2003</th>
<th>Method of measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>Hydrocarbons (ppm)</td>
<td>900</td>
<td>600</td>
<td>During speed 600-900 rpm</td>
</tr>
<tr>
<td></td>
<td>CO %</td>
<td>4.5 volume</td>
<td>2.5 volume</td>
<td>During speed 600-900 rpm</td>
</tr>
<tr>
<td>Diesel</td>
<td>Opacity</td>
<td>30</td>
<td></td>
<td>At maximum acceleration</td>
</tr>
</tbody>
</table>

Table 2-4: Maximum limits air pollutants in vehicle emissions

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.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maximum limit (mg / l)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sewage Effluent</td>
</tr>
<tr>
<td>Temperature</td>
<td>35°C</td>
</tr>
<tr>
<td>pH</td>
<td>6-9</td>
</tr>
<tr>
<td>Biochemical Oxygen Demand</td>
<td>60</td>
</tr>
<tr>
<td>Chemical Oxygen Demand (Dichromat)</td>
<td>80</td>
</tr>
<tr>
<td>Chemical Oxygen Demand (Permanganate)</td>
<td>40</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>Not less than 4</td>
</tr>
<tr>
<td>Oil and Grease</td>
<td>10</td>
</tr>
<tr>
<td>Dissolved Solids</td>
<td>2000</td>
</tr>
<tr>
<td>Suspended Solids</td>
<td>50</td>
</tr>
<tr>
<td>Coloured Substances</td>
<td>Free of col. sub.</td>
</tr>
<tr>
<td>Sulphide</td>
<td>1</td>
</tr>
<tr>
<td>Cyanide</td>
<td>….</td>
</tr>
<tr>
<td>Phosphate</td>
<td>….</td>
</tr>
<tr>
<td>Nitrate</td>
<td>5</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Standards and Specifications (mg/l unless otherwise noted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Not to exceed 50°C above normal average</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>Not less than 4 mg/l at any time</td>
</tr>
<tr>
<td>pH</td>
<td>Within the range 7 - 8.5</td>
</tr>
<tr>
<td>Synthetic Detergents</td>
<td>Not to exceed 0.5 mg/l</td>
</tr>
<tr>
<td>Phenol</td>
<td>Not to exceed 0.005 mg/l</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Not to exceed 50 mg/l</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>Not to exceed 650 mg/l</td>
</tr>
<tr>
<td>Total Coliform (MPN / 100 ml)</td>
<td>Not to exceed 5000 mg/l</td>
</tr>
</tbody>
</table>

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.

2.1.6 Egyptian Legislation Related to Land Acquisition

The Government of Egypt’s policy is to compensate or assist people whose property is affected by any governmental projects. Various laws are in place governing aspects of land acquisition and compensation.

2.2 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. In addition, the WB has made available their Pollution Prevention and Abatement Handbook (PPAH), as well as the General Environmental Health and Safety (EHS) Guidelines of the IFC, which further instruct on proper environmental and health related practices. Following are the policies which could be triggered by the project activities, and a brief description of the available guidelines to be followed.

2.2.1 OP 4.01 – Environmental Assessment

According to the World Bank Operational Policy OP 4.01, the Dahshour-Atfeeh pipeline is classified among Category A projects. Projects under this Category are likely to have significant adverse environmental impacts that are sensitive², 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.

2.2.2 OP 4.12 – Involuntary Resettlement

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.
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.

2.2.3 OP 17.50 – Disclosure

The World Bank policy OP 17.50 on “Disclosure” details the Bank’s requirements for making operational information available to the public. The Bank reaffirms its recognition and endorsement of the fundamental importance of transparency and accountability to the development process. In addition, timely dissemination of information to local groups affected by the projects and programs supported by the Bank, including nongovernmental organizations, is essential for the effective implementation and sustainability of projects.

2.2.4 IFC Environmental Health and Safety Guidelines

The EHS Guidelines are used by project proponents whenever one or more members of the World Bank Group are involved in a project. They are applied as required by the organization’s respective policies and standards. The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Both general and industry/sector specific guidelines are provided and should be used in conjunction in the planning and implementation of project activities.

The sector guidelines for Onshore Oil and Gas Development are applicable to the proposed project, as they cover activities including gas transportation pipelines, pigging stations, ancillary and support operations, etc. They provide instruction on good international practices for identification and management of industry specific impacts, and corresponding performance indicators and monitoring. The relevant impacts and suggested mitigation measures discussed include those related to:

- Air emissions
- Wastewater/effluent discharge
- Solid, liquid, and hazardous waste management
- Noise generation
- Terrestrial impacts and project footprint
- Spills
2.2.5 Pollution Prevention and Abatement Handbook

Recommendations on how to reduce pollution emissions, implement good management techniques, and achieve environmental and economic benefits through pollution prevention are provided in the PPAH. While the Egyptian legislation discussed above typically covers most of the issues presented in this document, some of the relevant numerical targets for pollution reduction and normally acceptable and achievable maximum emission levels may found useful.

The sector-specific guidelines for Onshore Oil and Gas Development primarily deal with the impacts of exploration, drilling, and production operations, and thus are not directly relevant to the proposed pipeline project. However, the associated waste streams identified (which include drilling-waste fluids or muds, drilling-waste solids, produced water, and volatile organic compounds) and their corresponding emission guidelines may be used to facilitate monitoring of these impacts.
3. Description of the Environment

3.1 Administrative Districts

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. Annex A provides detailed base line information about the administrative distribution, population, economical activities and nature of farming.

3.1.1 Bani Swaif Governorate

Bani Swaif governorate is located in the North Upper Egypt Region that encompasses Giza, Fayoum, Bani Swaif, and Menia governorates. It is known for being mostly rural. The governorate covers an area of 10,954 km² representing 1.08% of the Republic's total area. It comprises 7 Marakz, 7 cities, and 39 rural local units annexed by 222 villages and 690 hamlets. According to the preliminary results of 2006 census, the population is about 2.3 million; 23.3% live in urban areas, and 76.8% in rural areas. The population natural growth rate has reached 21.9 per thousand.

Bani Swaif is an agricultural governorate. The cultivated areas cover 279.8 thousand feddans. Major crops are wheat, cotton, sugar cane, in addition to medical and aromatic plants. Arable agricultural lands amount to 63 thousand feddans. Bani Swaif governorate is considered a museum for the heritage of different dynasties which exhibit Egypt's different treasures. It is home to the second oldest step pyramid "Meidum", as well as "Ehnasia" city which was Egypt's most important city and its capital in ancient times. It also includes Monasteries of Saint Antonius, Anba Pula, Mar Gergis, as well as the tomb of Marwan Ibn Mohamad, the last ruler of the Umayyad Caliphate. Snoor huge Cave is one of Egypt’s treasures that lies in the heart of the mountain, and is 19 meters deep.

The governorate contributes to the industrial activity through big industries such as cement, clay bricks, and textiles, besides small industries such as carpets and handmade kleem. Furthermore, it hosts a zone for light industries and another for medium industries, as well as small industries complex. In cooperation with the IDSC, 62 information centers were established and developed on all the administrative levels including the village level, Two IT training centers were also established: one in the governorate's Main Department (Diwan Aam) and the other in the local unit in Nasser city to develop work performance and provide job opportunities for fresh graduates. 3381 students, and fresh graduates as well as working staff of the governorate's administrative body have been trained in these centers.
3.2 Location and Land Use

The gas pipeline will cover the area located in the desert borders. It will pass through the four governorates. Agricultural lands represent only 35% of the total area. The main crops there are perfume plants, corn, maize and few trees. It is notable that people are in favor of planting perfume plants which are more lucrative. Table A.2 in Annex A presents information about the land use.

Figure 3-1 shows the pathway of the pipeline start at KORYMAT – BANY SWEF 30” gas pipeline to the Atfeeh power station.

The planned path of the pipeline runs through empty desert area and cross only one major road.

The pipeline is not expected to encounter any culturally or historically valuable sites. GASCO has a policy of avoiding such areas.

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 3-2. The annual minimum and maximum air temperature in this region vary from about 13°C to about 28°C, respectively. However the temperature frequently rises to about 35°C during the summer season.

![Figure 3-2: Land use and rainfall](image)

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°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 3-1: Mean monthly values of metrological parameters recorded in Giza Metrological Station between 1990 and 2004

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>13.9</td>
<td>14.8</td>
<td>17.5</td>
<td>21.7</td>
<td>25.3</td>
<td>28.0</td>
<td>29.1</td>
<td>28.9</td>
<td>27.4</td>
<td>24.6</td>
<td>19.9</td>
<td>15.2</td>
</tr>
<tr>
<td>Relative humidity (%)</td>
<td>68.1</td>
<td>63.8</td>
<td>60.3</td>
<td>53.4</td>
<td>51.5</td>
<td>54.5</td>
<td>59.6</td>
<td>62.3</td>
<td>61.3</td>
<td>63.5</td>
<td>66.7</td>
<td>68.9</td>
</tr>
<tr>
<td>Accumulation of Rain Quantity (mm/month)</td>
<td>2.9</td>
<td>3.1</td>
<td>2.2</td>
<td>0.1</td>
<td>0.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.04</td>
<td>3</td>
<td>2.8</td>
</tr>
<tr>
<td>Rain-days (day/month)</td>
<td>2.6</td>
<td>1.5</td>
<td>1.7</td>
<td>0.1</td>
<td>0.4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.3</td>
<td>1.2</td>
<td>1.8</td>
</tr>
<tr>
<td>Wind speed (knot)</td>
<td>66.4</td>
<td>69.2</td>
<td>58.8</td>
<td>63.0</td>
<td>47.1</td>
<td>44.1</td>
<td>57.3</td>
<td>57.7</td>
<td>58.5</td>
<td>47.6</td>
<td>37.5</td>
<td>63.9</td>
</tr>
</tbody>
</table>

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 3-3. (sky blue color)

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 3-4 and 3-5 represent the geologic map of the area and legend associated and as well as Table 3-2 gives an idea about the Stratigraphic 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
3.5.2 Geomorphology

Two main geomorphologic units can be identified in the area, which are The Old Fluviatile Plain and The Structural Plain (shown in Figure 3-6):

- The Old Fluviatile Plain (Unit 5): This unit is underlain by dark brown gravels and coarse sands with different degrees of cementation and occupies the outer fringes of the present floodplain. The surface of this plain is gently undulating and displays classical examples of landforms by wind deflation. The surface is also incised by the downstream portions of a good number of dry drainage channels (wadis), which have their uptake areas located in the adjacent elevated structural plains and plateau. Such lines acted as active rivers in Middle Pleistocene times (0.7 to 0.2 million years BP) and contributed to the supply of the Nile Delta sediments. Of particular interest is the occurrence of two negative landforms marking the outer limit of the Nile Delta.
The Structural Plain (Unit 6): The structural plains form the outer margins of the old Nile Delta. The surface is underlain by medium hard Neogene sediments and is characterised by a series of structural ridges of low topographic relief. Such ridges are essentially fault determined, oriented generally E-W and take the form of a complex set of Butts and Mesas. These alternate with shallow depressions filled with soft Quaternary deposits (playa deposits or shifting sand). Basalt extrusion and hydrothermal quartzitic sandstone hillocks are common elements the landscape, particularly in the southern portions of the structural plains the banks of the river Nile. The surface of this flood plain consist 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)](image)

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 has 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 epicenter of recent medium to large earthquakes (A) and the epicenter of small earthquakes.
Figure 3-8: Intensity distribution of earthquakes in Egypt

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.
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 earthquake 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 was 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

The pathway of the pipeline runs through Nile Delta Aquifer and partially the Moghra Aquifer. (Figure 3-10)

3.6.1 Nile Delta Aquifer

The most important regional aquifer within the mapped area is the Nile Delta aquifer. This aquifer consists of the Pleistocene graded sand and gravel, changing to fine sand and clayey facies in the north. It covers the greater portion of the Nile Delta area. In the floodplain of the Nile the aquifer is semi-confined, as it is overlain by Holocene silty and sandy clay. In the northwestern part of the mapped area, a calcareous loam layer acts as a semi-confined layer outside the floodplain. The thickness of the semi-confining layers is generally between 0 and 20 m but increases near the coast. In the desert fringes, outside the floodplain, the semi-confining
layer is missing and phreatic conditions prevail. The Nile Delta aquifer is underlain by Pliocene marine clay. The position of the base of the aquifer relative to mean sea level is indicated on the map by green contour lines. It ranges from sea level at the edges in the west and east to more than 1000 in the center of the Nile Delta. The (saturated) thickness of the aquifer ranges between 0 and more than 800 m. The permeability ranges between 35 and 75 m/day but decreases near the coastline, due to an increase of the clay content. The transmissivities range between less than 500 m²/day at the edges of the desert fringe, to more than 25,000 m²/day in the apex of the Nile Delta.

3.6.2 Moghra Aquifer

The Moghra aquifer consists of Lower Miocene Fluviatile and fluviomarine coarse sand and gravel of the Moghra Formation. The facies changes to clay near the Mediterranean Sea and in the Delta, thus bordering the productive zone of the aquifer. The aquifer is found in the western portion of the mapped area and extends westward towards the Qattara Depression and, southward in the direction of El Fayoum depression.

South of the latitude of 30° 30’ N the aquifer is exposed, but not completely phreatic, due to intercalated clay layers. North of that latitude it is confined by Pliocene deposits. The aquifer is underlain by Oligocene rocks (basalt or shale). At the southern border of the map it may be underlain by sandy Oligocene deposits. The base of the aquifer slopes from ground level near Cairo to 1000 m below mean sea level near west of Alexandria. The (saturated) thickness is between 70 and 700 m. Permeability ranges between 25 m/day in east Wadi el Farigh to less than 1 m/day in the Qattara area (west of the mapped area) and near the coasts (JVQ, 1979, Uppsala University 1985). Transmissivity ranges between 500 and 5000 m²/day.
Figure 3-10: Hydrogeologic map of the area (RIGW, 1992)
Figure 3-11: Legend of hydrogeologic map
3.6.3 Groundwater Flow

Groundwater flow is being observed by RIGW since 1950, consequently a large amount of data is available, it was observed that the piezometric level decrease gradually from more than 40 m+msl to 15 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)

3.6.4 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 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 River Nile, 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 the delta region, 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 these water courses.
3.8 Biodiversity and Habitats

Figure 3-13: Egyptian Protected Areas. The pipeline does not encounter any protected areas.
3.8.1 Flora

No plant in the area

3.8.1.1 Farmlands

No farm in the project area

**Figure 3-18:** Cultivated plots of wheat and onions

3.8.1.2 Irrigation-Drainage Ecosystems

No irrigation or drainage system in the project area

3.8.1.3 Rare and Endangered Species

The surveyed area of the project site is not listed under law 102-1983 as a Protected Area. Of the high number of species observed and recorded at the project site, there is no globally or locally threatened or endangered species.

3.8.2 Fauna

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 or and 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. Three common invertebrate species were recorded during the study, Sahara Desert ant *Cataglyphis bicolor*, Vagrant Emperor *Anax ephippiger*, and Honey Bee *Apis mellifera*.

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*.

3.8.2.1 Herpetofauna

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 the Nile Valley 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*, *Ptychadena mascarenensis*, *Natrix tessellate*, *Chamaeleo africanus*, *psammophis sibilans*, *Malpolon monspessulanus*, *Hemidactylus turiscus*, *Tarentola annularis*, *Trachylepis*
quenquaeniata, Naja haje, Acanthodactylus boskianus, Acanthodactylus scutellatus. No herpetofaunal species were recorded during the field survey of the pipeline route.

3.8.2.2  Avifauna

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; see the following tables. No nesting areas for any species were recorded during the field survey of the pipeline route.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Arabic name</th>
<th>Status</th>
<th>RA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barn Swallow</td>
<td>Hirundo rustica</td>
<td>عصفور الجنة</td>
<td>RB, PV, WV</td>
<td>C</td>
</tr>
<tr>
<td>Cattle Egret</td>
<td>Bubulcus ibis</td>
<td>أبوقدان</td>
<td>RB, PV, WV</td>
<td>C</td>
</tr>
<tr>
<td>Common Bulbul</td>
<td>Pycnonotus barbatus</td>
<td>بلبل</td>
<td>RB</td>
<td>C</td>
</tr>
<tr>
<td>Common Chiffchaff</td>
<td>Phylloscopus collybita</td>
<td>سكشة</td>
<td>PV, WV</td>
<td>C</td>
</tr>
<tr>
<td>Common Moorhen</td>
<td>Gallinula chloropus</td>
<td>دجاجة الماء</td>
<td>RB, PV, WV</td>
<td>C</td>
</tr>
<tr>
<td>Crested Lark</td>
<td>Galerida cristata</td>
<td>متوجة</td>
<td>RB</td>
<td>C</td>
</tr>
<tr>
<td>Eurasian Hoopoe</td>
<td>Upupa epops</td>
<td>هده</td>
<td>RB, PV</td>
<td>C</td>
</tr>
<tr>
<td>Graceful Primia</td>
<td>Prinia gracilis</td>
<td>فصية</td>
<td>RB</td>
<td>C</td>
</tr>
<tr>
<td>Gray Heron</td>
<td>Ardea cinerea</td>
<td>عصفور نبراس</td>
<td>PV, WV</td>
<td>C</td>
</tr>
<tr>
<td>Green Bee-eater</td>
<td>Merops orientalis</td>
<td>الخضر</td>
<td>RB</td>
<td>C</td>
</tr>
<tr>
<td>Hooded Crow</td>
<td>Corvus cornix</td>
<td>غراب بلدي</td>
<td>RB</td>
<td>C</td>
</tr>
<tr>
<td>House Sparrow</td>
<td>Passer domesticus</td>
<td>عصافور دورى</td>
<td>RB</td>
<td>C</td>
</tr>
<tr>
<td>Kestrel</td>
<td>Falco tinnunculus</td>
<td>الجراد صغير</td>
<td>RB, PV, WV</td>
<td>C</td>
</tr>
<tr>
<td>Little Egret</td>
<td>Egretta garzetta</td>
<td>أبيض بلشون</td>
<td>RB, PV, WV</td>
<td>C</td>
</tr>
<tr>
<td>Palm Dove</td>
<td>Streptopelia senegalensis</td>
<td>بسم مصرى</td>
<td>RB</td>
<td>C</td>
</tr>
<tr>
<td>Pied Kingfisher</td>
<td>Ceryle rudis</td>
<td>صياح السماح الابن</td>
<td>RB</td>
<td>C</td>
</tr>
<tr>
<td>Spur-winged Plover</td>
<td>Vanellus spinosus</td>
<td>رؤفان بلدي</td>
<td>RB, PV, WV</td>
<td>C</td>
</tr>
<tr>
<td>White-throated Kingfisher</td>
<td>Halcyon smyrnensis</td>
<td>قارون</td>
<td>BR</td>
<td>C</td>
</tr>
<tr>
<td>White Wagtail</td>
<td>Motacilla alba</td>
<td>أبيض بلشون</td>
<td>PV, WV</td>
<td>C</td>
</tr>
<tr>
<td>Yellow Wagtail</td>
<td>Motacilla Flava</td>
<td>أصفر</td>
<td>PV, WV</td>
<td>C</td>
</tr>
</tbody>
</table>

3.8.2.3  Mammalian Fauna
Over 30 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, rare and endangered Flower's shrew *Crocidura floweri* that localized in Delta and Valley, also the endemic Egyptian Weasel *Mustela subpalmata* and Swamp Cat *Felis chaus nilotica*. Despite of potentiality of occurrence for these endemic species in these ecosystems, *Crocidura floweri* only recorded four times with one dated record at 1918, *Mustela subpalmata* appears to be rather common in some places specially around Cairo, and *Felis chaus nilotica* recorded as common species and LC, Least Concern according to IUCN (International Union for Conservation of Nature) criteria and categories. No mammalian species were recorded during the field survey of the pipeline route.

In general, among all the mammalian fauna of Egypt, there are four critically endangered species, eleven endangered species, twenty four vulnerable species and fifteen data deficient species, also seven endemic species and ten near-endemic species (Basuony et al, 2010). No species that belong to these categories have been recorded during the study of the project area.

The rodent species that expected to be found based on the distribution of rodents in Egypt is not endangered or endemic species. The recorded dens of rodents were few (five dens) and deserted; see Figure 3-20.

The recorded ant species, Sahara Desert ant *Cataglyphis bicolor* (shown in Figure 3-21), is a common species and not endemic to Egypt.

The desert habitats that represent the potential habitats for these species (common ant species and common potential rodent species) are very common habitats and not unique ones. They are not expected to be adversely affected by the proposed earth and trenching work along the roads and in desert areas.
Figure 3-20: Deserted den of a rodent (old spider's web on the entrance)
Figure 3-21: Recorded species in project area

A) Hooded Crow *Corvus cornix*
B) Sahara Desert Ant *Cataglyphis bicolor*
C) Desert Rodent Den
D) Kestrel *Falco tinnunculus*
E) Crested Lark *Galerida cristata*
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 30" diameter, 1.2 km long underground pipeline to transport natural gas from KORYMAT – BANY SWEF 30" gas pipe line to a Pressure Reduction Station (PRS) at the Atfeeh power station. Assuming that the project will cover a width of 20 meters. This project will pass through one governorates: Bani Swaif. The following section will detail the pipeline location, components, work plan, construction activities, and the patrolling philosophy of the pipeline.

4.1 Pipeline Components

4.1.1 Pipeline Route

The route starts by making hot-tap on an existing gas pipe line (koraymat – bany swef 30") then it extends toward west intersecting koraymat – bany swef road with length equal to 300 m till it reaches front of hagara youth Centre then extends towards north direction parallel to koraymat-bany swef road for a distance equal to 900 m including 200 m parallel to eastern fence of Atfih power station till it reaches to pressure reduction and metering station inside atfih power station with total length about 1.2 K.M.

The entire length of the pipeline will be below ground. Figure 4-1 shows the entire path of the pipeline, including the locations of valve rooms, major crossings, and nearby settlements. These elements are described in more detail in the following sections. The distance of the path is marked in 5 km increments (indicated by green hash marks).

4.1.2 Pipeline Design Criteria

At the minimum, the pipeline will be built, operated, and maintained to the standards of ASME B31.8, which dictates the use of good engineering practices for public safety in all conditions and local regulations as a minimum, along with any additional local regulations. as well as other relevant high standards for pipeline routing with consideration for nearby settlements.

Settled areas along the pipeline are classified by population density, which is used to determine the Location Class, as defined in Table 4-1. Location Classes are used to determine the design criteria appropriate for different sections of the pipeline. They are also used in determining the amount of surveillance activity to be conducted.

Table 4-1: Determination of Location Class
Generally a zone 200m wide is considered on either side of the route of the pipeline. To include a maximum number of buildings for human occupancy, the pipeline route is also divided lengthwise into sections of 1 mile. Within a multiple dwelling unit, each separate dwelling unit is counted as a separate building. However, ASME B31.8 does not provide restrictions on the proximity of a pipeline to a building or group of buildings, which can lead to pipelines being constructed close to buildings (and vice versa).

The following proximity limits should be applied to all pipeline design and to new buildings developed close to existing pipelines.

- No pipeline operating at a pressure greater than 7 bar must be within 3m of a building in residential areas, and 6m desert areas.
- Any pipeline closer than 25 m to a normally occupied building should operate at a pressure that is 40% of the material yield strength or less, and have a wall thickness of at least 0.375".
- Any pipeline closer than 12.5m to a normally occupied building should operate at a pressure that is 40% of the material yield strength or less, and be laid with greater than or equal to 0.5" wall thickness.

Wall thickness is also increased at road crossings, and impact protection measures (cast in site or pre - cast concrete slab) shall be provided on all pipeline crossings. Warning tape is placed above and below such impact protection.
Figure 4-1: Dahshour-Atfeeh pipeline route
Figure 4-2: Typical valve room layout
4.1.3 Valve Rooms

One (1) valve rooms will be constructed along the pipeline, at the following points along the route (shown in blue on the maps):

- Valve room (1) at zero km

Valve room dimensions are a maximum of 25 m x 50 m, but may be smaller. A typical plot plan for a valve room is shown above in Figure 4-2.

4.1.4 Major Crossings

There is only one crossing that the proposed pipeline route encounters will be crossed using the Horizontal Directional Drilling (HDD) technique, described in Section 4.4.11. The following crossings will be encountered:

- Koraymat – banyswef road

The major crossings where HDD will be used are indicated in red on the Sectional Maps below.

4.1.5 Nearby Settlements

No nearby settlements as All of the pipeline passes through uninhabited desert lands,

4.1.6 Pressure Reduction Station

The PRS is present inside the Atfeeh power station. Its main function is to deliver 437,000 m³/hour of gas at an output pressure of 7 bar. The station consist 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>
<thead>
<tr>
<th>Contaminants</th>
<th>Lean Gas Composition</th>
<th>Rich Gas Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide</td>
<td>CO₂</td>
<td>0.150</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>N₂</td>
<td>0.760</td>
</tr>
<tr>
<td>Oxygen</td>
<td>O₂</td>
<td>0.000</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>H₂</td>
<td>0.000</td>
</tr>
<tr>
<td>Methane</td>
<td>CH₄</td>
<td>97.313</td>
</tr>
<tr>
<td>Compound</td>
<td>Formula</td>
<td>Volume %</td>
</tr>
<tr>
<td>------------</td>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td>Ethane</td>
<td>C₂H₆</td>
<td>1.710</td>
</tr>
<tr>
<td>Propane</td>
<td>C₃H₈</td>
<td>0.040</td>
</tr>
<tr>
<td>iso-Butane</td>
<td>i-C₄</td>
<td>0.020</td>
</tr>
<tr>
<td>n-Butane</td>
<td>n-C₄</td>
<td>0.000</td>
</tr>
<tr>
<td>iso-Pentane</td>
<td>i-C₅</td>
<td>0.000</td>
</tr>
<tr>
<td>n-Pentane</td>
<td>n-C₅</td>
<td>0.000</td>
</tr>
<tr>
<td>n-Hexane</td>
<td>n-C₆</td>
<td>0.000</td>
</tr>
<tr>
<td>n-Heptane</td>
<td>n-C₇</td>
<td>0.000</td>
</tr>
<tr>
<td>n-Octane</td>
<td>n-C₈</td>
<td>0.000</td>
</tr>
<tr>
<td>n-Nonane</td>
<td>n-C₉</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>100.000</strong></td>
</tr>
</tbody>
</table>

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

**Figure 4-2: Work Schedule. Reference: GASCO**
4.4 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.

4.4.1 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.

4.4.2 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

Unskilled labor from the nearby villages will be utilized, eliminating the need for large worker camps. Some additional technical staff will be housed in nearby apartments or hotels. An administrative camp will be set up 70 km from Dahshour, remaining for the entire 15 months of construction. This camp will include a water supply, mobile toilets, a cafeteria, and offices.

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

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Double Cabin Car</td>
<td>0</td>
</tr>
<tr>
<td>2 Double Cabin Car 4*4</td>
<td>0</td>
</tr>
<tr>
<td>3 Pick Up</td>
<td>1</td>
</tr>
<tr>
<td>4 Bus (26 Persons)</td>
<td>3</td>
</tr>
<tr>
<td>5 Puller</td>
<td>0</td>
</tr>
<tr>
<td>6 Generator 200-250 K.V</td>
<td>5</td>
</tr>
<tr>
<td>7 Crane 50 Ton.</td>
<td>7</td>
</tr>
<tr>
<td>8 Side Boom D8</td>
<td>3</td>
</tr>
<tr>
<td>9 Pipe Welder</td>
<td>1</td>
</tr>
<tr>
<td>10 Pipe Carrier</td>
<td>1</td>
</tr>
</tbody>
</table>
### 4.4.3 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\(^3\). 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.

### 4.4.4 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.

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\(^3\) 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.

4.4.5 Foundations Structural Work or Civil Work

At this stage, the site is ready for the commencement of starting the construction of the plant (valve room) 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 transmixers 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 m³ for the use with different types of a concrete mixes to yield different required concrete strengths.

4.4.6 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.

4.4.7 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.

4.4.8 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 nipolet (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.
4.4.9 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 the client.
- Impact type hand wheels or handles may be installed on extended stems if the stem is independently.

4.4.10 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.

4.4.11 Horizontal Directional Drilling

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. Other special crossings may be made using suitable techniques such as Tunnel Boring Machines (TBM) and micro tunneling. Locations of waterways, railways, and main roads along the route are indicated in Section 4.1.

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.

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.

4.4.11.1 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.
6.4.11.2 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.

4.4.11.3 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)

4.4.12 Pipeline 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.

4.4.12.1 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 the Nile River and the test will be done in separate sections of the line. Each section is about 20 km long. Water will be moved from section to section, and then discharged in Mohiet Bahr Youssef drain after examination to be sure no harmful material are present. The discharged amount will be approximately 11,000 m³.

### 4.4.12.2 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

### 4.4.13 Water Removal
Water removal from the pipeline 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 commencing to complete arrangement with the responsible authorities. Removal will continue until the company's engineer is satisfied that pipeline is free from water within the accepted limit.

4.4.14 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.

4.4.15 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.

4.4.16 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.

4.5 Description of Operation Phase
4.5.1 Normal Operation

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

4.5.2 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 repairs
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 Atfeeh Power Station, which will generate electricity for end user consumption. Without the project activities, there are two possible scenarios:

- Fuel is provided to the station using different means of transportation, and potentially a different fuel
- 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

5.2.1 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.

5.2.2 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 6.2.10. 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.

Luckily, this pipeline is intended to pass through empty desert areas. Moreover, the line will pass by the protected areas of highways. GASCO has an unwritten strategy that thoroughly avoids any construction buildings including: houses, graveyards, religious buildings and historical areas. "It is not allowed for us to pass through houses, mosques, churches, graveyards or any other historical areas. We try to do our best to avoid those areas, therefore the start point of the project and the end points are fixed but their routes might be changeable 10-20 meters right or left to the originally planned line," reported an engineer from GASCO.

One conceived alternative was for the pipeline to begin by going to the east and crossing the Nile Valley near Helwan, and then heading south along the east bank of the Nile to reach Atfeeh.
This would involve the disruption of new lands, since the path would no longer follow an existing pipeline. Additional complications may arise from the proximity to the Helwan area, which is more densely populated and has more sensitive receptors and infrastructure to worry about.

The proposed route go through desert lands and along main roads. GASCO considered running the pipeline along the west side of the korymat – bany swef road, but following the existing pipeline is greatly advantageous since the land is mostly unutilized, and there is already an existing buffer zone to reduce interference. Also it is simpler to receive permission for constructing the line.

The path selected by GASCO is sufficiently short and well chosen for its navigation of the critical crossing points and populated areas.
6. Assessment of Main Environmental and Social Impacts

The impacts of various activities are evaluated based on their effect on sensitive aspects of the surroundings in which GASCO operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation. The following sections will describe the potential positive impacts of the project, and describe and evaluate the potential negative impacts resulting from construction and operation activities.

Impacts are rated qualitatively based on their influence on the aforementioned aspects. Impact significance is judged based on four criteria:

- ecological importance
- social importance
- environmental standards
- statistical significance

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 skilled and unskilled laborers. It is worth mentioning that the job opportunities can be divided into two main categories.

- The first category encompasses the jobs directly affiliated with the project, namely employment of the staff of GASCO and the contractor.
- The second category consists of job opportunities for the community such as the restaurants workers in the area, those working in construction materials in the area, and the small markets and supermarkets in the area as well as the drivers of large vehicles and smaller transport vehicles which can serve the workers around the area. "A new project in any area means for community people a new life where they might work in or provide services,". 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. 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.
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

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

![Diagram showing potential job opportunities](Diagram)
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:

- Hazardous waste generation
- Risk to infrastructure from excavation
- Construction/excavation waste generation
- Water use/wastewater generation
- Air emissions
- Noise production
- Soil quality degradation
- Biodiversity and habitat destruction
- Risk to stability of existing structures from dewatering/tunneling
- Traffic disruption

Impacts in each area are evaluated qualitatively, and an environmental and social management and monitoring plan has been formulated to mitigate the most significant impacts. The plan is detailed in Chapter 7.

6.2.1 Hazardous Waste Generation

The primary sources of hazardous waste are:

- Demolished asphalt
- Containers of chemicals and lubricant oils used for construction machinery

Asphalt waste will come from the open-cut road crossings described in Section 4.1.4, while the chemicals and lubricants will result from the use of machinery described in Section 4.4.2. It is estimated that on average, 12 kg of such waste will be produced daily. Articles 26 through 28 of the Executive Regulations of Law 4 lay down certain steps that must be followed for the granting of handling licenses for these materials.

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 a normal 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. Improper disposal of these items can potentially directly affect the health of anyone who comes in contact
with them. Potential soil contamination may result from improper hazardous waste storage, handling, and disposal practices, as well as potential spillage and/or leaks during the course of the construction activities. There is a slight risk of a spilled or leaked substance spreading beyond the project site as a result of nearby ground or surface water contamination, thus becoming a more significant environmental risk, but in general the potential of this impact is local in nature.

Due to the proximity of agricultural lands and numerous waterways, the impact level is considered “medium”.

6.2.2 Damage to Existing 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.

Due to the extensive excavation required for this project, and the relative uncertainty in the location of existing infrastructure, the impact level is considered “medium”.

6.2.3 Construction/Excavation Waste Generation

It is estimated that approximately 100 kg/day of construction/excavation waste will be generated during the construction phase. The primary forms of solid wastes that are generated during the construction phase include:

- Excavated soil and excess sand
- Concrete and bricks waste

For the most part, excavated soil will be backfilled into the trench. Otherwise, it will be transported off-site with the construction waste by trucks to the general authorized landfill. 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 Chapter 2, stipulate that these wastes should be
disposed in licensed sites by the local authority, which minimizes any aesthetic effects of such waste.

An additional 5 kg/month of rubbish waste will be produced from the administrative camp.

Due to the inert nature of the waste, and the practice of backfilling excavated soil, the impact level is considered “low”.

6.2.4 Water Use/Wastewater Generation

The water used for this test will be from fresh water containers and then collected again in the water containers to be discharged by the local governorate after examination to be sure no harmful material are present. The discharged amount will be approximately 700 m$^3$.

no administrative camp will be constructed.

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 a nuisance and an environment for breeding of insects but this is neglected due to the very small amount of water used 700 m$^3$.

Normally dewatered water is relatively clean, and could be drained to a public sewer or even discharged at a watercourse. This course of action 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.

The amount of water used for project activities is not expected to have a significant or sustained effect on irrigation or other water use in the area.

Due to the relatively very small amount of water that will be used over the entire course of the project, the impact level is considered “low”.

6.2.5 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. In general, concentrations will be low, but if the machinery is stationary for an extended period, or the engine is not operating properly due to poor maintenance, potentially harmful quantities may be released. However, rapid dispersion is likely in the open areas of the project site, and a low number of people are potentially affected.
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. 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 Chapter 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 Chapter 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. Due to the point-source emissions from vehicles and relative distance from populated areas, the impact level in considered “low”.

6.2.6 Noise Production

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 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 nearby settled areas are the second level recipients of elevated noise levels, as the noise intensity will be relatively dissipated at their locations, and they will only be affected at certain locations along the pipeline route. When construction nears settled areas, 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.

*Due to the fact that noise generation is mostly a nuisance to the general public and activities are not in heavily populated areas, the impact level is considered “low”.*

### 6.2.7 Soil Quality Degradation

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. Most of the affected land is expected to return to full agricultural productivity once construction is finished.

As mentioned before, 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.

*Due to temporary nature of disturbance, the impact level is considered “low”.*

### 6.2.8 Biodiversity and Habitat Destruction

6.2.8.1  **Flora**

No plant in the area

6.2.8.2  **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 with 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 occurred 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 according to all previously mentioned reasons which indicate in general that the pipeline pathway has no passive effect on the fauna which potentially occurred in these ecosystems.
Due to the low occurrence of species and the lack of sensitive areas, the impact level is considered “low”.

6.2.9 Stability of Existing Structures

Although the pipeline RoW will not directly encounter any structures, the larger project working areas may contain various muddy and vulnerable old buildings in terms of construction. Any weak and old structures will be 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 2.0 meter. In the project region, there are very few areas which have groundwater 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

Due to the complications that will arise if any structures are damaged, the impact level is considered “low”.

6.2.10 Traffic Congestion

Construction of the pipeline and facilities will require a small-scale transport operation in order to deliver equipment to the work site.

6.2.10.1 Impact on Main Roads

The primary road network carries the highest traffic volume, and vehicles generally move at higher speed. Where complete obstruction of the only main road will be avoided by the use of the HDD technique described above, so traffic on these roads will not 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.

6.2.10.2 Impact on Secondary Roads

No secondary roads will be used

6.3 Negative Environmental Impacts during Operation

The following categories will have negligible negative impact during normal operation of the pipeline:

- Construction/Excavation Waste Generation
- Hazardous Waste Generation
- Water Use/Wastewater Generation
- Noise Production
- Soil Quality Degradation
- Biodiversity and Habitat Destruction
- Damage to Existing Infrastructure
- Stability of Existing Structures
- Traffic Congestion

6.3.1 Accidents and Emergencies (Quantitative Risk Assessment)

In order to assess the potential impact of pipeline operation in terms of human health and safety, a Quantitative Risk Assessment (QRA) was performed to determine the threat of injury or fatality to the public in the case of an accident or emergency. The nature of the project is such that an unforeseen failure in the pipeline operation could result in the release of significant amounts of natural gas into the surrounding environment. The possibility of this gas being ignited poses an environmental risk and threatens the safety of individuals and the public. This risk is fully assessed in the accompanying QRA report.
Due to the potential for harm to individuals, the impact level is considered “medium”.

6.3.2 Repairs and Maintenance

Emission sources during operation will be associated with fugitive emissions from pipeline relief valves, flanges, etc. Such events may happen during planned preventive maintenance, repairs, or unplanned venting of the pipeline. The impact level is considered “low”.

The negative impacts of excavation 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 pipeline. The impact level is considered “low”.

6.4 Environmental Impact Rating Summary

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<th>Impact Rating</th>
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<tr>
<td></td>
<td>Risk to infrastructure</td>
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<td></td>
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<tr>
<td></td>
<td>Repairs and maintenance</td>
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</tr>
</tbody>
</table>

6.5 Potential Social Impacts

As noted above, the project is likely to result in several positive social impacts, particularly related to the creation of job opportunities. The project will contribute to the improvement of the electricity provision by feeding Atfeeh Power Plant and this, in turn, will be reflected on the quality and regularity of the electricity provision in various places, not limited to the project site.

The project will not result in negative social changes like involuntary resettlement or change the demographical or the traditional lifestyle of area communities. The only potential negative impact of relevance to resettlement is the potential temporary land acquisition during construction (no land acquisition in our project) and the potential negative temporarily impacts on livelihoods (no PAP in the area).
6.5.1 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:

- Potential traffic congestion due to the accumulation of construction materials and dust that will result from digging. From a social prospective, this impact might affect the income of microbuses, small vehicles and taxi drivers.
- Potential temporary inconvenience as result of the construction activities. This could be in the form of accumulation of wastes (both construction and domestic waste in the construction areas, associated odor, air emissions, especially dust as a result of excavation. These impacts are of temporary nature and will be of very limited level of severity, particularly since the construction activities will be in farms and not populated areas.
- Risks of damaging existing community infrastructure, especially water pipes that are not mapped, can have detrimental social repercussions. Disruption of other utility services such as electricity and communications can also be a nuisance to those affected.

6.5.2 Negative Social Impacts during Operation

It is unlikely that the normal operation of the pipeline will create any significant negative social impacts. And even if any leakage happened it will be in an empty Deseret area.

6.5.3 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.

- there is the risk of work accidents and injuries to the construction workers during the construction phase. However, GASCO’s use of HSE guidelines should greatly reduce the possibility of any such accidents on the work site.

6.5.4 Key Issues for Consideration

6.5.4.1 Transparency in the Valuation of Compensations

- There are no PAP in the project area so there are no compensation process.
7. Environmental and Social Management Plan (ESMP)

7.1 Objectives of the ESMP

The objective of the Environmental Management Plan (EMP) is to propose mitigation measures for expected negative impacts and to monitor the efficiency of these mitigation measures on relevant environmental indicators.

7.2 Institutional Framework for Implementation

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.

![Organizational chart for Environmental Protection Department in EGAS](image)

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.

7.2.1 Environmental Management Structure of Implementing Agency

GASCO is also certified for ISO:14001 and OHSAS:18001, and has direct involvement in the environmental management and monitoring of the natural gas pipeline. One of the standard tasks of the HSE Department of GASCO, which is followed up by EGAS, is establishing Environmental Registers for facilities, and frequent auditing of this register. The Environmental Register is audited by the Environmental Department head of GASCO. The HSE Department performs audits twice annually on the average, in addition to infrequent and emergency inspections. The routine monitoring activities performed 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 SO₂, CO, CH₄ and O₂ in ambient air, and detect possible leaks
• Noise measurements

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.

The current positions and person-power of the HSE Department of GASCO is shown in Figure 7-2. These positions are divided over three sectors of the HSE Department, namely Environmental Protection, Safety and Fire Fighting, and Technical Consultancy and Inspection.
Furthermore, representatives from each sector are present at the Site HSE department, as well as the HSE headquarters. The organizational structure is shown in Figure 7-3.

**Figure 7-2: OHSE Department positions and person-power**

<table>
<thead>
<tr>
<th>Position</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Manager</td>
<td>1</td>
</tr>
<tr>
<td>Executive Manager</td>
<td>3</td>
</tr>
<tr>
<td>Assistant Manager</td>
<td>6</td>
</tr>
<tr>
<td>Director</td>
<td>7</td>
</tr>
<tr>
<td>Department Head</td>
<td>9</td>
</tr>
<tr>
<td>Engineer</td>
<td>8</td>
</tr>
<tr>
<td>Chemist</td>
<td>10</td>
</tr>
<tr>
<td>Specialist</td>
<td>13</td>
</tr>
<tr>
<td>Secretary</td>
<td>1</td>
</tr>
<tr>
<td>Technical Assistant</td>
<td>35</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>93</td>
</tr>
</tbody>
</table>

The ESMP will suggest mitigation and monitoring responsibilities for the contractor and GASCO’s HSE Department. The assignment of these responsibilities among the various sectors of the department is the decision of GASCO HSE Management.
Figure 7-3: GASCO OHSE organizational chart
7.2.2 Social Management Structure of Implementing Agency

The analysis conducted during the preparation of the ESIA showed clearly that the main impacts that should be carefully mitigated and addressed is the impact related to temporary and permanent land acquisition but this case in not present in our line route.

The results of the monitoring and management system should be reported quarterly to the Headquarter of GASCO. The monitoring and management will be implemented by the branches of GASCO in each governorate under the supervision of the Social Development Officer.

In addition to appointing the Social Development Officer other local-based mechanisms are also suggested, mainly the establishment Compensation Committee with main objective of working as a safeguard mechanism to ensure that the interests of the poor and most vulnerable are protected and to ensure that the valuation and compensation process is as transparent as possible.

7.3 Management and Monitoring Activities during Construction Phase

7.3.1 Management of Hazardous Waste Generation

7.3.1.1 Mitigation Measures

- 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. In this case, asphalt waste could be disposed with construction waste according the previous procedures.

- 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, repairs and fueling of machinery should occur over impervious surface such as plastic sheeting, and 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.

7.3.1.2 Monitoring Activities

- Monitoring activities for ensuring sound waste management practices shall depend mainly upon observation of hazardous waste stockpiles to ensure how often they are removed from the site, and whether normal construction waste stockpiles contain hazardous components.

7.3.2 Management of Excavation Activities Posing Risk on Infrastructure
If a line break occurs, the 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.

7.3.2.1 Mitigation Measures

- Collecting most accurate maps for infrastructure routes, whenever available and making such data available to the contractor prior to commencing the works
- Excavating manual trial pits in each street to allocated the pipes before using mechanical excavation
- In case an infrastructure pipe is 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)
- Analysis and statistics should be undertaken periodically for the accidents taken place, with recommendations to reduce such risks in consequent excavation activities

7.3.2.2 Monitoring 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, though it might be recommended for the authority owning the infrastructure line (Water and Sewage Authority or Telecommunication Authority) for their research activities.

7.3.3 Management of Construction/Excavation Waste Generation

7.3.3.1 Mitigation Measures

- The contractor should communicate with the local authorities for officially assigning locations for the disposal of construction waste. Agreement on these sites should be reached prior to commencing construction works
- A certain location in the construction site should be assigned for temporary storage or stockpiling of construction waste, in a convenient location close to the stretch of the pipeline that is being constructed. These areas should be agreed between the contractor and the HSE supervisor prior to starting construction works, and should be selected so as not to cause significant obstruction to traffic. The waste should be covered to prevent dust dispersion. No stockpiling is allowed on banks of waterways.
- Waste should be hauled at the end of each working day to the allocated disposal site. Waste transportation should be undertaken by adequately equipped trucks. The HSE supervisor should make sure that the trucks are not overloaded and that the waste is adequately contained inside the rear box to prevent dust or particle movements from the truck. The supervisor should also occasionally inspect that the truck drivers are disposing the waste in the approved location, and not through practicing open dumping in the midway, through irregular visits and inquiries in the disposal site.

7.3.3.2 Monitoring Activities

- 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 the site, and whether they contain hazardous components.

7.3.4 Management of Water Use/Wastewater Generation

7.3.4.1 Mitigation Measures

- Drainage of dewatering water should be pre-planned, and the necessary permits acquired from the local sewage or irrigation authority.
- If dewatering is taking place from a contaminated trench, or contains hydrocarbons that could be observed or smelled, it should be collected in barrels and transported to a wastewater treatment facility for special treatment.
- 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.

7.3.4.2 Monitoring Activities

- Field observation of oily appearance and possibly smell would indicate whether to classify this water as hazardous waste, and determine whether it should be sent to an appropriate treatment plant.

7.3.5 Management of Air Emissions

7.3.5.1 Mitigation Measures

- In areas of loose sandy soils the contractor should provide a source of water for spraying soil before excavation, filling, loading and unloading. If the site supervisor notices a visual/sensible increase of dust emissions, he should ask for additional spraying of water in the spot generating high emissions
- 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
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.

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. This can be ensured with a regular check-up and maintenance schedule.

Avoid or minimize traffic congestion on main roads during periods of air quality crises, such as during autumn (the black cloud) and during spring (Khamasin winds).

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.

7.3.5.2 Monitoring Activities

Monitoring of air emissions impacts can be done through periodic inspection of vehicle maintenance schedules, and on-site observation of black smoke being produced from any machinery.

7.3.6 Management of Noise Production

7.3.6.1 Mitigation Measures

Working hours for workers exposed to noise equipment should be designed so that noise exposure periods do not exceed the safe limits as described by the legal standards in Tables 2-1 and 2-2 in Chapter 2.

Workers that operate noisy machines or worker near them should be supplied with earmuffs and should be instructed to put them on when they get into noisy zones. Contractors should be responsible to instruct their workers to abide to this role, and the site supervisor should make sure the contractor is compliant with this role.

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.

7.3.6.2 Monitoring Activities

Monitoring of noise impacts consists of periodic observation of the extent of implementation of the above mitigation measures.

7.3.7 Management of Soil Quality Degradation

7.3.7.1 Mitigation Measures
Proper handling of hazardous liquids to avoid spilling or leaks is critical to reducing the chances of soil contamination. Appropriate measures should be taken as described in Section 7.3.2.

### 7.3.7.2 Monitoring Activities

- Recording incidents of spills or leaks and periodically analyzing the data
- Once construction has finished, the pipeline route should be revisited to ensure that the land has returned to normal agricultural production. These observations can be performed as part of the pipeline patrolling and leakage surveying, described in Section 7.5.1.

### 7.3.8 Management of Biodiversity and Habitat Destruction

#### 7.3.8.1 Mitigation Measures

- Refilling the dug trench-line to the same original level of the surface will help to mitigate the impact of making barriers which affect both habitat utilization and distribution of the fauna, and will allow plant species to resume growing on the disturbed land.

#### 7.3.8.2 Monitoring Activities

- Because of the low significance of this impact, monitoring in construction sites will not be required.

### 7.3.9 Management of Dewatering and Tunneling Activities Posing Risk to Structural Stability

#### 7.3.9.1 Mitigation Measures

- 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.
- Undertake soil investigation program using representative bore holes for soil classification and identification of groundwater depth.
- 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.

#### 7.3.9.2 Monitoring Activities
• 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.
• If necessary, surveys of structural status of buildings and performing soil investigations shall be undertaken under the supervision of a structural consultancy firm.

7.3.10 Management of Traffic Congestion

7.3.10.1 Mitigation Measures

• Whenever road obstruction is necessary due to lateral excavation or otherwise, informational and directional signs should be 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.
• An agreement between contractors and the site supervisor should be reached about the suitable location for temporary storage of construction materials, equipment, tools and machinery prior to starting construction of each reach of the power lines. No storage of construction materials or electric tools should be allowed in traffic lanes.
• When crossing a road via the open-cut method, alternative roads for entrance to the farms should be developed, and the crossing should be done after arrangement with the owners of these farms. Work should be conducted when there is not high traffic movement on the road.
• The contractors should make sure that the employed drivers of construction machinery (such as trucks and loaders) have received sensitization/training on safety utilization of their machines in order to minimize accidents risks.

7.3.10.2 Monitoring Activities

• All above mitigation measures should be implemented in coordination with Traffic Departments of the appropriate governorate.

7.3.11 Management of Social Impacts

No PAP in the project area so there are no social impact.

7.4 Mitigation and Monitoring Tables

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. Compliance with the roles and responsibilities set forth in these tables should be incorporated into any agreements made with contractors that will be working on site. Where the responsibility of mitigation or monitoring falls on the contractor, the cost will be included in the normal bid price of the contract.
<table>
<thead>
<tr>
<th>Impact</th>
<th>Mitigation measures</th>
<th>Responsibility of mitigation</th>
<th>Responsibility of direct supervision</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous waste generation</td>
<td>Separation of asphalt waste, arrange for asphalt recycling</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vehicle repairs and fuelling off site, on appropriate surfaces</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Approved storage and disposal of chemical and lubricant containers</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Risk of damaging infrastructure</td>
<td>Consult maps before excavation work</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Use of trial pits</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Analysis of accident log</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Construction/Excavation waste generation</td>
<td>Identification and use of approved nearby disposal sites through local authority</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Designation and use of appropriate stockpiling locations on site</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Daily hauling of waste to disposal site in covered trucks</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Water use/wastewater generation</td>
<td>Acquire discharge permits from sewage/irrigation authority</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Collection of potentially contaminated streams in separate tanks</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Air emissions</td>
<td>Water spraying before excavation, filling, loading and unloading</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Spraying of stockpiles, storage in covered areas</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Implementation of regular maintenance schedule for machinery</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Noise Production</td>
<td>Limit exposure time of workers to elevated noise levels</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------------------------------</td>
<td>------------</td>
<td>---------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>Use of earmuffs</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Effect on structures by dewatering/tunneling activities</td>
<td>Survey of buildings with damage potential</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Soil investigations</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Traffic congestion</td>
<td>Signage and markings to instruct drivers</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Use of alternative routes when roads are obstructed</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Employment of trained drivers</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Loss of farmer livelihood due to temporary land acquisition and crop damage</td>
<td>Not applicable (no pap on the path of the line route)</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Loss of farmer livelihood due to permanent land acquisition for valve rooms</td>
<td>Not applicable (no pap on the path of the line route)</td>
<td>Contractor</td>
<td>GASCO HSE Site supervisor</td>
<td>Contractor cost</td>
</tr>
<tr>
<td>Impact</td>
<td>Monitoring indicators</td>
<td>Responsibility</td>
<td>Frequency/Duration</td>
<td>Location</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>-------------------------------------------------------------------</td>
<td>----------------</td>
<td>--------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Construction/</td>
<td>Use of designated stockpile locations</td>
<td>Contractor</td>
<td>Weekly</td>
<td>Construction site</td>
</tr>
<tr>
<td>excavation and hazardous waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>generation</td>
<td>Separation of hazardous waste components</td>
<td>Contractor</td>
<td>Weekly</td>
<td>Construction site</td>
</tr>
<tr>
<td></td>
<td>Quantity and type of waste generated</td>
<td>Contractor</td>
<td>Daily</td>
<td>Construction site</td>
</tr>
<tr>
<td></td>
<td>Frequency and location of damage incidents</td>
<td>Contractor</td>
<td>Monthly</td>
<td>Documentati on offices</td>
</tr>
<tr>
<td>Risk of damaging infrastructure</td>
<td>Quantity of wastewater/sewage discharge from administrative camp</td>
<td>Contractor</td>
<td>Daily</td>
<td>Construction site</td>
</tr>
<tr>
<td></td>
<td>Quantity of water diverted for testing</td>
<td>Contractor</td>
<td>Continuous during testing</td>
<td>Construction site</td>
</tr>
<tr>
<td></td>
<td>Oily appearance or smell of wastewater stream</td>
<td>Contractor</td>
<td>Continuous during testing</td>
<td>Construction site</td>
</tr>
<tr>
<td></td>
<td>Contaminant concentrations in wastewater streams</td>
<td>Contractor</td>
<td>Upon detection of oily appearance or smell</td>
<td>Approved water treatment lab</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inspection of vehicle and</td>
<td>Contractor</td>
<td>Quarterly</td>
<td>Documentati on offices</td>
</tr>
</tbody>
</table>

⁴ A single sample costs approximately EGP 500, with 8 separate pipeline sections to be tested, the maximum costs is estimated to be EGP 4,000.
<table>
<thead>
<tr>
<th>Impact</th>
<th>Monitoring indicators</th>
<th>Responsibility</th>
<th>Frequency/Duration</th>
<th>Location</th>
<th>Methods</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise Production</td>
<td>machinery maintenance schedule</td>
<td>Contractor</td>
<td>Once before construction, once quarterly for each vehicle</td>
<td>Vehicle maintenance site</td>
<td>Emissions testing</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>HC, CO% and opacity</td>
<td>Contractor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Noise intensity, exposure durations and noise impacts</td>
<td>Contractor</td>
<td>Quarterly, at least one measurement per contractor per sector</td>
<td>Construction site</td>
<td>Noise recording, reporting in monthly reports</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Complaints from residents</td>
<td>Contractor</td>
<td>Quarterly</td>
<td>Construction site</td>
<td>Inspection of filed complaints</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Use of earmuffs by construction workers</td>
<td>Contractor</td>
<td>Weekly</td>
<td>Construction site</td>
<td>Site observation</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Amount of soil present in wastewater stream</td>
<td>Contractor</td>
<td>As necessary during dewatering/ tunneling</td>
<td>Construction site</td>
<td>Inspection of water from dewatering or tunneling</td>
<td>Contractor cost</td>
</tr>
<tr>
<td></td>
<td>Effect on structures by dewatering/ tunneling activities</td>
<td>Contractor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Loss of farmer livelihood due to temporary land acquisition and crop damage</td>
<td>Not applicable ( no pap on the path of the line route)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact</td>
<td>Monitoring indicators</td>
<td>Responsibility</td>
<td>Frequency/Duration</td>
<td>Location</td>
<td>Methods</td>
<td>Estimated Cost</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------</td>
<td>------------------------</td>
<td>-----------------</td>
<td>--------------------</td>
<td>----------</td>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td>Loss of farmer livelihood due to permanent land acquisition for valve rooms</td>
<td>Not applicable (no pap on the path of the line route)</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
7.5 Management and Monitoring Activities during Operation Phase

7.5.1 Management of Accidents and Emergencies

A large part of mitigating the possibility of an accident or emergency is regular monitoring of nearby activities that may threaten the safe operation of the line, as well as monitoring of the performance to ensure against leaks that may lead to any of the scenarios identified in the QRA. 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. A full description of the technical design measures used to mitigate against the risk of operational failures is provided in the QRA report. The following general measures are recommended:

- The emphasis on risk reduction should be on preventative measures, i.e. to minimize the potential for leaks to occur. This would chiefly be achieved through appropriate design (to recognized standards) and through effective inspection, testing and maintenance plans / procedures.
- Rapid isolation of significant leaks will not eliminate the risks but will help to minimize the hazards and, particularly, the ignition probability (by limiting the total mass of flammable vapor released). For isolation to be effective, first requires detection to occur and hence best practice fire and gas detection systems, with associated shutdown systems and procedures, will be important mitigation measures.

7.5.1.1 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>
<thead>
<tr>
<th>PIPELINE LOCATION</th>
<th>VEHICULAR</th>
<th>WALKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location Class 1</td>
<td>6 Months</td>
<td>No survey</td>
</tr>
<tr>
<td>Location Class 2</td>
<td>1 Month Vehicular accessible areas inc canal and river crossings</td>
<td>6 Months Arable land, AGIs, valve rooms, crossings, sleeves</td>
</tr>
<tr>
<td>Location Class 3</td>
<td>2 Weeks Survey all areas</td>
<td>2 Weeks Survey all areas</td>
</tr>
<tr>
<td>Location Class 4</td>
<td>2 Weeks Survey all areas</td>
<td>2 Weeks Survey all areas</td>
</tr>
</tbody>
</table>
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 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 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 patrolling.

7.5.1.2 **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.

7.5.1.3 **Emergency Response**

GASCO already has its own Emergency Preparedness and Response Procedures which instructs workers on how to identify the potential occurrence of accidents and emergency situations and how to respond to each. These procedures also include mitigating actions needed for dealing with and reducing the risks and impacts that may be associated with emergency situations. The
procedures cover all emergency situations at all GASCO sites and premises. The plan includes the following aspects:

- Overview of emergency management
- Emergencies classes brief description
- Key personnel responsibilities
- Typical site emergency procedure
- Emergency communication plan

The GASCO HSE General Manager coordinates with all GASCO sites to review and updated a plan at least once a year, and all GASCO sites are provided with sufficient and suitable facilities and capabilities needed for emergency situations. These facilities may be some or all of the following:

- Fire fighting equipments
- Fire fighting systems & automatic safety control systems
- Personal protective equipments
- A clinic center or first aid materials.

Such facilities are checked periodically by HSE site department for adequacy and validity.

Arrangements with neighbor community working field sites are agreed and considered, under the umbrella of GASCO and EGAS, to integrate emergency preparedness facilities and capabilities to overcome any actual happening accidents.

Experimental drilling takes place periodically according to contingency plan requirements. A report of each drill results is made by HSE dept. and introduced for debate in the nearest HSE Meeting. Training programs are planned and performed for the purpose of raising staff awareness of emergency subjects, right behavior to avoid accidents and correct the response to emergency cases.

Results of any actual accidental situations are reported by the HSE department and discussed in the nearest HSE general department meeting. Related documents and procedures should be revised after actual accidental situations to insure its adequacy.

Drill reports and emergency case reports (emergency response practices evaluation sheets) are maintained by the site’s HSE department.

7.5.2 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.
7.5.3 Management of Social Impacts

7.5.3.1 Mitigation Measures

- In cases where the land where the lines or their right of way of 6 meters from both sides pass enter into urban boundaries, GASCO should purchase the land from the owners in order to ensure the safety of the line. In this case, GASCO should purchase the land in full market price and this is regarded as a permanent land acquisition.
- Local Governorate Unit (LGUs) should ensure that the roads are paved immediately after finishing the installation to avoid any further congestion and disturbances.
- To mitigate the unlikely incidence of fires, there is a need for full compliance with maximum safety measures and close monitoring of the site.
- Raising the level of awareness of the people in the project areas through different media channels and with the help of local NGOs.

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.

7.6 Management and Monitoring Tables for Operation

A matrix illustrating management and monitoring activities during operation, proposed responsibilities of different stakeholders and approximate costs are given in Tables 7-4 and 7-5.
<table>
<thead>
<tr>
<th>Impact</th>
<th>Mitigation measures</th>
<th>Responsibility of mitigation</th>
<th>Responsibility of direct supervision</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidents and Emergencies</td>
<td>Design to recognized standards, effective inspection, testing, and maintenance plans</td>
<td>GASCO HSE Department</td>
<td>GASCO Headquarters</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td></td>
<td>Rapid isolation of leaks to minimize potential hazards</td>
<td>GASCO HSE Department</td>
<td>GASCO Headquarters</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td></td>
<td>Pipeline patrolling for encroachment and damage risks</td>
<td>GASCO HSE Department</td>
<td>GASCO Headquarters</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td>Pipeline leakage surveys</td>
<td></td>
<td>GASCO HSE Department</td>
<td>GASCO Headquarters</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td>Permanent expropriation of land entering urban zoning</td>
<td>Not applicable (no paper on the path of the line route)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporary loss of crops during maintenance</td>
<td>Not applicable (no paper on the path of the line route)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 7-5: Environmental monitoring matrix during operation

<table>
<thead>
<tr>
<th>Impact</th>
<th>Monitoring indicators</th>
<th>Responsibility</th>
<th>Frequency/Duration</th>
<th>Location</th>
<th>Methods</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidents and Emergencies</td>
<td>Performance of regular maintenance</td>
<td>GASCO HSE Department</td>
<td>Quarterly</td>
<td>Documentation offices</td>
<td>Inspection of maintenance schedule</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td></td>
<td>Buildings on RoW, land alterations</td>
<td>GASCO Inspection Department</td>
<td>Twice monthly for populated areas</td>
<td>Pipeline route</td>
<td>Site observation, inspection of permits</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td></td>
<td>Leakage noise, pipeline pressure, etc.</td>
<td>GASCO Inspection Department</td>
<td>Twice monthly for populated areas</td>
<td>Pipeline route</td>
<td>Leakage detection tools</td>
<td>GASCO regular management cost</td>
</tr>
<tr>
<td>Permanent expropriation of land entering urban zoning</td>
<td>Not applicable (no pap on the path of the line route)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporary loss of crops during maintenance</td>
<td>Not applicable (no pap on the path of the line route)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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5 See Table 7-3, above.
6 See Table 7-3, above.
8. Public Consultation

as the project will pass in a desert area with no population at all and on a land owned by government no public consultation will be done( there are no public).

Conclusion

The study concluded, after analyzing the various project activities through the phases of construction and operation, and the consequent various environmental impacts, that the basic designs were based on the latest technologies and cleaner production technologies. The study also concluded that the project has many positive impacts on the socio-economic level, in terms of providing several employment opportunities, especially during construction phase, which support the national economy.

As for the negative environmental impacts during construction phase, they are considered to be limited and short-term, and can be reduced to the minimum that could be made these impacts negligible, by applying the proposed environmental monitoring and management plan during the construction phase. With regard to the negative environmental impacts during operational phase, the study concluded that they are insignificant and very limited.

Similarly, the social impacts of the project are mostly of temporary nature.
From the foregoing, the study concluded that the project is acceptable in terms of environmental and social aspects, with the following of the proposed social and environmental monitoring and management plan.