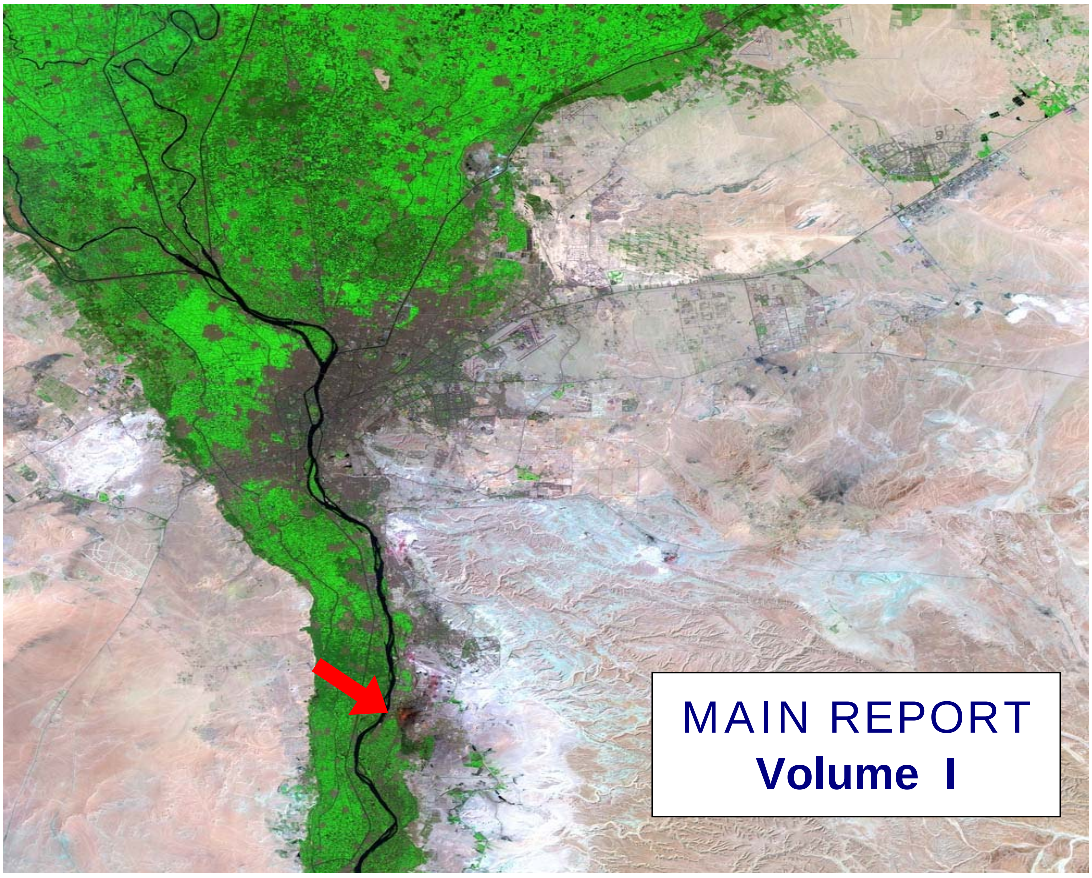
Ministry of Electricity and Energy
Egyptian Electricity Holding Company
Cairo Electricity Production Company

NEW TEBBIN 2x325 MWe GAS/OIL THERMAL POWER PROJECT

E1233 V. 2

Environmental and Social Impact Assessment



October 2005

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LIST OF ABBREVIATIONS

ADMS3	Air Dispersion Modeling System-Version 3
BOD	Biochemical Oxygen Demand
BPIP	Building Profile Input Program
CAA	Competent Administrative Authority
CAPMAS	Central Agency for Public Mobilization and Statistics
CEPC	Cairo Electricity Production Company
COD	Chemical Oxygen Demand
CSEDC	Cairo South Electricity Distribution Company
CWDS	Circulating Water Discharge Structure
DCS	Distributed Control System
DO	Dissolved Oxygen
DS	Dissolved Solids
EAAQLs	Egyptian Ambient Air Quality Limits
EEA	Egyptian Electricity Authority
EEAA	Egyptian Environmental Affairs Agency
EEHC	Egyptian Electricity Holding Company
EGSMA	Egyptian Geological Survey and Mining Authority
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
ENIT	Egyptian National Institute of Transport
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EUPS	Egyptian Unified Power System
FHWA	Federal Highway Administration, (US)
GARBLT	General Authority for Roads, Bridges and Land Transport
GEP	Good Engineering Practice
GDP	Gross Domestic Production
GIS	Gas-Insulated Switchgear

HCM	Highway Capacity Manual
HGVs	Heavy Goods Vehicles
LFO	Light Fuel Oil
LOS	Level of Service
MSDSs	Material Safety Data Sheets
MWe	Mega-Watt electrical
NFRA	National Fire Protection Authority
NRIAG	National Research Institute for Astronomy and Geophysic
OSHA	Occupational Safety and Health Administration
PCBs	Polychlorinated Biphenyls
PCDA	Public Consultation and Disclosure Activities
pcph	passenger car per hour
RIGW	Research Institute for Ground Water
SS	Suspended Solids
STG	Steam Turbine Generator
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TPP	Tebbin Power Plant
TSS	Total Suspended Solids
TWA	Time-Weighted Average
vph	vehicle per hour

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NEW TEBBIN 2x325 MWe GAS/OIL THERMAL POWER PROJECT

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EXECUTIVE SUMMARY

1. INTRODUCTION

1.1 Background

1. SPEEDOTRANS (Egypt) was commissioned by the Egyptian Electricity Holding Company (EEHC) to prepare the technical documents and procedures required by the World Bank Group (WB) and the Egyptian Environmental Affairs Agency (EEHC) concerning the Environmental and Social Assessment of the proposed Tebbin thermal Power Project at the old Tebbin power plant location.

2. EEHC is seeking financial assistance from the WB for the construction and operation of this 2x325 MWe, dual fuel power plant. The proposed plant is designated as a Category A project under WB rules and a Category C project under the Egyptian environmental regulations and therefore requires a full Environmental Impact Assessment. Financing from WB is conditional upon obtaining the environmental clearance from both the Egyptian regulatory authorities and the WB.

1.2 Project Overview

3. Cairo Electricity Production Company (CEPC), a company incorporated in Egypt and affiliated to the Egyptian Electricity Holding Company (EEHC) proposes to construct and operate a new thermal power plant at Tebbin, about 35km south of the city of Cairo on the east bank of the Nile river. The site is within an existing walled compound of the former Tebbin power plant. The overall proposed site area is approximately 100,000 m^2. Construction of the plant is due to commence in 2006 and will last approximately 37 months. Operation of the power plant will begin in 2009.

4. The proposed power plant will consist of two thermal units, each with a nominal electricity generating capacity of 325 megawatts (MWe), which will be known as New Tebbin Power Plant. The overall generating capacity of the power plant will be 650MWe. The power output from the proposed plant will be sold to the Egyptian Electricity Transmission Company (EETC).

5. The power plant will utilize natural gas as its primary fuel, delivered to

the site via an existing pipeline to be operated by GASCO, and also have the capability to operate using mazout (heavy fuel oil) in emergency situations, which will not be used for more than 7 days (or less than 2%) of operating time per year. The ability to "dual-fuel" the power plant (with natural gas or mazout) will provide security of electricity supply in the event that gas supplies are unavailable for any reason.

6. Nile river water, pumped to the plant via an intake structure located on the Nile bank, will be used as non-contact cooling water and for process water following demineralisation. Cooling, water will be returned to the Nile river via a discharge structure located on the Nile bank.

7. The location of the proposed site is shown in *Figure 1.* Also, *Figure 2* depicts this location within the context of the Greater Cairo Region. This map was developed by the Cairo Governorate for land use planning and urban development. This plan has been updated and revised in 2000 to be the Comprehensive Development Long-Term Plan- Cairo 2017. According to this Plan, Tebbin area has been designated as an Industrial Domain. This identification has been adhered to the Tebbin area since mid 1950's.

8. The project comprises, also, the dismantling and demolition of the present El-Tebbin old power plant, which has seized to operate, and ended to decommissioning on Monday, 8th June 2005. *Figure 3* illustrates a general view for the existing facilities layout where components of the old El-Tebbin power plant are shown in their respective locations within the plant boundaries.

9. Old facilities to be dismantled and demolished include the following main components:

- Gas Turbines
  - 2 x 23 MWe Gas Turbine (France Manuf. – Alsthom)
  - 2 x 30 MVA Generator 11 kV
- Transformers
- 66 kV building
- Circuit Breakers
- Water Treatment Equipment
- Boiler Feed Water Treatment
- Sanitary Wastewater
- Steam Generations Equipment
  - 4 Boilers Hungarian Manufacture
  - 1 Boiler Polish Manufacture
  - Instrument air compressors 3 x 1250 l/m
  - Fuel "heavy oil" pump station 3 x 20 t/h
- Steam Turbines Equipment
  - 3 Steam turbine (15 MWe/h) each
  - Generators 20 MWA 10.5 kV (Ganz – Hungarian Manufacture)
  - 2 Diesel Engine – Power 300 kWe – 380 Volt

Figure 1

Location of proposed El-Tebbin Power Plant

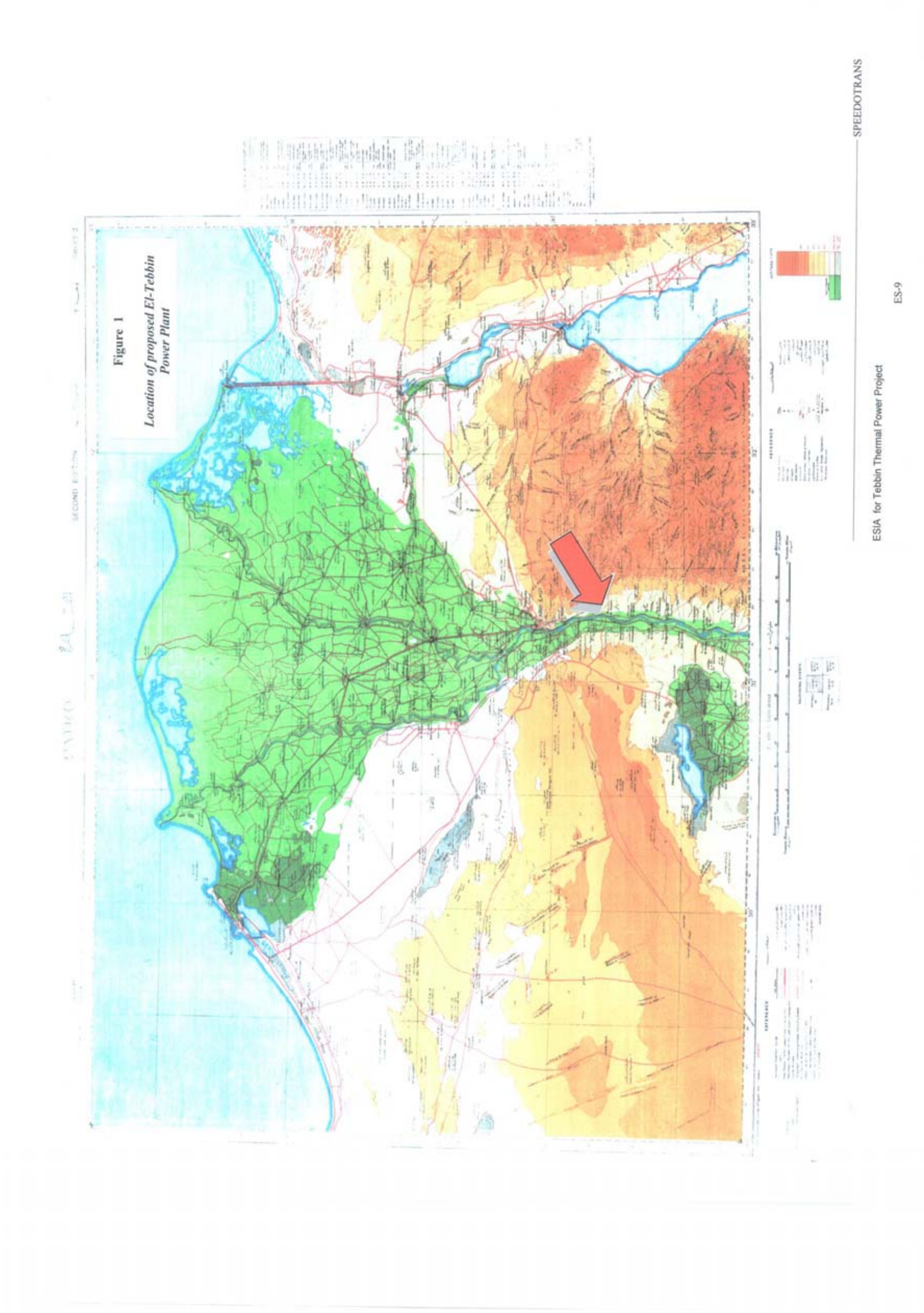


Figure 2

Location of the Proposed Site within the Context of the Greater Cairo Region

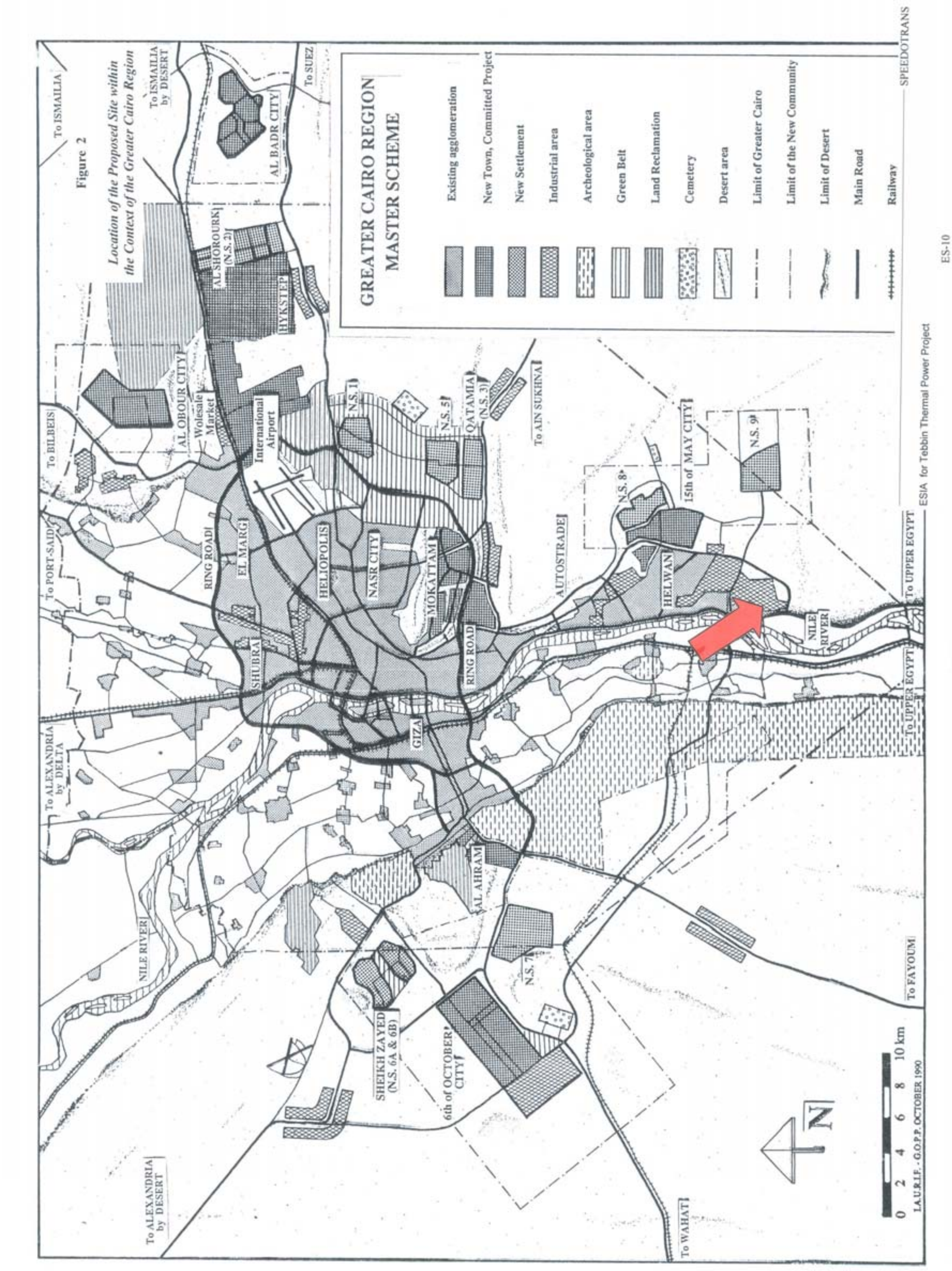
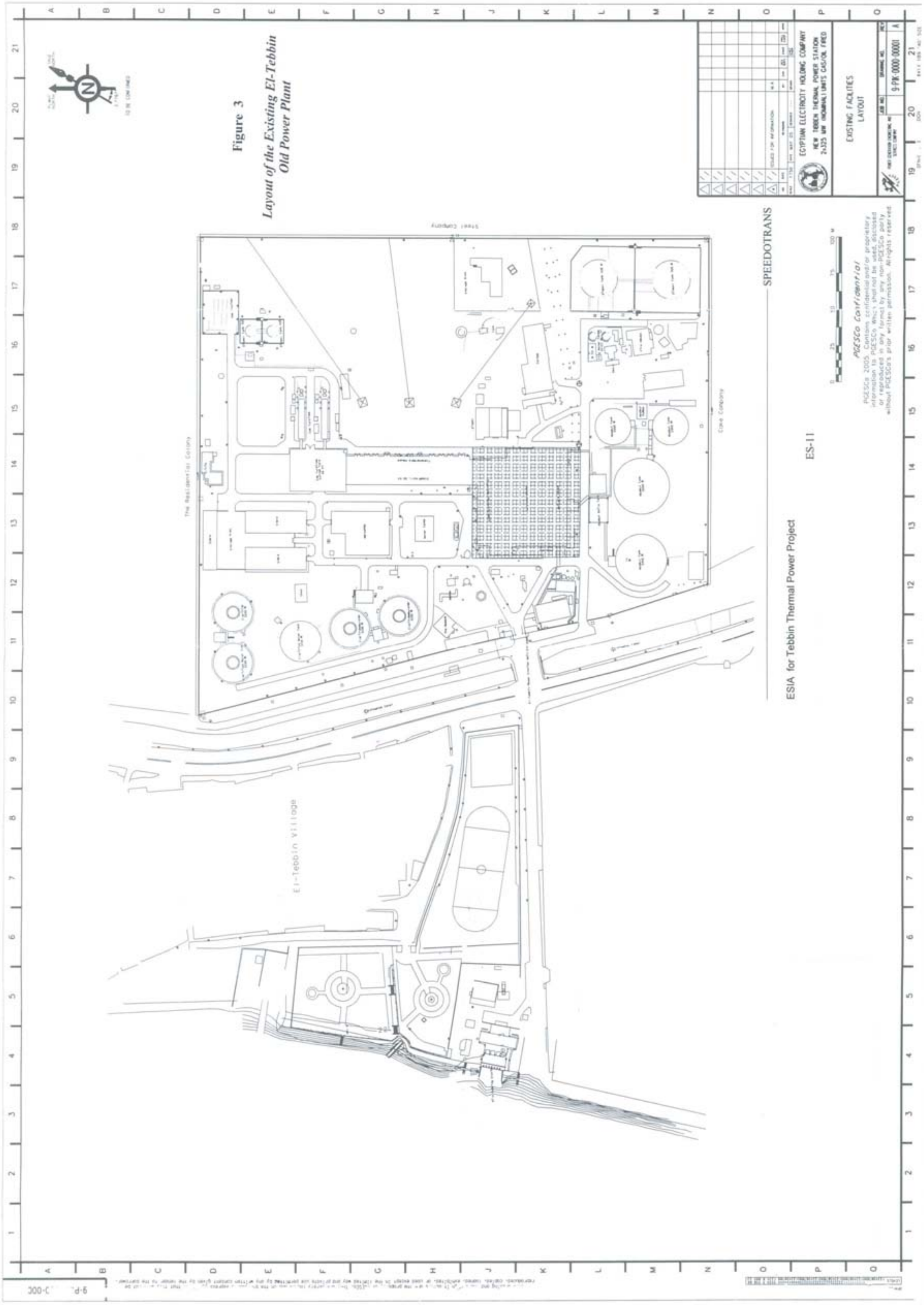


Figure 3

General View for the Existing Facilities Layout



- Cooling System Equipment
- Storage and Service Fuel Tanks
- Main Building:
  Administration building, Boiler building, Turbine building, and 66 kV building
- Clarification Area
- Other Facilities:
  Central workshop building, Warehouse buildings, Security fire fighting and transportation buildings, All batteries are Alkali-type, contained in Sealed containers.

10. No Asbestos Containing Materials or PCBs were used in the old Tebbin plant. The Consultant conducted a survey on both materials and concluded to the following:

- Transformers' oil was replaced more than one time before (approximately every 15 years). If it was started in 1958 with PCBs it has ended up with "Diala B oil" since many years ago.
- Irrespective of the fact that no asbestos was found during the survey, asbestos management plan will be undertaken during demolition by the contractor under supervision of CEPC.

2. THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

2.1 Contributors to the EIA Report

11. The Environmental and Social Impact Assessment (ESIA) report is prepared by SPEEDOTRANS, a private consulting firm (Egypt), based on many baseline studies undertaken by independent national and international consultants and on information provided by EEHC, CEPC and their sub-contractors. Public consultation activities are undertaken by SPEEDOTRANS and EEHC in conjunction with CEPC. The ESIA report draws heavily on the environmental and social assessment documentation prepared by group of local and international multidisciplinary consultants and submitted to SPEEDOTRANS, for preparing the ESIA report for local permitting purposes and financing requirements. All such documentations were reviewed by SPEEDOTRANS and cleared for inclusion in this report. Most of the relevant local permits for the construction of the power plant have now been received.

2.2 Scope of the ESIA Report: Legal and Administrative Framework

2.2.1 Government of Egypt Requirements

12. Beginning in the 1950s, the Government of Egypt has promulgated several laws and regulations concerning protection of the environment.

13. The Egyptian standards have been drawn from the range of provisions in the following documents:

- Law 4/1994 and the Prime Minister's Decree No. 338 of 1995, which promulgates the Executive Regulations of Law 4.
- Law 48 of 1982 regarding the protection of the River Nile and waterways from pollution and the Decree No. 8 of 1983 promulgating its Executive Regulations.
- Law No. 93 for 1962 regarding the drainage of liquid wastes, particularly sanitary drainage.
- Law of Labor No. 12/2003.
- Law No. 38/1967 amended by Law No. 31/1976 on public cleanliness and collection and disposal of solid waste.

14. Law 4/1994 requires that, for establishments requiring licenses, an environmental impact assessment must be prepared and submitted to the Egyptian Environmental Affairs Agency (EEAA) for review. The environmental impact assessment must be submitted to the EEAA by "the Competent Administrative Authority (CAA) or the licensing authority" for the project in question. For the Power Plant Project, the Competent Administrative Authority is the Cairo Governorate.

15. The Cairo Governorate will send the EIA to EEAA for review and provide its opinion within 60 days. Once EEAA has approved the project, a license to proceed can be issued. No additional environmental or social clearances are required other than the EIA approval to proceed with the project activities. The law requires that any new project should comply with all the relevant articles pertinent to environmental attributes, which could be impacted from project activities.

16. Egyptian EEAA regulations specify the technical scope or contents of an environmental impact assessment. As a matter of practice, environmental impact assessments for power plant projects typically have a scope and organization similar to World Bank environmental assessments.

17. In addition to environmental impact assessment requirements, the Government of Egypt has established air pollution and water pollution limits applicable to the Power Plant project. These limits are discussed in Chapter 6,

along with the actual air and water pollution levels expected from the Power Plant.

2.2.2 World Bank Guidelines and Safeguard Policies

18. The World Bank includes environmental impact assessment as an integral part of the evaluations it performs before financing a proposed project. The World Bank's Operational Policy 4.01 (October 3, 1991 and its updates, 1999) provides guidance on the types of assessments that should be performed for different types of projects, and on the scope and content of those assessments. According to Operational Directive 4.01, thermal power plant projects require a full Environmental Assessment (EA).

19. World Bank Environmental Safeguard Policies provide 10 potential issues that may need to be considered in an EA, depending on the specific characteristics of each project. *Table 1* summarizes the expected applicability of the potential Safeguard Policies to the Tebbin Power Plant Project. The Safeguard Policies identified as "applicable" are those which may be triggered and thus considered "Requiring Management". When the detailed design of the Tebbin Power Plant has been determined, the CEPC should prepare project-specific plans to manage these potential impacts.

20. No safeguard policies were triggered except for the Environmental Impact Assessment. *Table 1* shows potential World Bank environmental Safeguard Policies and El-Tebbin project applicability. The table justifies the applicability or lack thereof for WB Safeguard Policies.

21. Annex B to Operational Directive 4.01 provides an outline of the information that should be included in a full EA. This Environmental and Social Impact Assessment follows the scope of Annex B.

Table 1

Potential World Bank Environmental Safeguard Policies and El-Tebbin Power Project Applicability

No. Safeguard Policy	Applicability to Tebbin Project	Policy Triggered?	Justification
1. Environmental Assessment	Yes	Yes	• This policy applies to all projects requiring a Category A Environmental Assessment Under OP 4.01. • All environmental and Social aspects included in El-Tebbin project are adequately examined. • Tebbin project is not likely to have significant potential (reverse) environmental risks & impacts in its area of influence (impacts on the natural environment: air, water & land; human health & safety; physical cultural resources; and transboundary and global environment concerns).
2. Forest	No	No	• No forest areas exist.
3. Involuntary Resettlement	No	No	• No relocation or loss of shelters. • No loss of assets or access to assets. • No loss of income sources or means of livelihood. • The re-employment of workers program is voluntary and re-employed workers will keep all their benefits (salary, health insurance etc.) and will commute daily from their present locations. Incentives for workers to remain in the El-Tebbin colony are strong as the rent is heavily subsidized. The re-employment program will thus not result in any loss of income or physical resettlement. • All activities related to the construction of the new plant will take place within on CEPC land either on the site or on land directly adjacent to the site. i.e. no land acquisition. Not even temporary will result from the construction. • Experience from a number of similar power plants along the Nile river has shown that the impacts on fisheries of the discharge of warm water into the Nile have been positive. Consultations with the fishermen support this assertion. Impacts will be positive rather than negative, i.e. no loss of livelihood. • Transmission lines which will evacuate power generated by the Tebbin power plant will replace existing 66kV transmission lines. Some short distances $\leq$ 5 km will connect the power plant to existing substations via underground cables. No land take or resettlement will be associated to the power interconnecting lines.

Table 1 (Contd.)

Potential World Bank Environmental Safeguard Policies and El-Tebbin Power Project Applicability

No. Safeguard Policy	Applicability to Tebbin Project	Policy Triggered?	Justification
4. Indigenous Peoples	Yes	No	• The project does not affect the indigenous peoples in the project area.
5. Safety of Dams	No	No	• The project does not involve construction of a large dam. • The project is not dependent upon an existing dam.
6. Pest management	No	No	• Procurement of pesticides or pesticide application equipment is not envisaged. • The project will not affect pest management in any way.
7. Physical Cultural Resources	Yes	No	• Physical cultural resources are adequately examined. • The Tebbin project is not likely to have any significant impact on physical cultural resources.
8. Natural Habitats	Yes	No	• Natural Habitats are adequately addressed and examined. • The Tebbin project is not likely to have any significant impacts on natural habitats.
9. Projects in Disputed Areas	No	No	• The CEPC/EEHC is not involved in any disputes over an area with any of its neighbors. • The project is not situated in a disputed area. • Any component likely to be financed as part of the project is not situated in a disputed area.
10. Projects on International Waterways	No	No	• Cooling water abstracted from the Nile river (20-26m^3/sec.) is returned totally back to it. Actual water consumption is less than 0.07% of the abstracted water. • No disturbance to the Nile flow is expected either upstream or downstream. • Hydrological/hydraulic study is carried out and the study revealed that no impact is expected and the mixing zone is limited to 50m distance with 5°C above ambient, which diluted to 3°C at a distance between 100 and 150 m with full compliance with Egyptian Law 48/1983 and WB regulations. • MWRI is in full agreement with EEHC regarding its plan for water abstraction.

22. In addition to environmental impact assessment guidelines, the World Bank has established guidelines concerning air pollution and water pollution form thermal power plants *(Pollution Prevention and Abatement Handbook-Part III* (July 1998)). The guidelines were officially published in 1988; since then, several sets of revisions have been proposed, most recently on March 22, 1996. The 1988 and proposed 1996 guidelines are discussed in Chapter 6, along with the actual air and water pollution levels expected from the Power Plant.

23. World Bank's *Pollution Prevention and Abatement Handbook-Part III* (July 1998) also, provides with principles of industrial pollution management, monitoring and air emission & effluent discharge requirements presented in the industry Guidelines including Guidelines for New Thermal Power Plants.

24. Public Consultation Process has been designed in accordance with World Bank Guidance for the Preparation of a Public Consultation and Disclosure Plan (January 1996);

25. The ESIA has assessed the impacts of the demolition of the old El-Tebbin power plant and the construction and operation of the New Tebbin Power Plant and has also considered the cumulative air quality impacts of the plant and other existing industry in the project area. Consideration has also been given to the operation of the transmission line and other outside facilities. Permits will be required from the relevant Competent Administrative Authorities.

26. The ESIA report presents the full assessment of the environmental, social, health and safety impacts of the Tebbin power plant. This Executive Summary presents a short resume of the findings of the ESIA report. For further details, reference should be made to the full ESIA report.

3. GENERAL SETTING OF THE SITE: DESCRIPTION OF THE ENVIRONMENT

27. The Tebbin site is located within an existing walled compound of the former Tebbin power plant. It is situated on a 10 hectare wedge-shaped piece of land located in an industrial area characterized by many heavy industries.

28. The site is located some 35 km southeast of Cairo. The site is delimited by Latitude: 29^{o} 46 N and Longitude 31^{o} 17 E and the elevation is about 22 m above sea level.

29. The project area lies within the hyper arid climatic province of Egypt characterized by a mild winter and hot summer. Assuming equilibrium with average air temperature at Cairo, the river water at Tebbin is estimated to have an average high temperature of 29^{o}C (84^{o}F) in July and August, and an average low temperature of 14^{o}C (57^{o}F) in January and February.

30. Land cover on the site consists primarily of bare sand, with scattered low-growing vegetation. Only the northern part of the power plant site is characterized by dense vegetation coverage, despite the fact that it is located in a heavily industrialized location.

31. The main transport infrastructure that links the Cairo South area to the country main ports facilities is principally based on road network. The site is accessible through, at least, nine main highways; out of which, most importantly: Cairo-Alexandria desert road, Cairo-Alexandria agricultural road, Cairo-Damietta road, Cairo-Ismailia -Arish road, Cairo-Ismailia-Port Said road, the Maadi-Helwan-Ain El Sukhna highway and Cairo-Suez highway. The road network is supplemented by rail systems to the north of the site.

32. The site is located within a totally urban/urbanized landscape with heavy industrial and infrastructure facilities such as Iron & Steel and cement industries in the Tebbin and Helwan area and the fresh water treatment facility to the north direction of the power plant site.

33. There are no significant habitats within the project's area of influence. Vegetation, an important ecological indicator, is found far from this area although some small patches may be present. The only and most important ecological feature is the Nile river that runs as a corridor to the west of the project site.

34. The water resources in the project area are mainly: the surface water supply which is provided from the Nile river at a distance of about 200m west of the station site, and the ground water in Nile Valley aquifer system which is composed of sands and gravels with interbeds of clay lenses.

35. The proposed site lies within the administrative boundary of the Cairo Governorate. The Cairo Governorate has produced its Long Range Urban Development Master Scheme for the Greater Cairo Region. Both of the investment map of Egypt and the Greater Cairo Region Master Schemes, 2000 update designate Tebbin and Helwan area for industrial activities.

4. PROJECT DESCRIPTION

4.1 Overview of the Power Plant

36. The power plant site will occupy an area of approximately 100,000 m^2, within a total allocated area of 276,000 m^2 wedge-shaped piece of land and will include the following main elements:

- Conventional steam power plant, comprising two generating units primarily fired by natural gas, at approximately 7 bar gauge at the interface, but also designed to run on mazout (heavy fuel oil) in emergency situations as a secondary fuel. Each unit will consist of one outdoor boiler for steam generation and one steam turbine generator (STG) providing 325 MWe (nominal) electrical generation capacity per unit at the 100% of the STG output case. Each STG will be fed by steam from the respective steam generator (boiler);

- Circulating water system, with the main pumps and associated piping, the intake and discharge structures, the screening system, the chlorination system and the cathodic protection system;
- Heavy fuel oil and light fuel oil storage tanks;
- Intermediate water storage, the demineralization plant and the make up water system; and
- Power will be generated at the manufacturer's standard voltage and stepped up through main transformers to be connected to the new 220 kV switchgear.

37. The power plant will include the following main components:

- Boiler Unit 1A.
- Boiler Unit 1B.
- Reboiler.
- Auxiliary Boiler.
- Steam Turbine Unit 1A.
- Elec. Bldg. Unit 1A.
- Elec./Control Bldg. Unit 1B.
- Main Transformer Unit 1A.
- Main Transformer Unit 1B.
- Aux. Transformer Unit 1A.
- Aux. Transformer Unit 1B.
- Switchgear Area.
- Diesel Generator.
- Switchgear Control Room.
- Stack Module 1.
- Fuel Gas Receiving/Reducing Station.
- Mazout Fuel Oil Unloading Pumps.
- Sollar Oil Transfer Pumps.
- Mazout Fuel Oil Storage Tank 1.
- Mazout Fuel Oil Storage Tank 2.
- Sollar Oil Unloading Pumps.
- Mazout Oil Heaters/Transfer Pumps.
- Sollar Oil Storage Tank.
- Water Treatment Area.
- Circulating Water/fire Water Pump House.
- Circulating Water Electrical Equipment Bldg.
- Chlorine Tank/Pump.
- Condensate Water Tank.

- Circulating Water Discharge Structure.
- Circulating Water Seal Well.
- Demineralized Water Storage Tank.
- Waste Water Treatment Plant.
- Administration Building.
- Warehouse / Work Shops.
- Security Office.
- Fire Station.
- Hydrogen Generation Building.
- Bottled Gas Storage/Gen. Area.
- Foam Equipment.
- Black Start Facility.

38. The power plant is designed to operate as a base load unit with the STG operating in sliding pressure mode up to approximately 60% load and at fixed pressure for higher loads.

39. The layout and main components for the power plant is presented in *Figure 4.*

4.2 Process Description

40. The key steps of the generating process of the proposed power plant are as follows:

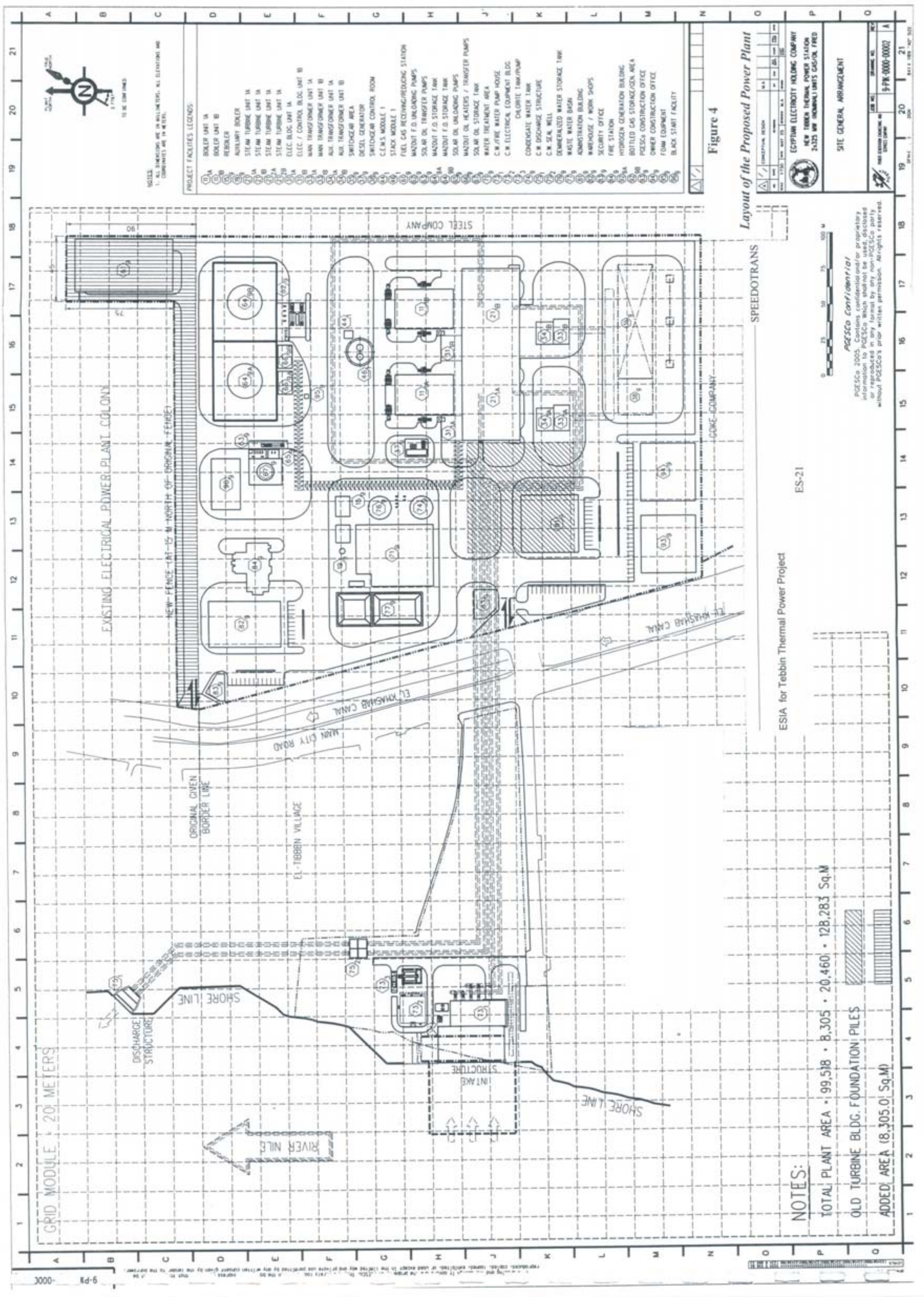
- The key inputs to the generating process comprise natural gas or mazout oil, (sulfer content 2.5%w on average) which will be delivered to the site via underground pipelines (gas or mazout), together with air and water.

- Natural gas (or mazout oil when natural gas is unavailable) will be mixed with air and combusted to generate steam from demineralized water to drive two turbines serving electrical generators. The combustion of the fuel is supported by injection of air. The process results in the generation of electricity and also produces hot exhaust gases.

- The steam is cycled from the boilers through the turbines to condensers. The condensers are cooled by a direct cooling system, abstracting water from, and discharging the used effluent to, the Nile river. The condensate is then returned for recirculation within the boilers.

Figure 4

Layout of the Proposed Power Plant



- The final exhaust gases will be discharged to the atmosphere via two flues housed in a single stack in accordance with emission standards set by the EEAA and the W.B. The main by-products from combustion of natural gas are carbon dioxide (CO_2), water vapour, carbon monoxide (CO) and nitrogen oxides (NOx). Sulfur dioxide (SO_2) and particulates, which are typically associated with coal and oil combustion, will not be produced other than in trace quantities during natural gas firing. When mazout oil is used instead of natural gas (during emergency for no more than 2% of the total operating hours allover the year), SO_2 and particulates will also be key emissions from the power plant.

4.3 Operational Releases from the Power Plant

41. During operation, the key releases into the environment from the power plant will comprise the following:

- Exhaust gases, will be emitted into the atmosphere, normally from the Boilers' stack as result of fuel combustion. Emissions from the combustion of natural gas are carbon dioxide (CO_2), water vapor, carbon monoxide (CO) and nitrogen oxides (NOx). Sulfur dioxide (SO_2) and particulates, which are typically associated with coal and oil combustion, will only be produced in trace quantities during natural gas firing. In emergencies when heavy fuel oil (mazout) is used instead of gas, SO_2 and particulates will however be key emissions from the power plant.

- Heated cooling water will be discharged into the Nile river via the cooling water discharge structure at a temperature of no more than 8^{o}C at the point of discharge. Process waste water will be treated and discharged into the discharge system, which includes two pathways: one to the City sewer system and the other to the plantation irrigation network. Any oil and residual solids will be removed before discharge and the pH of discharged water maintained at between 6 and 9.

- Chlorine will be added to the cooling water system to control bacterial and algal growth on various surfaces and in the cooling water intake. The cooling water discharge will contain residual quantities of chlorine at concentrations below the World Bank standard for free chlorine of 0.2 mg/l.

- Small volumes of solid wastes will be segregated, collected and disposed of by licensed waste disposal contractors.

42. The power plant incorporates a rang of measures to eliminate or reduce operational releases within its design and layout, such as low NOx burners in the boilers, oil interceptors fitted to the site drainage system and effluent treatment facilities to treat wastewater prior to discharge. As a result, the power

plant is designed to meet high environmental standards and comply with the emission limits of the Arab Republic of Egypt and the World Bank.

5. ANALYSIS OF ALTERNATIVES

5.1 Current Situation ("No Action" Option)

43. The no action alternative to the proposed El-Tebbin power plant would result in the demand for electricity exceeding supply, with an increasing deficit as demand increases in the future. Hence the lack of a secure and reliable electricity generation and supply system, would have significant social and economic implications including constraining existing and future economic development and restricting socio-economic development. As a result, the "no action" option is not considered to be a viable or acceptable alternative to the proposed project.

5.2 Alternative Technologies and Fuels

44. On the basis of security of supply, response to demand and economic advantages, the EEHC has specified that the Tebbin project should be a two gas/oil-fired steam cycle units of 325MWe nominal generating capacity each. The EEHC's rationale for choosing this technology in preference to other electricity generating technologies as follows:

45. The EEHC generation expansion plan includes provision of the following:

- gas/oil-fired steam units;
- gas/oil-fired combined cycle units;
- gas/oil-fired simple cycle combustion turbine units;
- pumped storage;
- wind farms; and
- integrated solar-thermal generating units.

46. Other possible options include "importing electricity", "rehabilitation of existing power plants", "transmission and distribution investment" and "IPPs".

47. These technological alternatives constrained by the following:

- ***Importing electricity:*** Egypt is interconnected to Libya and Jordan and is exporting electricity to both countries. Interconnection to Libya has a capacity of 300 MWe, and that of Jordan has a capacity of 350 MWe, which will be increased to 450 MWe in 2006. Libya and Jordan are currently paying 4 US¢/kWh for the Egyptian power supply. As they are net importers, there is currently not much scope for electricity imports to Egypt from the interconnected networks. In addition, the cost of electricity in both countries is much higher than that of Egypt, making it an uncompetitive alternative. There is currently no south border connection to Sudan, although there is an ongoing discussion in the context of the Nile Basin Initiative (NBI) whereby Egypt could potentially import hydroelectric power starting in 2010-2012, if the price is competitive. However, considering the abundance of natural gas and thus the low cost electricity provision in Egypt, it will be difficult for imported electricity to be competitive.

- ***Renewable energy*****:** The cost of wind based electricity 2.1 US¢/kWh with current grant financing for wind projects, which is higher than the cost from natural gas thermal plants: combined cycle (1.7 US¢/kWh) and steam cycle (1.85 US¢/kWh). Therefore, renewable energy is not competitive unless further subsidies are provided.

- ***Rehabilitation of existing power plants:*** EEHC has concluded that the rehabilitation option is cost effective in seven of its existing power plants, and these sites have already been or will be rehabilitated. However, these efforts are not enough to cope with the growing demand for electricity. The Tebbin power plant (3 steam units of 15 MWe) is too old (1958 vintage) and not appropriate to rehabilitate.

- ***Transmission and distribution investments*****:** EEHC has developed a transmission and distribution (T&D) development plan and the T&D system is optimized for the current load requirements and generation capacity. To meet the demand growth for the fast track period and medium term expansion, a T&D investment plan has been developed. New electricity generation capacity is required in the network; therefore, strengthening of T&D capacity alone will not replace the need for the generation capacity. Furthermore, T&D losses are at a relatively low level, around 10% on average, and reducing the losses further would not free up the amount of electricity supply required.

- ***BOOTs/IPPs*****:** Three BOOT projects (650 MWe each) have been built in Egypt in recent years. The government is encouraging private sector participation in order to attract private investment. However, given the worldwide reduction in investor's interest in the power sector, private financing for power generation in the near term is unlikely.

48. Consistent with the generation expansion plan, the EEHC has stipulated that the Tebbin should be gas/oil-fired steam units of a net 2 x 325 MWe generating capacity. The reasons for the selection of this technology

are as follows:

49. The steam cycle (SC) technology, which fires natural gas as a main fuel and mazout as a back-up fuel, has been used for decades in Egypt. The plant efficiency is around 40% with 300 MWe size drum type sub-critical steam cycle. The investment cost of SC plant, based on recent Egyptian experience, is around $ 530/kWe (EPC basis with multiple packages). The application of large scale (750 MWe) gas turbine combined cycle (CC) technology, which fires natural gas as a main fuel and diesel fuel as a back-up, has just started. Plant efficiency exceeds 50% and the investment cost, based on recent Egyptian experience, is around $ 300/kWe (EPC basis with multiple packages). Given that CC plants show lower investment cost and higher plant efficiency, there should be a distinguished rationale to justify why the SC technology has been selected for the proposed project. The reasons are the following:

- *Operational flexibility:* The EEHC plans to operate large scale (i.e., 750 MWe) CC plants at 100% full flat base-load with a possibility of reducing operations to 50% once a week. This is because the cycling capacity of large-scale CC plants is still to be confirmed (frequent start and stop, and partial load operation capacity). Consequently, SC plants are required to take the role of reducing the load, while CC plants keep 100% full load. EEHC therefore sets the maximum proportion of CC in the generation mix to be 30-35%. As a result, the Electric Generation Expansion Analysis System (EGEAS) model selected the proposed El-Tebbin SC plant as the most viable option based on this generation mix criteria. If the CC technology were selected, it would exceed the limit of CC in the generation mix, requiring CC plant cycling operation beyond what it is capable of.

- *Grid stability*: SC turbine has bigger inertia and is therefore more stable to network disturbances. When the CC ratio is too high in the generation mix, CC may overreact to the disturbances and interfere with each other, which could cause load instability.

- *Unforeseen risk of new technology*: Applying a new technology to the Egyptian specific climate and environment may have unforeseen risks. For example, recently, dust and humidity caused a quick filter pressure drop in the Cairo North plant, commissioned in May 2004, which was not expected when the CC plant was designed.

- *Fuel flexibility*: SC plants use mazout as a back-up fuel, easily available domestically, while CC plants use imported diesel oil that is more expensive. Even though the back-up fuel is not expected to be used often, the SC plant has lower back-up fuel cost.

- *Local manufacturing capacity*: In Egypt only 30% of CC plants are manufactured locally, in comparison to about 40-45% of SC plants manufactured locally. Therefore, the use of SC technology creates more local employment and requires less foreign exchange.

50. Given this rationale, existing and planned generating capacity using gas/oil-fired combined cycle units is already considered sufficient by the EEHC and further reliance on this particular technology is not preferred for reasons of security of supply, response to demand and economics. Actually, almost 14% of installed capacity in 2003/2004 was provided by combined cycle technology. The new combined cycle units at both Cairo North and Nubaria will add more 3000 MWe to the installed capacity within the next 2 years. Also, declared combined cycle additions of both new Kureimat and new Talkha will increase the combined cycle capacity by another 1500 MWe within the same period. The EEHC is implementing a process of meeting and generating increased demand through the provision of conventional steam generation plants in order to generate sufficient demand to install further CCGT capacity in the future. This will result in increased potential to incorporate more CCGT capacity.

51. Hence, with the current policy to limit CC to 30-35% in the generation mix (as identified by EGEAS), and with urgent need of supply capacity with load following capability, SC technology has been identified as the most viable option for the Tebbin project. This will ensure operational flexibility, network stability, fuel flexibility, local job creation, and avoid unforeseen risks of applying new technologies too rapidly in Egypt.

52. Natural gas has been selected as the main fuel for the power plant and compared to other fossil fuels generating technologies, steam turbine generators have relatively low emissions of carbon dioxide (CO_2), moderate emission level of nitrogen oxides (NOx), and lowest emissions, almost traces, of sulfur dioxide (SO_2) and particulates.

5.3 Power Plant Design

53. There are a wide variety of potential designs for the proposed power plant. On the basis of the key design features selected for the power plant, together with the adoption of general good practices within its overall design and layout, fuel and chemical storage facilities and pollution monitoring equipment, the power plant minimizes its potential impacts on the environment whilst ensuring safe, secure and efficient operation. Key aspects of the design, which have been compared with alternatives, are as follows:

- the stack has been designed to maximize buoyancy and dispersion of emissions and its height (152m) exceeds good engineering practice;

- the steam generators will be equipped with low NOx burners, minimizing emissions of NOx which is the key pollutant associated with combustion of natural gas;

- direct cooling water will be used to maximize generating efficiency, minimizing visual impact, noise emissions and the potential for visible vapor plumes or ground fogging. Alternatives such as cooling towers and air cooled condensers (open, whilst using less water, result in lower generating efficiencies and also result in impacts such as vapor plumes, visual and noise impacts). The availability of water is not considered an issue for this project given the use of water from the Nile river;

- cooling water will be supplied from a sustainable water supply, namely the Nile river, and the intake and outfall structures can be constructed and operated without significant impacts.

5.4 Alternative Sites

54. The EEHC designated the proposed El-Tebbin site for power plant construction from a group of three alternative sites, namely: Safaga, Damietta and El-Tebbin. The site area was allocated to the Egyptian Electricity Authority (EEA) (today, EEHC) for former El-Tebbin Steam Power Plant by the Government of Egypt (Ministerial Decree no. 402 of the year 1958, issued on 29 September 1958). In selecting the required site, consideration was given to the following criteria:

Economic Factors:

- capital costs;
- operation and maintenance costs;
- requirement for natural gas;
- requirement for cooling water;
- demand loads for electricity; and
- requirements for electricity transmission lines and sub-stations.

Non-economic Factors:

- potential environmental impacts; and
- site development.

55. Potential environmental impacts have been examined for all sites. Screening level assessment during feasibility study indicated that the level of environmental impact will be relatively constant for all three sites.

56. Following negotiations with the concerned authorities, the planned location of El-Tebbin power plant was found to be the most cost effective site for the following reasons:

- minimal additional infrastructure would be required;

- desirable benefits for development of the site area; and
- no workers' colony is required during construction as a local workforce is available.

57. In addition, the power plant will be constructed and operated on a land originally dedicated for power generation activity, thus it will not include any land take. Also, the power plant site will bring socio-economic benefits to the Greater Cairo Region, through employment opportunities, supply contracts and the effects of project expenditure within the local economy.

6. KEY FINDINGS OF THE ENVIRONMENTAL IMPACT ASSESSMENT

6.1 Introduction

58. A thorough assessment of the impacts of the proposed plant has been carried out based on information provided by EEHC, CEPC and their sub-consultants. A combination of quantitative and qualitative assessment techniques, ranging from computer and/or physical modeling for air, water, noise and traffic impacts to ecological and aquatic surveys and visual evaluation, have been undertaken. The results of the assessment work have been compared with the environmental standards set by the Government of the Arab Republic of Egypt and the World Bank, whichever is the more stringent.

59. The following items are examined in the corresponding sub-sections of the ESIA Study Report:

- Air Quality;
- Aquatic Environment;
- Noise and Vibration;
- Flora and Fauna;
- Land use, Landscape and Visual Impacts;
- Soils, Geology and Hydrology;
- Traffic;
- Socio-economics and Socio-cultural Effects;
- Archaeology, Historical and Cultural Heritage;
- Natural Disaster Risks;
- Major Accident Hazards;
- Solid Waste Management;
- Public Health Effects;
- Occupational Health and Safety; and
- Associated Infrastructure.

60. *Table 2* presents environmental, health and safety issues relating to demolition, construction and operation of El-Tebbin power project.

61. For each of these items, a concise description and evaluation of the significance of potential impacts of the project is presented in the ESIA

study report. Where modeling has been undertaken, a description of the model as well as corresponding maps summarizing the results of the assessment are provided.

62. Where potentially significant adverse impacts are identified, possible mitigation measures are suggested wherever possible, to ameliorate the impact to an acceptable level. Where identified, beneficial or positive impacts/effects of the project are also highlighted.

63. The conclusions of the assessment are that (with suitable mitigation measures described in *Tables 4, 5, 6 and 7*) the project is in compliance with the environmental requirements of both the Government of Egypt and the World Bank with respect to demolition process of existing facilities, stack emissions of the new power plant, ambient air quality, discharge quality and noise. *Table 3* provides with a summary of anticipated impacts in relation to the Egyptian and World Bank environmental guidelines for stack emissions, ambient air quality, liquid effluent and noise. The following discussion highlights some of the key considerations and results of the assessment.

Table 2

Environmental, Health and Safety Issues Relating to Demolition, Construction and Operation of El-Tebbin Power Project

Subject Area	Potential Impacts During Demolition and Construction	Potential Impacts During Operation
Air Quality	Dust from construction activities. Traffic-related air quality impacts.	Impacts of emissions from stacks on ambient air quality. Traffic-related air quality impacts. Global warming potential.
Aquatic Environment	Control and management of site drainage. Wastewater discharge. Sewage disposal and foul drainage.	Thermal water discharge. Water requirements for power plant operation. Discharge of process and wastewater. Operation of drainage systems on site. Discharge of storm water, sewage and drainage.
Noise and Vibration	Noise from construction activities.	Noise from power plant operations on surrounding land uses.
Land Use, Landscape and Visual Issues	Land use on site. Land use in the surrounding area. Effects of construction activities on landscape character. Visual impact of construction activities.	Land use on site. Land use in the surrounding area. Effects on landscape character. Visual impact of the power plant and operation activities.
Soils, Geology and Hydrogeology	Effects on soils and geological features. Soil contamination. Effects on groundwater.	Soil contamination. Effect on groundwater.
Flora and Fauna	Loss of habitat or species due to landtake. Disturbance or damage to adjacent habitat of species.	Disturbance or damage to adjacent habitat. Effects of structures on bird migration routes.
Traffic	Traffic conditions/disruption to road users. Traffic-related air quality. Traffic-related noise.	Traffic conditions/disruption to road users. Traffic-related air quality impacts. Traffic-related noise impacts.
Major Accident Hazards	Risk to third-party hazardous industry.	Risk to third-party hazardous industry. Risk to power plant of third-party hazardous industry.
Natural Disaster Risk	Seismic risk. Flood risk.	Seismic risk. Flood risk.
Solid Waste Management	Contamination of soils and water. Hazards to workers health. Accident risks.	Contamination of soils and water. Hazards to workers health. Accident risks.
Occupational Health and Safety	Accidents. Effects on health of workforce. Safety at work.	Accidents. Effects on health of workforce. Safety at work.

6.2 Air Quality

Demolition and Construction Dust

64. Demolition and construction activities will result in locally high levels of dust. This may affect residential receptors or sensitive environments which lie in the immediate boundaries of the power plant. Existing concentrations of airborne dust are already high in this urban industrial area. Potential impacts from dust emissions on site will be significantly reduced by careful management and the implementation of mitigation measures to reduce dust generation.

Stack Emissions and Background Air Quality

65. The power plant will burn natural gas as its primary fuel. As a result, the principle pollutant during normal operation will be NOx. During emergency operation (and for not more than 2% of operating time), the burning of light fuel oil will result in emissions of particulate matter and SO_2 along with trace amounts of other pollutants. Emissions from the plant will meet Egyptian and World Bank Guidelines.

66. In order to analyze the potential impacts of the plant's emissions during normal operation (firing gas) on ambient air quality in the project area, dispersion modeling has been undertaken.

67. The assessment indicates that the highest concentrations for each of the averaging periods under consideration (annual, daily, hourly) are found to the south-east of the site. This is because the winds are overwhelmingly from the north and northwest for most of the time. Maximum annual concentration of NOx emissions in the ambient atmosphere due to operation of the Tebbin power plant will not exceed 10 $\mu g/m^3$ (highest annual maximum is 9.6 $\mu g/m^3$ at the location [300m, - 300m]) and the maximum daily reaches 56.8 $\mu g/m^3$ at a distance of 141 m southeast the powerhouse. Also, Maximum "One-hour Average" concentration of NOx emissions in the ambient atmosphere reaches 96.3$\mu g/m^3$ at the location [130m, 95m] (see *Figure 5*). ***It is recommended that an air quality monitoring system composed of 2 or 3 monitoring stations will be utilized. The monitoring station equipped with meteorological monitoring system will be located near to, or within, the Tebbin power plant site, the other one or two stations will be located one down wind within the designated area of maximum predicted pollutant concentration and the other (if any) upwind***.

Figure 5

El-Tebbin Air Quality Monitoring Locations

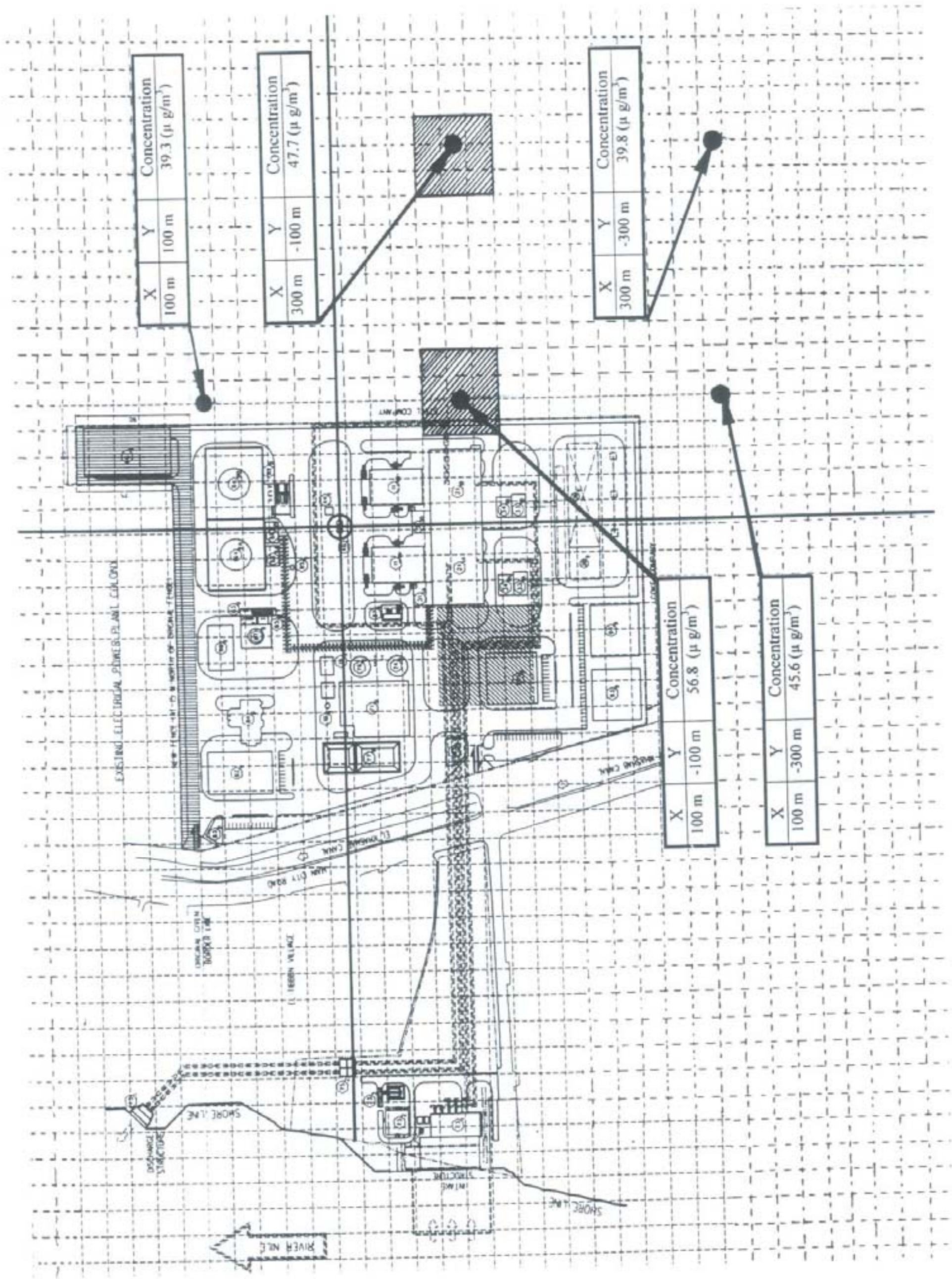


Table 3
Environmental Impacts and Environmental Guidelines

Impact Area	Predicted Max. Concentration from Tebbin Power Plant	Existing Ambient Air Quality (Effect of All Surrounding Industries)[2]	Cumulative Air Quality Impact of the Tebbin Power Plant and Surrounding Industries	Egyptian Standard	World Bank Cuideline
Stack emissions (100% load) (when firing Natural Gas)					
NOx[1]	300 mg m^{-3}			300 mg m^{-3} [1]	320 mg m^{-3}
SO_2	300 mg m^{-3}			2,500 mg m^{-3}	2,000 mg m^{-3}
TSP – General (all sizes)	50 mg m^{-3}			200 mg m^{-3}	50 mg m^{-3}
Stack emissions (100% load) when firing Heavy Fuel Oil (<2% of total annual operating time))					
NOx – oil firing	300 mg m^{-3}			300 mg m^{-3} [1]	460 mg m^{-3}
SO_2 – oil firing	2,000 mg m^{-3}			2,500 mg m^{-3}	2,000 mg m^{-3}
TSP – General (all sizes)	50 mg m^{-3}			200 mg m^{-3}	50 mg m^{-3}
Ground Level Concentration (when firing National Gas)					
NOx – 1 hour	96.6 μgm^{-3}	44.7 μgm^{-3}	141.3 μgm^{-3}	400 μgm^{-3}	-
NOx – 24 hours	56.8 μgm^{-3}	26.62μgm^{-3}	83.42 μgm^{-3}	150 μgm^{-3}	150 μgm^{-3}
NOx – 1 year	9.6 μgm^{-3}	3.6 μgm^{-3}	13.2 μgm^{-3}	-	100 μgm^{-3}
SO_2 – 1 hour	Trace	30.45 μgm^{-3}	30.45 μgm^{-3}	350 μgm^{-3}	-
SO_2 – 24 hours	Trace	17.97 μgm^{-3}	17.97 μgm^{-3}	150 μgm^{-3}	150 μgm^{-3}
SO_2 – 1 year	Trace	2.44 μgm^{-3}	2.44 μgm^{-3}	60 μgm^{-3}	80 μgm^{-3}
PM_{10} – 24 hours	Trace	101.93 μgm^{-3} [3]	101.93 μgm^{-3}	70 μgm^{-3}	150 μgm^{-3}
PM_{10} – 1 year	Trace	13.8 μgm^{-3}	13.8 μgm^{-3}	-	50 μgm^{-3}
Liquid Effluent					
pH	6-9			6-9	6-9
BOD	<30 mg/l			<30 mg/l	-
Chromium	-			0.05 mg/l	0.5 mg/l
Copper	<0.5 mg/l			1 mg/l	0.5 mg/l
Iron	<1 mg/l			1 mg/l	1.0 mg/l
Zinc	<1 mg/l			1 mg/l	1.0 mg/l
Oil and Grease	<5 mg/l			5 mg/l	10 mg/l
Total Suspended Solids (TSS)	<30 mg/l			30 mg/l	50 mg/l
Residual Chlorine (total)	<0.2 mg/l			-	0.2 mg/l [4]
Temperature Increase (°C)	≤5°C within 50 m from discharge point and ≤3°C within 150m. Width of plume trajectory ≤ one third of Nile width			(max. absolute temp 35°C at Nile surface, ≤5°C above ambient Mixing zone up to 150°C.	≤3°C at edge of mixing zone [5]
Noise [6]					
Daytime (max.)	Max. <59.1 dB(A)			60-70 dB(A)	70 dB(A)
Night time (max.)	Max. <59.1 dB(A)			50-60 dB(A)	70 dB(A)

(1) Egyptian standards for NOx are expressed in terms of NO_2.
(2) Ambient air quality continuous monitoring results measured by the EEAA air quality monitoring equipment in Tebbin area during 2004.
(3) PM_{10} for the first 6 months of 2005 has showed marked improvement with an average level of 52.16 $\mu g/m^3$. The PM_{10} concentrations resulting from the power plant itself only is traces.
(4) "Chlorine shocking" mey be preferable in certain circumstances, which involves using high chlorine levels for a few seconds rather than a continuous low level release. The maximum value is 2 mgl^{-1} for up to 2 hours, which must not be more frequent than once in 24 hours (and the 24 hour average should be 0.2 mg/l).
(5) The effluent should result in a temperature increase of no more than 5°C at the edge of the zone where initial mixing and dilution take place. Where this zone is not defined, use 100 m from the point of discharge when there are no sensitive aquatic ecosystems within this distance.
(6) There are sensitive receptors for noise within 150m of the power plant. The area has been categorised as "Industrial area" with respect to Egyptian ambient noise standards and "Industrial commercial" with respect to World Bank guidelines. It is decided that the northern fence between the power plant and the residential colony will be raised to 5 m height to achieve about 3-5 dB(A) reduction in predicted noise level.

6.3 Aquatic Environment

68. Cooling water and process water for power plant operation will be drawn from the Nile river via an intake structure. The quantity of the cooling water that will be returned back to the Nile river is about 20-26m^3/sec. Process water that will be abstracted from the Nile river is about 0.07% of this quantity. Potable water will be supplied to the power plant via City potable water system. Cooling water will be returned to the Nile river via a discharge structure whilst waste process water will be disposed of after treatment via discharge system, which includes two pathways: plantation irrigation network and City sewer system. Sanitary waste water will be disposed of via City sewer system. No ground water or other surface water will be used during power plant demolition, construction and operation. The Contractors will be responsible for relevant water/toilet facilities during demolition and construction and the need to provide appropriate services will be specified in their contracts. The key potential impacts of the power plant on the aquatic environment will therefore be impacts to the aquatic flora and fauna during power plant construction and operation.

69. The aquatic environment surrounding the project site is characterized by generally fair water quality. The aquatic flora is characterized by poor biodiversity and no sensitive ecosystems. No commercial fishing and very limited fishing activity occurs in the vicinity of the project.

70. During construction of the power plant dredging and construction of the intake and discharge structures could lead to potential impacts on physical aquagraphy, water quality and removal of, or disturbance to, aquatic habitats, flora and fauna. Given that the area of impact is very localised, losses are in many cases temporary and field survey data available do not indicate significant or sensitive habitats, the impacts of power plant construction on the aquatic environment are not considered to be significant. In addition, good site management and engineering practices during construction will ensure that any residual impacts are reduced to a minimum.

71. Power plant operation will result in a heated plume of waste cooling water being discharged into the Nile river. Process water will be disposed of to the discharge system (identified above). All discharges of process water will be treated prior to discharge to ensure that the Egyptian and World Bank waste water quality guidelines are met. Treatment includes neutralization, oil separation, flocculation and filtration.

72. The returned cooling water will be released at a temperature of no more than 8^oC at the point of discharge. Thermal modeling of the discharge plume shows that, during lowest flow at full load operation, the point at which the plume has decreased in temperature to 5^oC above ambient, lies at approximately 50 m from the point of discharge. The mixing zone has been defined by the HRI/MWRI to be 150 m from the point of discharge.

73. The temperature of the returned cooling water at the point of discharge conforms to the Egyptian Standard, and the discharge as modeled satisfies the World Bank standard of a maximum increase of 3°C above ambient at the edge of the mixing zone (100 m from the point of discharge). In addition, the area affected by the highest temperature increases and therefore where aquatic ecology is likely to be most affected, is localized and the aquatic habitats in this area have been found to already be relatively impoverished. Outside this area, more marginal increases in the Nile river water temperature are likely to create new or improved habitats for flora and fauna.

74. Physical aquagraphy, Nile bank access, fishing and navigation are not predicted to be significantly affected by the presence of the intake and discharge structures.

6.4 Noise Impacts

75. The demolition and construction of the Tebbin power plant is expected to generate a maximum noise level of 59 dB(A) during the day at the fence of the power plant and 57dB(A) at night. These worst-case demolition and construction noise levels are both within Egyptian and World Bank[(1)] guidelines, and for most of the demolition and construction periods, the noise levels will be lower than these values. There are residential receptors within 150m of the plant.

76. Demolition and construction traffic on local roads will also generate additional noise, however noise levels on local roads predicted for peak construction activity (during 2007/2008) is expected to be only 0.3dB(A) above ambient levels. This magnitude of increase is generally not perceptible to the human ear, consequently no construction traffic impacts are predicted.

77. The potential noise emissions from the Tebbin plant during operation have been modeled to provide noise contours in the area around the site. The predicted operational noise levels at the site boundary and at all receptors are below the Egyptian and World Bank guidelines during daytime and nigh-time. Although this is the case, it is recommended that the fence between the power plant and the residential colony should be elevated to a 5m height.

(1) There are no World Bank Guidelines for demolition and construction noise, therefore Operational noise guidelines are applied here.

6.5 Flora and Fauna

78. No areas protected for their conservation value are located on, or in the vicinity of, the project area. The proposed site itself, excluding its northern part where some valuable old trees exist, and the surrounding land is poorly vegetated with much of the area having been disturbed by urban developments. Given that the potential impacts of demolition, construction and operation on power plant area likely to be localized, and provided that a plantation ecologist expert will be hired for implementing a conservation/replantation program for the old trees at site, and good site management practices will be implemented, no significant effects are predicted.

6.6 Land Use, Landscape and Visual Impacts

79. The land use at the project site is industrial land. There is no loss of this land to the power plant development, as this land is dedicated for a power generation activity since late 1950's, therefore there is not significant land use impacts due to the Tebbin power project.

80. The surrounding land use is generally industrial. As the land is highly urbanized with limited vegetation, all existing views will be in significantly influenced by the power plant and given the surrounding industrial context, the visual intrusion of the power plant will be minimal.

81. Visual impacts of the power plant from the residential areas to the north and northwest are also not expected to be significant given the orientation of the apartments. The potential landscape and visual impacts of the project are therefore expected to be minor and not significant.

6.7 Soils, Geology and Hydrology

82. Due to the characteristics of the soils and geology of the site, in particular the lack of any sensitive features, and the mitigation measures proposed as part of the demolition, construction and operation of the power plant, no significant impacts are predicted to occur. In addition, preliminary land surface investigations confirmed the site as being uncontaminated. However, soil sample testing is recommended for further geotechnical investigation.

6.8 Traffic

83. The assessment of traffic and transport covers the changes in traffic conditions in terms of delay and congestion during construction and operation.

84. The greatest potential for traffic impacts to occur arises during a short

period at peak construction. There is some potential for increased congestion on the main roads to the power plant, however the impacts will only occur during the peak construction phase and during peak hours. The overall impact is therefore predicted to be insignificant. Mitigation measures will be put in place to reduce the potential for impacts to arise.

85. During operation, a small number of workers and HGVs are associated with operating the power plant and no impacts are predicted to occur.

6.9 Socio-economics and Soico-cultural effects

86. Re-employment program, associated with the demolition of the existing Tebbin facilities, is already implemented by the CEPC within the entire Cairo Electricity Generation System. All rights of the present workforce of the old Tebbin power plant are reserved.

87. There were 376 workers at the old plant, of which 235 will be retained. In other words 141 workers will start working elsewhere within the overall CEPC facilities. Besides many of these are expected to reply for unpaid leave to be able to work on the construction of the new plant where preference is given to local labor. The re-employed workers will not lose any of their previous rights (employment benefits, insurance, health care etc.).

88. Although a considerable number of workers will be re-employed elsewhere in the greater Cairo metropolitan area, their families/homes will remain in El Tebbin, i.e. no resettlement or loss of income will take place as a result of the re-employment.

89. It is anticipated that the power plant will provide a net positive socio-economic impact through the provision of employment opportunities and attraction of economic investment into the area. In addition, the use of local labor (95% during construction), will maximize these positive impacts through the development of the local skill base and will also generate increased demand for local services, materials and products.

90. In addition to the area specifically designated for the plant, there are large empty spaces next to the power plant site. All activities related to the construction of the new plant will therefore take place within the area belonging to the CEPC, i.e. there will be no off-site activities or associated land acquisition during construction.

91. As indicated in the main document, scientific research has shown that certain species of the fish grow considerably faster in warmer water.

92. The effects on the fisheries of warmer water returned to the Nile from similar power plants along the river are well known. Experience from a dozen

other power plants that have operated for a number of years indicates that the overall impacts on fisheries of slightly warmer water actually are positive, and consultations with the fishermen indicate that the catches in these areas have increased rather than decreased. Since this is part-time, small-scale fisheries no statistics are available, but after many years the warmer water around the various points of discharge, is clearly perceived by the fishermen to have positive effects.

93. In line with this recognition, discussions have already been initiated between the EEHC and the General Authority for Fishery Development with a view to jointly take advantage of this, e.g. establishing a fry collection station near the edge of the mixing zone.

6.10 Archaeology, Historic and Cultural Heritage

93. No available information was found which identified any archaeological, historic or cultural remains on the site or in the surrounding area. Consequently, no impact is predicted to occur on any known archaeological, historic or cultural resources.

94. CEPC have incorporated mitigation measures into the construction program (preparation of a chance finds procedure, Annex I) to ensure that any potential finds of significance are recorded and are accorded the required protection in consultation with Supreme Council for Antiquities.

6.11 Natural Disaster Risks

95. An assessment of the risks to the power plant from seismic activity has concluded that given the engineering measures incorporated into the design of the power plant, the potential environmental impacts of a seismic event during power plant operation are not anticipated to be significant.

96. Furthermore the power plant will be designed to conform to the Uniform Building Code Zone 2 seismic criteria, according to US regulations for earthquake. These design criteria are therefore considered sufficient to withstand the level of seismic activity experienced in the area.

97. The risks of flooding during power plant demolition, construction and operation were also examined. However, site drainage will be constructed to minimize any risks of contaminated water reaching the surroundings and to properly drain the site, no significant flood risk impacts are anticipated.

6.12 Major Accident Hazards

98. Given the wider land surrounding the Tebbin power plant and the measures incorporated into the design of the plant to minimize the risk from fire and explosion, the plant is not anticipated to pose a potential risk of any significance to any third party facilities.

6.13 Solid and Hazardous Waste Management

99. The management of wastes during demolition, construction and operation of the power plant will include mitigation measures to collect and store waste on-site, record all consignments of solid or contaminated waste for disposal and periodically audit waste contractors and disposal sites to ensure that disposal is undertaken in a safe and environmentally acceptable manner according to the rules set by Law 4/1994 and the Governorate of Cairo.

100. The only hazardous waste expected to be disposed of, if any, is asbestos. During demolition, special management procedure will be followed for any asbestos containing materials, if found, to be disposed of safely.

101. Private sector contractor will be assigned via general bidding process and the contract will include detailed environmental procedures, according to Law 4/1994 and Governorate of Cairo regulations, for demolishing about 20,000m^3 of debris materials. The contract covers all fees required.

102. During demolition, construction and operation, all wastes including debris waste, general waste, packaging waste, commercial wastes, raw-water pre- treatment sludge, tank sludge and interceptor sludge will be disposed of by licensed waste contractors according to the rules set by Law 4/1994 and the Governorate of Cairo.

103. Solid and hazardous waste management is not predicted to cause any significant impacts.

6.14 Occupational Health and Safety

104. With the provision of a high standard of health and safety management on site, demolition, construction and operation of the power plant in accordance with good industry practice, the occupational health and safety risks associated with demolition, construction and operation of the power plant will be minimized and are not significant.

6.15 Associated Infrastructure

105. Connections to existing gas, oil and electrical facilities will be the responsibility of GASCO, EGPC, EETC and the CEPC respectively. In regard

to the gas connection with the gas reducing station of the site and oil pipeline to the oil tanks on the site no environmental or social impacts are anticipated.

106. EEHC has already submitted a request to GASCO for their needs for the new plant which will necessitate a bigger diameter pipeline, and which will follow the same existing pipeline.

107. The electricity generated by the proposed power plant will be exported via the 220 kV electricity transmission system. The power plant will be connected to the 220 kV switchyard via step-up transformers. The generated power will be evacuated to the national grid via an overhead transmission line. The 220 kV lines will be tied to a 220 kV cables that will be a double circuit of a length about 5 km, extended from El-Tebbin power plant to Tebbin South 220 kV S/S following an existing route.

108. Transmission line upgrades will follow existing routing, i.e. no land will be expropriated. However, the Bank will be notified if any subsequent changes occur as it is recognized that this may have policy procedural implications.

109. EETC and CEPC will submit Screening Form B to the EEAA concerning this interconnection. No significant impacts are anticipated.

6.16 Global Impacts

110. Natural gas has been selected as the main fuel for the power plant. Compared to other fossil fuel generating technologies, gas fired steam generators have a relatively low emissions of carbon dioxide (CO_2), moderate emission levels of nitrogen oxides (NOx) and the lowest emission levels (almost traces) of sulfur dioxide (SO_2) and particulates.

111. The greenhouse effect is caused by the build-up of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and chlorofluorocarbons (CFCs) in the atmosphere. Water vapor and ozone (O_3) can also act as greenhouse gases. For power generation processes, CO_2 is the key emission of concern, as methane and CFCs are not emitted by power plants and none of the other greenhouse gases are emitted in sufficient quantities from power generation to be considered important in terms of the greenhouse effect.

112. The efficiency of the proposed steam power plant is 38-40% with natural gas, with associated CO_2 emissions of about 54kg/s. This compares with the efficiency of a typical CCGT power plant of 53-54%.

113. Emissions of carbon dioxide are estimated to be up to 1600 kilotonnes per year (expressed as CO_2). This assumes that the plant operates for the whole year and consumes around 65 tonnes of gas per hour. The emissions of CO_2 from fuel burning in Egypt amounted to around 118,262 kilotonnes in 2002/2003 (Ref: Energy in Egypt, 2002-2003; Organization for Energy

Planning). Fuel combustion will account for most of Egypt's CO_2 emissions from all sources. Hence, the power plant as proposed will emit up to around 1.3% of the total Egyptian CO_2 emissions in 2002/2003. This is an upper estimate as the plant will not operate 100% of the year or at full load 100% of the time.

114. Natural gas, which is the main fuel to be used in the Tebbin plant, contains very low concentrations of sulfur or particulate matter, therefore the potential for emissions of SO_2 and particulates from the electricity generating process are also very low. Fuel oil however, leads to greater emissions of SO_2 and particulates, due to the relatively high sulfur content of these fuels and the generation of ash during their combustion.

115. Natural gas fuel also has the significant benefit of being able to be delivered by an existing pipeline (even though it may be enlarged in capacity).

7. ENVIRONMENTAL MITIGATION AND MONITORING: THE ENVIRONMENTAL AND SOCIAL MNAGEMENT PLAN (ESMP)

7.1 Enhancement and Mitigation Plan

116. The Environmental and Social Management Plant (ESMP) includes mitigation measures, design of monitoring programs where appropriate, and specification of management measures (including institutional responsibility and training requirements).

117. The mitigation measures represent a synthesis of those measures which are part of the basic power plant design and those that have been recommended in Section 6 of the ESIA report for both the construction and operational phases of the power plant. The mitigation measures discussed in this section are summarized in the following three Tables, together with respective environmental monitoring and management arrangements. It should be noted that many of the mitigation measures presented below for the construction phase, will be carried forward into plant Operation.

118. All the mitigation, monitoring and management measures proposed below and in Section 8 of the ESIA report (the Environmental and Social Management Plan (ESMP)), will be adopted by the Project Company and imposed as conditions of contract on the contractor and any sub-contractors employed to build or operate any part of the power plant. Since many of the mitigation measures presented are considered an essential, integrated component of the construction and operation works, it is not possible to separate the specific costs of their implementation from the overall construction costs.

119. Mitigation measures introduced into the design and construction phase of the power plant will be carried forward into the operational phase by the CEPC Company. Many mitigation measures, as described in Sections 4 and 6 of the ESIA report, have already been integrated into the design of the power plant in order to minimize any operational impacts on the environment. Mitigation measures such as low NOx combustors, noise silencers and water discharge controls are for example considered integral to the design of the power plant.

120. The key features of the ESMP relate to air quality, aquatic discharge and implementation of good site management practice. The ESMP is summarized in *Tables 4, 5, 6, 7 and 8* which relate to demolition, construction and operational phases as well as to transmission system impact mitigation and management respectively. *Table 9* summarizes the cost of ESMP which will require to be included in the project financial plan.

Table 4

Institutional Arrangements for El-Tebbin Power Project

Issue/Impact	Mitigation Measures	Implementation Schedule	Type and Frequency of Reporting / Monitoring	Responsibility		Monitoring Indicators	Budget in US$
				Implementation	Supervision		
Demolition Phase							
Institutional capacity to address environmental and social issues	Basic training of CEPC employees responsible for supervising the demolition.	Prior to starting demolition. Ongoing training	Quarterly to EEHC & EEHC Environmental Coordinating Committee (ECC)	CEPC/TPP (EEHC training facility)	EEHC EEHC Environmental Coordinating Committee (ECC)	Training programs Compliance with ESMP	CEPC responsibility(*)
Construction Phase							
Institutional capacity to address environmental and social issues	Establishment of the Environmental Management Unit (EMU), construction phase. Basic training of persons employed to operate the monitoring activities. Basic induction training for all employees on good construction and site management practice.	Prior to starting construction. Ongoing training	Quarterly to EEHC & EEHC Environmental Coordinating Committee (ECC)	CEPC/TPP	EEHC EEHC-ECC	Training programs Compliance with ESMP	Included in air quality monitoring package CEPC responsibility
Operation Phase							
Institutional capacity to address environmental and social issues	Establishment of the Environmental Management Unit (EMU), operation phase. Basic training of persons employed to operate the monitoring activities. Induction, specific and refresher training for all employees on good operation management practice. Training methods, facilities & manuals	Prior to starting operation. Ongoing training	Quarterly to EEHC & EEHC Environmental Coordinating Committee (ECC)	CEPC/TPP	EEHC EEHC-ECC	Training programs Compliance with ESMP	Included in air quality monitoring package CEPC responsibility

Notes:
(*) CEPC responsibility: means that training and capacity building activities are included in the company's organizational structure and budget.

Table 5

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Air Quality Dust emissions caused by demolition activities, demolition vehicle movements, and transport of demolished materials.	Implementation of good site practices including: • demolition method is not blasting, but is top-down deconstruction, in the reverse order to that of demolition, progressive, level by level having regard to type of demolition; • wherever possible, external non-load bearing cladding shall be removed first; • debris to be removed at frequent intervals and stockpiles shall not be allowed to build up. Waste shall be removed on a daily basis as far as reasonably practicable; • appropriate siting and maintenance of stockpiles of demolished materials so as to minimize dust blow; • minimizing drop heights for material transfer activities; • roads will be kept damp via a water bowser; • roads will be compacted and graveled if necessary; • site roads will be maintained in good order; • regulation of site access; • sheeting of lorries transporting demolished materials and spoil; • enforcement of vehicle speed limits on dust roads to <35 km/h.	During demolition contract commencing 1st Quarter 2006.	Demolition air quality monitoring of NO_2 , SO_2 , CO, TSP and PM_{10} using air quality monitors, measurements to be undertaken by the NRC(1). Measurements and analysis of these pollutants to be made on an interval basis, e.g. monthly.	CEPC/TPP/Local Consultants (NRC) Implementation of Good Site Management practices shall be the responsibility of all contractors on site.	CEPC/TPP Assistant Plant Manager EEHC Environmental Management & Studies Sector	Dust levels (TSP and PM_{10}) NO_2, SO_2, CO, levels	CEPC/TPP to check dust suppression measures daily. NRC to measure pollutants monthly. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC responsible for management of the air quality monitoring measurements. Basic training of persons employed to operate and maintain the monitoring system. CEPC to ensure the contractor and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practice.	Mitigation measures and management, Contractor responsibility (included within demolition costs). Air Quality measurements: US$ 20:40k

Notes:
NRC = National Research Center.

Table 5 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Water Quality Generation of demolition site run-off. Surplus groundwater during soil remediation and wastewater that may cause adverse water quality impacts on water sensitive receivers.	Mitigation activities will include the following: • no discharge of effluents into the Nile river or El-Khashab canal - all effluents shall be collected and removed off site for treatment by approved firms; • development of a site drainage plan which reduces flow velocity and sediment load; • protection of temporary stockpiles of soil from erosion by using a reduced slope angle where practical, sheeting and by incorporating sediment traps in drainage ditches; • maintenance of well kept demolition site. • proper site management to minimize surface water run-off, soil erosion, soil remediation activities and the impacts of sewage effluents; • adequate maintenance of drainage systems to prevent any overflow; • critical areas within the Site shall be clearly marked and provided with protective measures to control site run-off. • Temporary channels shall be provided to facilitate run-off discharge into the appropriate watercourses, via a silt retention pond; • drainage channels shall incorporate sediment basins or traps and baffles to enhance deposition rates;	During demolition contract commencing 1st Quarter 2006.	Continuous monitoring is required to ensure the implementation of good management practices during demolition.	Implementation of Good Site Management practices shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP.	EEHC Environmental Management & Studies Sector.	Fluid effluents within the site. Soil erosion. Surface water run-off. Sewage effluents. Earth, mud and debris depositions on roads.	Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, MWRI, WB, etc.), if required.	CEPC to ensure the contractor and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practices.	Costs for mitigation measures included within demolition costs.

Table 5 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
	• wheel washing facilities will be installed to ensure no earth, mud and debris is deposited on roads. Sand and silt in the wash water from such facilities shall be settled out and removed before (in line with effluent discharge standards discharging the used water into water drains; • temporary water/toilet facilities will be provided and sewage discharges on site will be connected to the existing sewer or sewage treatment facilities where possible; • the contractor shall not discharge directly or indirectly into any public sewer stormwater drain any effluent or contaminated water without the prior written consent of the site engineer in consultation with the Asistant Plant Manager.								

Table 5 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Noise Arising noise impacts related to operation of demolition plant and vehicles.	Implementation of good site practices including: • enforcement of vehicle speed limits; • strict controls of vehicle routing; • demolition plant equipment to be fitted with silencers; • no noisy demolition activities at night; • prohibition of heavy vehicle movements at night; • use of protective hearing equipment for workers.	During demolition contract commencing 1st Quarter 2006.	Continuous monitoring and supervision by CEPC is required to ensure the implementation of good site management practices by the contractor and subcontractors during demolition. Third party audit.	Implementation of Good Site Management practices shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP. Auditor (Noise Expert).	EEHC Environmental Management & Studies Sector.	Noise complaints register to identify concerns. Check validity using noise measuring devices already available at CEPC and operated by CEPC noise specialists.	CEPC/TPP will produce a monthly log of valid complaints and actions taken to EEHC. Quarterly audit. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure the contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practices.	Management time and costs (US$ 25K)

Table 5 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Flora and Fauna Site clearance-vegetation removal and habitat disturbance.	• Good site management practices will be observed to ensure that disturbance of habitats off-site are minimized. Specific mitigation measures include restricting personnel and vehicles to within demolition site boundaries, lay down areas and access roads; • Plantation ecologist will work closely with the engineer and/or contractors in order to develop a detailed conservation plan for trees at the site; • Plants near the agricultural drainage banks will be kept due to its important role in accumulating pollutants especially heavy metals. This important ecological role was reported in the literature on the same genera; • Trees growing by the fence of the power plant will be kept since they will not obstruct any demolitions and due to their importance as wind shields.	During demolition contract commencing 1st Quarter 2006.	Continuous monitoring and supervision by CEPC is required to ensure the implementation of good site management practices by the contractor and subcontractors during demolition.	Plantation Ecologist. Implementation of Good Site Management practices shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP.	EEHC Environmental Management & Studies Sector.	Good conservation of floral wealth.	Assistant Plant Manager to check status of trees and other floral species daily. No. of trees conserved or replanted.	CEPC to ensure the contractor and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practices.	Management time and costs plus ecologist specialist (between US$ 7-9K)

Table 5 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Land Contamination Site clearance, excavation and disposal of material, exposure of potentially contaminated soils, spillage or leakage of substances on land, movement of equipment and vehicles on site.	The potential for impacts are largely dependent on management of the demolition site and activities. The following mitigation measures will be implemented: • development of effective site drainage systems; • restriction of access only to demolition site areas; • monitoring and control of spoil; • disposal of waste materials unsuitable for reuse at appropriately licensed sites; • provision of oil and suspended solid interceptors; • management of excavations during demolition to avoid the generation of drainage pathways to underlying aquifers; • provision of impermeable bases in operational areas to prevent absorption of spillages. • machinery and/or any other items that are suitable for reuse on other locations or sold out to a licensed contractor will be transported using safe means so as to keep the soil secured against any hazard; • Hazardous wastes will be disposed of by a licensed contractor, with strict adherence to the EEAA regulations and controls of the Law 4/1994. Disposal procedures will be audited by the project engineer and CEPC.	During demolition contract commencing 1st Quarter 2006.	Site investigation, including the collection of subsurface samples will be taken at various depths and a contaminated land specialist shall present during all stages of the sampling to instruct and amend sampling strategies at the time of sampling as necessary to take account of particular site conditions. Groundwater samples will also be taken. Samples will be tested at an accredited laboratory in accordance with standard international methods (USEPA or ASTM or equivalent) in line with best international practice.	Implementation of Good Site Management practices shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP.	EEHC Environmental Management & Studies Sector.	• site drainage. • access only to demolition site areas. • spoils. • waste materials. • oily waters. • drainage pathways. • potential spillage in operational areas. • soil sample test, including, but not limited to, total petroleum hydrocarbons and heavy metals.	Continuous monitoring is required to ensure the implementation of good management practices during demolition. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure the contractor and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practices.	Costs for mitigation measures included within demolition costs with the exception of Management time. Any additional features may incur additional costs of between US$ 10-30K dependent on the measure. Subsurface sampling and analysis: approx US$75-100K.

Table 5 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Traffic and Transport Disruption, noise and increased air pollution due to increased traffic, heavy loads and abnormal loads.	Standard good practice measures will be implemented as follows: • adherence of abnormal load movements to prescribed routes, outside peak hours and advance publication of movements if required; • demolition shifts will be staggered; • scheduling of traffic to avoid peak hours on local roads; • transportation of demolition workers by contract bus. •	During demolition contract commencing 1st Quarter 2006.	Continuous monitoring is required to ensure the implementation of good site management practices by the contractor and subcontractors during demolition.	Implementation of Good Site Management practices shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP.	EEHC Environmental Management & Studies Sector.	Increased congestion Travel time (compared to reasonable daily commute)	Daily	CEPC to ensure the contractor and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practices.	Management time

Table 5 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Socio-Economic Environment Positive Impacts identified.	Present labor force of the existing old Tebbin power plant have already been granted the right to choose where they will go to work within the overall Cairo Electricity Production Facilities. Quite fair rules for re-employing all members of the old Tebbin staff with no loss of their employment rights, including salaries, overtime, insurance, health care, and social & cultural benefits. Families/homes of considerable number of workers who will be re-employed elsewhere in the greater Cairo Metropolitan area will remain in El-Tebbin, i.e. no resettlement or loss of income will take place of the re-employment. Activities related to demolition work take place on the construction site, i.e. on CEPC land. Public and Industry Relations will be maximized through open dialogue between CEPC (through the Assistant Plant Manager who has direct responsibility for EHS Liaison) and local authority, public and industry representatives.	Before demolition contract commencing 1st Quarter 2006.	Record local employment provided by the project.	CEPC/TPP	EEHC Environmental Management & Studies Sector.	Social satisfaction as measured by staff interviews and complaints submitted.	Interim and closing reports	Responsibility of CEPC.	Responsibility of CEPC.

Table 5 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Asbestos Control Potential health hazard due to asbestos contamination.	There is a potential for finding Asbestos Containing Materials (ACM) during dismantling and demolition processes. If found, standard good practice measures will be implemented as follows: • any ACM present in the stacks and superstructures shall be removed before commencement of the demolition works; • removal of asbestos materials in certain locations may run more smoothly if both asbestos contractors and civil demolition contractors work in tandem. This is due to the convenience of the main civil demolition contractor providing access (scaffolding etc.) to the ACM, for the asbestos contractor and avoiding duplication of effort; • work actually involving the removal of ACM, that involves the handling of the ACM shall be carried out by a Specialist Asbestos Contractor; • all remaining ACM on the site is not accessible to the general public.	During demolition contract commencing 1st Quarter 2006.	The multi-party nature of the project and the involvement of non-asbestos contractor increase the risk of accidental disturbance of ACM. The CEPC should ensure that there is a reliable supervision and co-ordination mechanism to guard against any accidental disturbance of the asbestos containing material (ACM) by non-asbestos professionals.	The CEPC will control and monitor work progress and make the necessary adjustment to their workforce to meet the work requirements.	EEHC Environmental Management & Studies Sector.	Any ACM to be found	Daily reporting to EEHC Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	An Specialist Asbestos Contractor (SAC) shall be totally responsible for completing the asbestos abatement within the given time frame. It is anticipated that a minimum of 5 competent workers in various trades would be employed over the whole period. A full time Safety Supervisor shall be required to assist the contracting regarding safety and health of the site personnel and to keep the necessary records.	Management time and costs plus ACM specialist (between US$ 10-15)

Table 5 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility: Implementation	Responsibility: Supervision	Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
Waste Management	Recycling, storage, transportation and disposal measures are recommended to avoid or minimize potential adverse impacts. The Contractor will incorporate these recommendations into a Waste Management Plan that incorporates site specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials. Good practice measures such as the following: • wastes should be handled and stored in a manner which ensures that they are held securely without loss or leakage thereby minimising the potential for pollution; • only reputable waste collectors authorised to collect the specific category of waste concerned will be employed; • appropriate measures will be employed to minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers; • necessary waste disposal permits will be obtained from the appropriate authorities, if they are required, in accordance with the Waste Disposal Regulation and the Government Land Ordinance; • collection of general refuse will be carried out frequently, preferably daily; • waste will only be disposed of at licensed sites and site staff and the civil engineering Contractor will develop procedures to ensure that illegal disposal of wastes does not occur; • waste storage areas will be well maintained and cleaned regularly; • records will be maintained of the quantities of wastes generated, recycled and disposed, determined by weighing each load.	During demolition contract commencing 1st Quarter 2006.	Continuous monitoring is required to ensure the implementation of good management practices during demolition.	Implementation of Good Site Management practices shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP.	EEHC Environmental Management & Studies Sector.	Management contract in place. Functional transfer station.	Monthly reports from management contractor to CEPC. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure the contractor and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practices.	Management time and costs (<US$ 10K)

Table 5 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Occupational Health & Safety	Good local and international demolition/demolition practice in Environment, Health and Safety (EHS) will be applied at all times and account will be taken of local customs, practices and attitudes. Measures include: • implementation of EHS procedures as a condition of contract the contractor and subcontractors; • clear definition of the EHS roles and responsibilities of all demolition staff; • management, supervision, monitoring and record-keeping as set out in plant's operational manual; • pre- demolition assessment of the EHS risks and hazards; • completion and implementation of Fire Safety Plan prior to starting demolition to any part of the plant; • provision of appropriate training on EHS issues for all workers; • provision of health and safety information; • regular inspection, review and recording of EHS performance; • maintenance of a high standard of housekeeping at all times.	During demolition contract commencing 1st Quarter 2006.	Continuous monitoring is required to ensure the implementation of EHS Policies, plans and practices during demolition.	Implementation of Good Site Management practices and the EHS policies shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP.	EEHC Environmental Management & Studies Sector.	Management procedures in place. Workers health and safety as measured by no. of incidents.	Daily 6- monthly reporting of summary results and submitted to the EEHC and other concerned authority (e.g. EEAA, WB, etc.) if required.	CEPC to ensure the contractor and subcontractors for workers on site include reference to the requirements of the ESMP and are aware of the EHS policies and plans. All employees will be given basic induction training on EHS policies and practices. Contractor is responsible for ensuring that a Fire Safety Plan is prepared and implemented prior to starting demolition to any part of the plant under supervision of CEPC/TPP.	Mitigation measures will require management time plus costs of up to US$ 10K for preparation of Plans.

Table 6

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Air Quality Dust emissions caused by construction activities, construction vehicle movements, and transport of friable construction materials.	Implementation of good site practices including: • appropriate siting and maintenance of stockpiles of friable materials so as to minimize dust blow; • minimizing drop heights for material transfer activities such as unloading of friable materials; • construction phase to begin with construction of access roads; • roads will be kept damp via a water bowser; • roads will be compacted and graveled if necessary; • site roads will be maintained in good order; • regulation of site access; • sheeting of lorries transporting friable construction materials and spoil; • enforcement of vehicle speed limits on unmetalled roads to <35 km/h.	Before construction and during construction	Initiate baseline air quality survey of NO_2 , SO_2 , CO, TSP and PM_{10} using air quality monitors and continue during construction. Two analyzer stations will be electronically connected to the EEAA ambient monitoring system. Measurements and analysis of these pollutants to be made on a continuous basis by a trained staff assigned by CEPC/TPP and submitted to EEHC for reporting to any concerned authority.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Dust levels (TSP, PM_{10}) NO_2, SO_2, CO levels.	Quarterly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority. (e.g. EEAA, WB, etc.).	CEPC responsible for management of the air quality monitoring system. Submission of annual summary reports to EEHC and any other concerned authority. Basic training of persons employed to operate and maintain the monitoring system. CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice.	Mitigation Measures, Management time and costs (<included in construction costs) Baseline Air Quality Monitoring: Permanent Continuous Monitoring System-approx. US$ 1000-1500K plus management time & reporting.

Table 6 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting / monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Aquatic Environment Dredging and construction of the intake structure and pipe-laying for water intake and discharge pipes- increased suspended sediment and pollutant loads, permanent loss and disturbance to aquatic flora and fauna.	The following measures will be taken: • Construction Method Statement to be produced by the Contractor; • dredged areas limited to minimum area required; • disposal of dredged sediments to an agreed site; • all works will be made clearly visible using flags, beacons and/or signals; • bank area will be reinstated following construction.	During construction of intake and discharge structures	Nile survey undertaken April 2005 along 5 profiles fronting the site. Report to be maintained for later monitoring and evaluation during operation. Water quality will be measured monthly (monitoring of temperature, pH, COD, BOD, TOC, DO, TSS, oil & grease, residual chlorine, heavy metals and other pollutants).	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Bank line Dredged areas & dredging waste material.	Daily (for bankline and dredged areas) Monthly (for water quality).	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice. These mitigation measures must be a condition of any construction contracts commissioned.	Mitigation Measures: Management time and costs (included in construction cost). Water quality measurement costs (between US$ 10-15K)

Table 6 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting / monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Contamination of the aquatic environment as a result of construction activities on land e.g. spillages, disposal of liquid wastes; surface run-off, exposure of contaminated soils (see also under "Soils and Hydrology").	Mitigation activities will include the following: • no discharge of effluents into the Nile river - all effluents shall be collected and removed off site for treatment by approved firms; • development of a site drainage plan which reduces flow velocity and sediment load; • protection of temporary stockpiles of soil from erosion by using a reduced slope angle where practical, sheeting and by incorporating sediment traps in drainage ditches; • maintenance of well kept construction site.	During construction	Continuous monitoring is required to ensure the implementation of good management practices during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Fluid effluents within the site. Soil erosion. Surface water run-off. Sewage effluents. Earth, mud and debris depositions on roads.	Daily Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time and costs (included in construction cost).

Table 6 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Noise Increased noise in the project area as a result of the use of noisy machinery and increased vehicle movements.	Implementation of good site practices including: • enforcement of vehicle speed limits; • strict controls of vehicle routing; • diesel engine construction plant equipment to be fitted with silencers; • limited noisy construction activities at night; • prohibition of heavy vehicle movements at night; • use of protective hearing equipment for workers.	During construction	Continuous monitoring and supervision by CEPC is required to ensure the implementation of good site management practices by all contractors during construction. Third party audit.	Implementation of Good Site Management practices shall be the responsibility of all contra-ctors on site under supervision of the Assistant Plant Manager. Auditor (Noise Expert)	EEHC Environmental Management & Studies Sector. 6-monthly audit.	Noise complaints register to identify concerns. Check validity using noise measuring devices already available at CEPC and operated by CEPC noise specialist.	CEPC/TPP will produce a monthly log of valid complaints and actions taken to EEHC. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time and costs (US$ 50K)
Flora and Fauna Site Clearance-Vegetation removal and habitat disturbance.	• Good site management practices will be observed to ensure that disturbance of habitats off-site are minimized. • Specific mitigation measures include restricting personnel and vehicles to within construction site boundaries, lay down areas and access roads. • CEPC to hire a specialist ecologist to conserve and maintain old valuable trees and vegetation on site during construction phase.	During construction.	Continuous monitoring and supervision by CEPC is required to ensure the implementation of good site management practices by all contractors during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Good conservation of floral wealth. Assistant Plant Manager to check the status of trees and other floral species daily.	Weekly No. of trees conserved or replanted.	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time and costs plus ecologist specialist (between US$ 20-25K)

Table 6 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Soils and Hydrology Site clearance, excavation and disposal of material, exposure of potentially contaminated soils, spillage or leakage of substances on land, movement of equipment and vehicles on site.	The potential for impacts are largely dependent on management of the construction site and activities. The following mitigation measures will be implemented: • development of effective site drainage systems; • restriction of access only to construction site areas; • monitoring and control of spoil; • disposal of waste materials unsuitable for reuse on-site, (e.g. for landscaping) at appropriately licensed sites; • provision of oil and suspended solid interceptors; • management of excavations during construction to avoid the generation of drainage pathways to underlying aquifers; • provision of impermeable bases in operational areas to prevent absorption of spillages.	During construction.	Continuous monitoring is required to ensure the implementation of good management practices during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	• site drainage. • access only to construction site areas. • spoils. • waste materials. • oily waters. • drainage pathways. • potential spillage in operational areas. • soil sample test. • ground water sample test.	Continuous monitoring is required to ensure the implementation of good management practices during demolition. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Costs for mitigation measures and management time included within construction costs. Any additional features (e.g. bunding, interceptors etc.) may incur additional costs of between US$ 20-30K dependent on the measure.

Table 6 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Traffic and Transport Disruption, noise and increased air pollution due to increased traffic, heavy loads and abnormal loads.	Standard good practice measures will be implemented as follows: • adherence of abnormal load movements to prescribed routes, outside peak hours and advance publication of movements if required; • construction shifts will be staggered; • scheduling of traffic to avoid peak hours on local roads; • transportation of construction workers by contract bus.	During construction.	Continuous monitoring is required to ensure the implementation of good site management practices by all contractors during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Increased congestion Travel time (compared to reasonable daily commute)	Daily	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time

Table 6 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Socio-Economic Environment Positive impacts identified.	All activities related to the construction of the new plant will take place within the area belonging to CEPC, i.e. there will be no off-site activities or associated land acquisition during construction. The entire labor force will be daily commuters, thus no worker housing or associated facilities will be erected on site during construction. The contractors will be responsible for relevant temporary water / toilet facilities during construction and the need to provide appropriate services will be specified in their constracts. Public and Industry Relations will be maximized through open dialogue between CEPC (through the Assistant Plant Manager who has direct responsibility for EHS Liaison) and local authority, public and industry representatives.	During construction.	Record local employment provided by the project.	CEPC/TPP Assistant Plant Manager	EEHC Environmental Management & Studies Sector.	Workers satisfaction as measured by staff interviews and complaints submitted.	Editing a special report	Responsibility of CEPC.	Responsibility of CEPC.

Table 6 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Archaeology Potential chance finds of archaeological remains during construction.	The project site does not lie on, or in the immediate vicinity of any known archaeological areas of interest. If remains are found CEPC is committed to: • cease activities and consult Antiquities authority; • protection in situ if possible; • excavation of areas where protection not feasible; • preparation of a Chance Finds Procedure and Method Statement.	During construction.	Supervision of construction activities.	Construction contractors CEPC will allocate responsibilities in accordance with the Chance Finds Procedure.	EEHC Environmental Management & Studies Sector.	Chance finds (see annex II)	Daily	CEPC to ensure that all workers on site are aware of the importance of archaeological remains and must report any potential finds immediately. Immediate liaison with Competent Administrative Authority should a potential find be uncovered.	Mitigation measures require management time. Should chance finds occur, protection & excavation could add significantly to the cost.
Natural Disasters Flash flooding.	Good engineering design will incorporate the following mitigation measures: • drainage system designed to direct flood water from main plant areas into the City sewer system and direct potentially contaminated waters through the oil interceptor.	During construction.	No monitoring measures are envisaged.	CEPC/TPP Assistant Plant Manager	EEHC Environmental Management & Studies Sector.			CEPC to ensure that all workers on site receive training in emergency preparedness and response procedures.	Relevant costs are included within the construction costs

Table 6 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Solid Waste Management	Good practice measures such as the following: • all waste taken off-site will be undertaken by a licensed contractor and CEPC will audit disposal procedure; • collection and segregation of wastes and safe storage; • recording of consignments for disposal; • prior agreement of standards for storage, management and disposal with relevant authorities.	During construction.	Continuous monitoring is required to ensure the implementation of good management practices during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Management contract in place Functional transfer station.	Monthly reports from management contractor to CEPC and then to EEHC. These reports are to be submitted to any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time plus costs (< US$ 10K)

Table 6 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting / monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Occupational Health & Safety									
	Good local and international construction practice in Environment, Health and Safety (EHS) will be applied at all times and account will be taken of local customs, practices and attitudes. Measures include: • implementation of EHS procedures as a condition of contract all contractors and sub-contractors; • clear definition of the EHS roles and responsibilities of all construction companies and staff; • management, supervision, monitoring and record-keeping as set out in plant's operational manual; • pre-construction and operation assessment of the EHS risks and hazards; • completion and implementation of Fire Safety Plan prior to commissioning any part of the plant; • provision of appropriate training on EHS issues for all workers; • provision of health and safety information; • regular inspection, review and recording of EHS performance; and • maintenance of a high standard of housekeeping at all times.	During construction.	Continuous monitoring is required to ensure the implementation of EHS Policies, plans and practices during construction.	Implementation of Good Site Management practices and the EHS policies shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Management procedures in place. Workers health and safety as measured by no. of incidents.	Daily Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure all contractors and sub-contractors for workers on site include reference to the requirements of the ESMP and are aware of the EHS policies and plants. All employees will be given basic induction training on EHS policies and practices. Contractors are responsible for ensuring that a Fire Safety Plan, which conforms to NFPA 850, is prepared and implemented prior to commissioning of any part of the plant under supervision of CEPC/TPP.	Mitigation measures will require management time plus costs of up to US$ 50K for preparation of EHS Plans.

Table 7

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Air Quality Emissions from stack are not expected to exceed standards.	Mitigation measures have already been included in the design of the plant and, given CEPC/TPP's strict commitment to use mazout fuel oil for <2% of operating time, no further mitigation measures are proposed. CEPC/TPP will however demonstrate the validity of the conclusions drawn in the ESIA report.	During first three years of operation.	**Automatic monitoring** of stack emissions for NOx, SO_2, particulate matter and carbon monoxide (CO) via test ports installed in the main stack.	The analyzer stations will be owned and operated by CEPC/TPP. Assistant Plant Manager	EEHC Environmental Management & Studies Sector. Report introduced to EEAA as requested. Third party inspection.	Stack emissions (at least PM_{10}, NOx, SOx and CO).	Continuous Hourly data acquisition. Quarterly reporting to EEHC. Reports are to be available to any of the concerning authorities (EEAA, WB, etc.).	Records must be kept and summary data (including any deviations from Egyptian and World bank standards) will be submitted to the Government and WB on annual basis (or more frequently if required). Annual reporting by CEPC/TPP to Government and WB etc. (or more frequently if required) highlighting key features and comparing results with air quality standards and prediction in ESIA report	Automtic stack monitors: included in included in the project cost. Management time for compilation of reports and performance monitoring: included in operation cost. Purchase of Continuous Monitors (see construction management table). Annual servicing, calibration & running costs: included in operation cost.
Ambient air quality affected by emissions from the power plant.	CEPC/TPP will demonstrate the validity of the conclusions drawn in the ESIA report. If ground level concentrations are found to be above local and World Bank standards options for further mitigation will be discussed.		**Install two continuous** NOx, SO_2, CO, PM_{10} & TSP **monitoring stations** to monitor short-term concentrations in the area predicted to have the highest impacts on humans (as there are no other sensitive environments). The analyzer station near or within the site boundaries will include a **continuous monitor** of meteorological conditions (temperature, wind speed, wind direction and mixing heights). The analyzer stations will be electronically connected to the EEAA ambient monitoring system.			Ambient air pollutants concentrations (at least TSP, PM_{10}, NOx, SOx and CO).			

Table 7 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Aquatic Environment Discharge of process and cooling water.	The design of the intake and cooling water structures have already incorporated measures to reduce impacts. In addition, good site management practices including the following will be implemented: • neutralization, oil separation, flocculation and filtration of any contaminated water before discharge to either city sewer or the plantation irrigation network; • no disposal of solid wastes or waste water into the discharge structure; • regular maintenance of site drainage system to ensure efficient operation; • all discharges will comply with local Egyptian and World Bank guidelines. In addition, CEPC/TPP will demonstrate the validity of the conclusions drawn in the ESIA report. If pollutant concentrations in the discharge or impacts to the surrounding aquatic environment are found to be above local and World Bank standards or unacceptable, options for further mitigation will be discussed.	Lifetime of the plant	Prepare regular water quality monitoring program including: • quality of all water prior to discharge (**continuous monitoring** of all discharged water for temperature and pH, daily monitoring of process water for COD, TSS, oil & grease and residual chlorine and **monthly monitoring** of heavy metals and other pollutants) • ambient water quality in the area affected by the discharge plume (**3-monthly monitoring** of temperature, pH, COD, BOD, TOC, DO, TSS, oil & grease, residual chlorine, heavy metals and other pollutants. **Annual monitoring** of benthic environment within a 2 km radius of the discharge point (**over a 3 year period**) **Weekly monitoring** of fish catches on intake screens inclu-ding species, num-bers and size (**over a 1 year period**).	CEPC/TPP Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Basic parameters as per the Law the 48/1982 and Law 93/1962	Monthly reports from CEPC/TPP to EEHC Continuous monitoring of water quality etc. Monthly monitoring of heavy metals and other pollutants. 3-monthly monitoring of the plume. Annual monitoring of benthic environment (over a 3 year period). Weekly monitoring of Fish Catches on intake screens (over a 1 year period. Reports are to be available to any of the concerning authorities (EEAA, WB, etc.).	Records will be kept and compared on regular basis against Egyptian and World Bank standards and impacts predicted in ESIA. Summary reports (with any exceptions identified) will be submitted to the Government and WB etc. on annual review basis (or more frequently if required). CEPC/TPP to ensure that all employees are given basic induction training on the requirements of the ESMP, good site management practices and H&S procedures. The Assistant Plant Manager will ensure implementation of procedures.	Management time for implementation of site management practices. (included in operation cost) All costs are included in operation cost.

Table 7 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility: Implementation	Responsibility: Supervision	Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
Noise	Although noise levels at northern fence of the plant (where residential colony is located beyond it) are complying with law 4/1994, northern fence will be elevated to a height of 5 m for gaining a reduction 3-5 dB(A) in noise levels. Specific design mitigation measures to minimize noise impacts include: • steam turbine generators; air compressors, pumps and emergency diesel engines are enclosed in buildings; • air compressors are equipped with silencers; • noisy outdoor equipment are designed to a noise limit of 85 dB (A) at 1 m. In addition, plant workers will be provided with protective wear in plant areas with high noise levels. The plant will operate in accordance with internationally accepted health and safety measures.	During first year of operation.	Given that sensitive receptors are located in the immediate vicinity of the plant, noise monitoring is envisaged. When the plant is fully operational, noise audit measurements are to be carried out at noise sources and at the fence of the power plant as well as at noise receptors around the plant.	CEPC/TPP Third party audit supervised by Assistant Plant Manager	EEHC Environmental Management & Studies Sector.	Power plant compliance with ESMP.	Quarterly to CEPC and EEHC. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	Should any complaints be received regarding noise, these will be logged and the Assistant Plant Manager will investigate problem. CEPC/TPP to ensure that all employees are given basic induction training on the requirements of the ESMP, good site management practices and H&S procedures. The Assistant Plant Manager will ensure implementation of procedures.	Costs for raising the height of the northern fence included within construction costs. Minimal costs (up to US$ 5K per annum) required for provision of protective wear-included in operation cost. No further mitigation or monitoring costs envisaged with the exception of management time. Noise audit US$ 20-24K

Table 7 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Flora and Fauna Disturbance to habitats as a result of noise, vehicle and personnel movements.	The following mitigation measures will be implemented: • restrict personnel and vehicle movements to access roads and within boundaries of site only; and • control of noise during operation.	Lifetime of the plant.	No monitoring is envisaged.	CEPC/TPP Assistant Plant Manager	EEHC Environmental Management & Studies Sector.	Good plantation	Yearly	CEPC/TPP to ensure that all employees are given basic induction training on the requirements of the ESMP, good site management practices and H&S procedures. The Assistant Plant Manager will ensure implementation of procedures.	Management time
Visual Impact Visual image of power plant from surrounding areas.	The visual effect of the power plant will be improved through: • creation of landscaped boundary along the fence of the power plant. • *Ficus elastica var decora* and *Ficus nitida* will be propagated and the resulting plants will be used for decorating and landscaping the site when completing the new power plant. One may obtain 200-300 individual plants from a single tree.	Lifetime of the plant.	No monitoring is envisaged.	CEPC/TPP Assistant Plant Manager	EEHC Environmental Management & Studies Sector.	Improved visual image		Considered management of landscaped areas to maximize visual image and habitat creation. CEPC/TPP to contract a suitable firm to manage landscaped areas.	Approx. US$ 10-25K for landscaping measures (included in operation cost)

Table 7 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Soil and Hydrology Spillage of oils, chemicals or fuels on site.	Good site management measures as **described under Aquatic Environment** will minimize any potential risks. As part of this, regular checks of bunds and drainage systems will be undertaken to ensure containment and efficient operation.	Lifetime of the plant	The Assistant Plant Manager will continuously monitor application of ESMP and good site management practices and take corrective action if required.	CEPC/TPP Assistant Plant Manager	EEHC Environmental Management & Studies Sector.	Quality of bunds and drainage systems. Efficiency of operation.	6-monthly reports from management to EEHC. Annual reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC/TPP, through the Assistant Plant Manager, will implement a Spills Response Plan and all employees will receive corresponding training.	Management time
Solid Waste	Good practice measures **undertaken during the construction phase** will be continued into the operation phase (see Table 6).	Lifetime of the plant	Continuous monitoring is required to ensure the implementation of good management practices during operation.	CEPC/TPP Implementation of Good Site Management practices shall be conducted under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Management contract in place. Functional transfer station.	3-monthly reports from management to EEHC. Annual reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC/TPP to ensure all employees are given basic induction training on good operation and site management practices.	Management time and costs (<US$ 5K per annum) (included in operation cost)

Table 7 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Occupational Health and Safety, Risks and Hazards	Standard international practice on EHS issues shall be employed on site. The mitigation measures summarized in construction management Table apply. In addition, the following measures will be undertaken: • Provision of training in use of protection equipment and chemical handling. • Use of protective equipment. • Clear marking of work site hazards and training in recognition of hazard symbols. • Installation of vapour detection equipment and control systems. • Development of site emergency response plans.	Lifetime of the plant	Regular on-site training. Regular staff checks, system checks and field tests of emergency procedures by on-site management.	CEPC/TPP Assistant Plant Manager	EEHC Environmental Management & Studies Sector.	Management procedures in place. Workers health and safety measured by incidents, injuries and illnesses.	Monthly reports from management to EEHC Annual reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC/TPP to ensure that all employees are given basic induction training on H&S policies and procedures, Emergency Preparedness and Response Plan and a Spills Response Plan. The Assistant Plant Manager is to ensure implementation of procedures. CEPC/TPP is responsible for ensuring that the site emergency response plan is complete and implemented prior to commissioning any part of the power plant.	Management time and costs (< US$ 10K per annum) (included in operation cost)

Table 7 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Socio-Economic Environment Positive impacts identified	Fish Catch: based upon experience with similar plants elsewhere along the Nile and the opinions of the fishermen, impacts are very likely to be positive.	First year of operation. (possibly 2 other years)	In collaboration with the Fishery Authorities, monitor any changes to the fish catch	CEPC/TPP Assistant Plant Manager Fishery Authorities	EEHC Environmental Management & Studies Sector.	Fish catch no. & quality	Monthly reports from management to EEHC		Included in operation costs.

Table 8

Transmission System Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Direct Vegetation damage, habitat loss, and invasion by exotic species along the ROW and access roads and around substation sites. Habitat fragmentation or disturbance. Increased access to sensitive lands.	• Utilize appropriate clearing techniques, (e.g., hand clearing versus mechanized clearing). • Maintain native ground cover beneath lines. • Replant disturbed sites. • Manage ROWs to maximize wildlife benefits. • Select ROW to avoid important natural areas such as sensitive habitats. • Maintain habitat (i.e., native vegetation) beneath lines. • Make provisions to avoid interfering with natural fire regimes. • Select ROW to a avoid sensitive lands. • Develop protection and management plans for these areas. • Use discontinuous maintenance roads.	During Construction and Operation	Visual inspections of the materials being used, the construction practices and mitigation measures. Short-term monitoring to assure that negative land use and/or ecological impacts are avoided and proper mitigation measures are employed. Occurs along the line as it is constructed. Monitoring of ROW maintenance activities to assure proper control methods.	Egyptian Electricity Transmission Company (EETC) CEPC/TPP	EEHC management EEHC Environmental Management and Studies Sector	Effects on environmental and human resources involved (negative land uses, ecological damage) Degree to which they are affected.	Weekly (during construction). Maintenance time (during operation)	Environmental training and management will be warranted for ROW maintenance techniques, including the proper use of chemical and mechanical clearing methods. Training will be conducted by EETC and CEPC with assistance from environmental consultant. Staff workers should have an understanding of the rational for the recommended mitigation and monitoring that they may be implementing.	Included in construction and operation cost.

Table 8 (Contd.)

Transmission System Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Runoff and sedimentation from grading for access roads, tower pads, and substation facilities, and alteration of hydrological patterns due to maintenance roads.	• Select ROW to avoid impacts to water bodies, floodplains, and wetlands. • Install sediment traps or screens to control runoff and sedimentation. • Minimize use of fill dirt. • Use ample culverts. • Design drainage ditches to avoid affecting nearby lands.								
Loss of land use and population relocation due to placement of towers and substations.	• Select ROW to avoid important social, agricultural, and cultural resources. • Utilize alternative tower designs to reduce ROW width requirements and minimize land use impacts. • Adjust the length of the span to avoid site-specific tower pad impacts. • Manage resettlement in accordance with World Bank procedures.								
Chemical contamination from chemical maintenance techniques.	• Utilize mechanical clearing techniques, grazing and/or selective chemical applications. • Select herbicides with minimal undesired effects. • Do not apply herbicides with broadcast aerial spraying. • Maintain naturally low-growing vegetation along ROW.								

Table 8 (Contd.)

Transmission System Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Avian hazards from transmission lines and towers.	• Select ROW to avoid important bird habitats and flight routes. • Install towers and lines to minimize risk for avian hazards. • Install deflectors on lines in areas with potential for bird collisions.								
Aircraft hazards from transmission lines and towers.	• Select ROW to avoid airport flight paths. • Install markers to minimize risk of low-flying aircraft.								
Induced effects from electromagnetic fields.	• Select ROW to avoid areas of human activity.								
Impaired cultural or aesthetic resources because of visual impacts.	• Select ROW to avoid sensitive areas, including tourist sites and vistas. • Construct visual buffers. • Select appropriate support structure design, materials, and finishes. • Use lower voltage, DC system, or underground cable to reduce or eliminate visual impacts of lines, structures, and ROWs.								

Table 8 (Contd.)

Transmission System Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Indirect Induced secondary development during construction in the surrounding area. Increased access to sensitive lands.	• Provide comprehensive plans for handling induced development. • Construct facilities to reduce demand. • Provide technical assistance in land use planning and control to local governments. • Route ROW away from sensitive lands. • Provide access control.								

Table 9

Summary of Implementation Cost of the ESMP

No.	Phase of Implementation	Cost in US$	
		Measures	**Monitoring**
1	Demolition Phase	174K	65K
2	Construction Phase	115K	1565K
3	Operation Phase	-	24
	Sub. Total	**289K**	**1654K**
	Total	**1943K**	

121. *Table 9* shows that the total implementation cost of the environmental and Social Management Plan is about US$ 1.943 million, which amounts to about 0.77% of the total project cost.

7.2 MONITORING PROGRAM

Stack Emissions

122. Stack emissions will be monitored continuously during plant operation at a representative point in the stack. Operational monitoring of stack emissions shall comprise monitoring the levels of: Oxides of Nitrogen; Sulfur Dioxide; Carbon Monoxide; and Total Suspended Particles and PM_{10}.

123. The automatic monitoring system used will be linked to an alarm to warn when emission limits (as stated in Section 2) for each pollutant are being approached.

124. Concentrations will be recorded as hourly rolling averages and reports on stack emissions monitoring will compare recorded emissions against predicted levels and Egyptian and WB guidelines (as given in Section 2). Reports will be submitted to the EEAA, the WB and any other concerned authority on an annual basis (or as required).

Ambient Air Quality - Validation of Modeling Predictions Using Continuous NOx, SO_2 and TSP Analyzer

125. The use of a continuous NOx, SO_2, CO and TSP analyzer allows for baseline air quality monitoring on a continuous basis. The provision of two continuous monitors (or three: one at the site, one upwind and the third downwind) will provide the basis for “validating” the predictions made in the ESIA. The monitors will also include a weather station providing data on air

temperature, wind speed, wind direction and mixing heights on a continuous basis. These monitors shall, also, be connected electronically to the EEAA ambient monitoring system.

126. The demolition, construction and operational monitoring of air quality around the Tebbin power project will include the parameters summarized in *Table 10.*

Aquatic Environment

127. Monitoring of impacts of the power plant on the aquatic environment will include monitoring of the quality of the discharge water, river bank and benthic sediments, ambient water quality and the impact on aquatic flora and fauna. The survey techniques and areas will be comparable to the survey undertaken by both of the Hydraulics Research Institute and the National Research Center during April-June 2005. The survey will include the area affected by the thermal plume (i.e. 100m from the discharge point).

Table 10

Monitoring Program for Ambient Air Quality, Noise and Vibration

Item	Monitoring Parameters	Sampling Frequency	Monitoring Locations	Indicative Cost Estimate (US$)
Demolition and Construction Phases				
Air Quality Dust emissions caused by demolition and construction activities, demolition and construction vehicle movements, and transport of demolition debris and friable construction materials.	NO_2 , SO_2 , CO, TSP and PM_{10}.	Monthly during demolition. Continuous monitoring during construction.	2 locations minimum: at nearest residence and site boundary during demolition. 2 locations minimum: at nearest residence and site boundary during construction.	Permanent Continuous Monitoring System- approx. US$ 1000-1500K
Noise	Decibels (dB) A	Quarterly (demolition) 6-monthly construction	6 locations minimum: at nearest residences	Management time and costs (US$ 75k)
Operation Phase				
Air Quality Emissions from stack are not expected to exceed standards. Ambient air quality affected by emissions from the power plant.	**Automatic monitoring** of stack emissions for NOx, SO_2, particulate matter and carbon monoxide (CO) via test ports installed in the main stack. In addition, conduct surrogate **performance monitoring**. **Install (at least) two continuous** NOx, SO_2, CO, PM_{10} & TSP **monitoring stations** to monitor short-term concentrations in the area predicted to have the highest impacts on humans (as there are sensitive environments). The analyzer station near or within the site boundaries will include a **continuous monitor** of meteorological conditions (temperature, wind speed, wind direction and mixing heights).	Continuous and/or 24 hour average Continuous and/or passive samples every 2/4 weeks The analyzer stations will be electronically connected to the EEAA ambient monitoring system.	2 locations minimum: at maximum predicted pollution concentration and downwind. Third location, if any, will be 1 km upwind.	Included in the plant operation
Noise		Bi-annually to annually (first year)	6-10 sites at nearest residences and fence around the plant	Noise audit US$ 20-24K

128. The operational monitoring of cooling water and effluent discharge will include the parameters summarized in *Table 11* below.

Table 11

Monitoring of the Aquatic Environment During Operation

Issue	Parameter	Method	Frequency of measurements
Water Quality	Temperature & pH of all discharged water COD, TSS, Oil & Grease, residual chlorine of effluent Heavy metals & other pollutants of effluent	Continuous automatic monitor in discharge structure Sample taken from water in discharge structure and submitted for lab. Analysis As above	Continuous Daily Monthly
Ambient Water Quality	Temperature, pH, COD, BOD, TOC, DO, TSS, oil & grease, residual chlorine, heavy metals & other pollutants	Grab sampling and analysis within the area predicted to be affected by the discharge plume	3-monthly
Flora & Fauna (1)	Benthic flora & fauna	Transect sampling (following same method as in baseline monitoring) within a 2 km radius of the discharge point	Annual
Entrainment (2)	Fish entrainment on screens	Removal and analysis of any debris caught in intake screens	Weekly

Notes:
(1) To be undertaken for the first 3 years of plant operation.
(2) To be undertaken for the first year of plant operation.
Abbreviations:
COD: Chemical Oxygen Demand
BOD: Biological Oxygen Demand
TOC: Total Organic Carbon
DO: Dissolved Oxygen
TSS: Total Suspended Solids

129. Monitoring data will be analyzed and reviewed at regular intervals and compared with Egyptian and World Bank guidelines (as given in Section 2). Records of monitoring results will be kept in a suitable format and will be reported (in summary format with any exceptions identified) to the responsible government authorities and the WB or any other concerned authority as required. As a result, the project company, in discussion with the EEAA, EEHC and the WB or any other concerned authority, will review the need to implement any additional mitigation features, such as provision of further water treatment facilities on site and also on the need to continue monitoring.

Waste Monitoring

130. Wastes generated on site and collected for disposal by skilled firms will be referenced, weighed and recorded. Environmental audits will be undertaken

which will assess the quality and suitability of on- and off-site waste management procedures.

8. PUBLIC CONSULTATION AND DISCLOSURE

131. In order to ensure that the views and interests of all project stakeholders are taken into accounts, public consultation has been carried out according to the EEAA guidelines which require coordination with other government agencies involved in the EIA, obtaining views of local people and affected groups. This consultation has been undertaken as part of the Environmental Impact Assessment process.

132. The objectives of consultation and disclosure are to ensure that all stakeholders and interested parties, are fully informed of the proposed project, have the opportunity to voice their concerns and that any issues resulting from this process are addressed in the EIA and incorporated into the design and implementation of the project.

133. The adopted methodology for the public consultation comprises four elements, namely:

Phase I

- discussions with local stakeholders and interested parties during preparation of the environmental documents for local permitting requirements;
- discussions with local stakeholders during scoping and preparation of this ESIA-Report;

Phase II

- the organization of a Public Meeting in the Cairo Governorate, and
- on-going consultation through an “open-door” policy during construction and operation of the power plant.

134. As far as public disclosure is concerned, major initiatives to inform the public and interested parties about the Tebbin Power project include the following:

- press advertisement describing the project and inviting interested parties to attend the public meeting and review the Draft Final ESIA Report;
- distribution of an invitation and Arabic copy of the Non Technical Summary describing the context of the power plant, the technology employed, the impact on the environment, the mitigation measures and the ESMP; and
- disclosure of the Draft Final ESIA Report locally and the Executive Summary, including ESMP via the Infoshop.

135. The full methodology for consultation and disclosure is presented in the project’s Public Consultation and Disclosure Activities (PCDA), given in Annex D. The purpose of the activities is to establish the process by which

CEPC/TPP will consult and involve stakeholders in the planning, development, construction and operation of the power plant.

136. During the preparation of an ESIA-Report for local permitting requirements, SPEEDOTRANS, EEHC and CEPC undertook consultations with a variety of organizations to assist them in the identification of environmental and social concerns and the overall development of the project. These stakeholders included the Egyptian Electricity Holding Company (EEHC), Cairo Electricity Production Company (CEPC), Egyptian Environmental Affairs Agency (EEAA), the Cairo Governorate and the District Council of EL-Tebbin Zone, Egyptian General Authority for Shore Protection, Hydraulics Research Institute and local population leaders.

137. The purpose of these consultations was primarily to provide information regarding the project, identify published and non-published sources of relevant data and information relating to the site and surrounding area, obtain views on the scope of the project, and open channels for ongoing discussions.

138. A scoping session for this ESIA undertaken by SPEEDOTRANS in collaboration with the EEHC and CEPC, took place on Tuesday, 7 June 2005 during which a wide selection of personnel from different orientations contributed actively to its activities.

139. The key objectives of this consultation were to identify primary and secondary stakeholders, ensure that they had received sufficient information about the project during earlier SPEEDOTRANS/EEHC/CEPC consultation activities and to identify their immediate concerns.

140. In addition to the scoping meeting, several mini-meetings were held with some particular affected stakeholders for taking their viewpoints into consideration.

141. Mini-meetings were held with fishermen on the Nile segment fronting the power plant site, the Tabbin Institute for Metallurgical studies (TIMS), Tebbin District Administration, Tebbin power project staff, General Authority for Fishery Development and two active NGOs in Tebbin zone, namely El-Ataa Association for Environmental Protection, Haie El-Tebbin El-Bahari and Local Community Development Association, El-Tebbin, Marazique.

142. The key environmental issues raised during this consultation process are summarized in *Table 12* and these issues were subsequently taken into account in the preparation of ESIA documentation both for local permitting requirements and this ESIA report.

143. The main results of phase 1 consultation was to successfully raise the level of local awareness about the plant, to identify the immediate local

concerns and to seek stakeholder involvement in the implementation of the project.

Table 12

Key Issues Raised During ESIA Scoping and Public Consultation Meetings

Key issue discussed	Comments
Overall Project	All parties consulted expressed their overall approval for the project. Local Stakeholders commented that the power plant will be central to securing power supply for the industrial and commercial activities in the area and will benefit the local economy through labor opportunities.
Social and Economic Impact	Local stakeholders and council leaders considered the social and economic impact of the plant to be wholly positive.
Demolition Phase	There was need for clarifications on procedures set out for demolishing the existing old Tebbin power plant and for waste disposal.
Cooling Water	EEAA representative raised the issue of algae suppression at the intake structure using chlorine instead of using sodium hypochlorite to avoid salt production. There was scientific discussion on the technical reasons for choice of once-through system instead of using closed-circuit cooling system.
Waste water discharge and the aquatic environment	All local stakeholders expressed concern about the quality of water in the Tebbin Nile segment and the quality of water which will be discharged from the power plant. It was however acknowledged that there are no significant aquatic ecosystems close to the power plant. The suggestion was made that treated wastewater could be used for irrigation of landscaped areas.
Air Quality	There was big concern over the following issues: • compliance with air quality standards and the effect that non-compliance and subsequent plant closure could have on security of employment in the area; • accumulated effects of the relatively degraded air quality in the Tebbin atmosphere and the impact of the power project; • back-up heavy fuel oil is prohibited in residential areas, but Tebbin, as identified in several urban planning schemes for Greater Cairo Region since 1950's, belongs to an industrial setting. • connection of the plant monitoring system automatically with EEAA ambient air quality system.
Noise	EEAA representative gave concern about intermittent high noise impact during commissioning period and got clarification on abatement plans.
Ecology of the Site	There was significant attention to keeping a landscape area inside the power plant fence for preserving the old trees already existing within the site.
Hazardous Waste	Some parties expressed their fears of finding asbestos containing materials during demolition.
Environmental Compliance	An underlying concern expressed by all local stakeholders was compliance with environmental regulations. Assurances from CEPC are sought to the effect that CEPC will guarantee implementation of the environmental compliance measures which will be stated in the Environmental and Social Management Plan.

144. Phase II of the public consultation and disclosure process included the disclosure of information about the project (advertisement, invitation including

a copy of the Non-Technical Summary, in Arabic, and public access to the Draft Final ESIA Report) and organization of a public meeting.

145. A public meeting was held in the Cairo Governorate on 4th September 2005. The aim of the meeting was to present and explain the results of the Draft Final ESIA Report to local stakeholders, to provide them with the opportunity to raise any further or additional concerns and to ensure that all issues are taken into account in the Final ESIA Report and corresponding ESMP.

146. The key environmental issues raised during this public scoping and consultation meetings are summarized also in *Table 12*.

Ongoing Consultation and Disclosure

147. TPP's Assistant Plant Manager, who is responsible for the Environment, Safety and Quality Assurance program for the plant, will have full responsibility for implementing and supervising the ESMP. This role includes ongoing communication with local industrial and commercial interests, local authorities and other interested parties. An "open door" policy will be adopted to allow stakeholders to voice ongoing concerns.

148. The process and results of the public consultation activities held to date are documented in the EISA, Chapter 9 and Annexs A, B, C and D.

149. All issues have been taken into account and addressed in the ESIA through assessment and the inclusion of mitigation, management and monitoring requirements which are detailed within the ESMP.

9. RESPONSIBILITIES AND INSTITUTIONAL ARRANGEMENTS

9.1 Environmental Management Organization

During Demolition, Design and Construction

150. Suitably qualified and experienced contractors will be responsible for the detailed demolition plan and the detailed design and construction of the power plant. Construction workers will be required to demonstrate appropriate skills, qualifications and/or experience prior to employment.

151. During demolition and construction, CEPC/TPP will ensure that all contracts with Contractors and sub-contractors stipulate all demolition and construction management measures (as given in this ESMP), operational design criteria and environment, health and safety standards which must be implemented at the project site.

152. Implementation of these measures will be enforced and supervised by

the Assistant Plant Manager who will have direct responsibility for the Environment, Safety and Quality Assurance program on site during demolition, construction and operation. The Assistant Plant Manager is responsible for ensuring that demolition and construction works comply with the requirements of the ESMP and all environmental permits. His key roles will be to:

- assume the interface with authorities for environmental authorizations and permits;
- act as the Assistant Plant Manager for local authorities, industrial and commercial interests and any other interested parties;
- ensure that mitigation measures to reduce impacts during the demolition and construction phases are implemented;
- ensure that monitoring to be undertaken during demolition and construction is implemented;
- ensure compliance with the environmental and social management plan; and
- ensure that health and safety requirements are respected.

During Power Plant Operation

153. During operation, direct responsibility for environmental compliance and the implementation of the mitigation, management and monitoring measures described in this section and in Section 7 of this report, will continue to be with the Assistant Plant Manager. This position, will report directly to the Chairman/General Manager of CEPC/TPP.

154. The Assistant Plant Manager will be based at the site and will be responsible for recruiting, training and managing his staff. He will be responsible for implementing the mitigation and management measures described above and for monitoring and record keeping of the following:

- stack emissions;
- air quality;
- noise emissions;
- quality of water discharge; and
- waste management.

155. In his role, the Assistant Plant Manager will also be responsible for maintaining any pollution control equipment and for developing and implementing procedures for safe handling and storage of any hazardous materials used on site.

156. Chemicals used during plant operation are process-related. Hazardous chemicals to be used include chlorine (267.2 kg/hr), sulfuric acid (15 kg/hr). Handling, storage and application of these chemicals will be used under strict

regulations of handling hazardous materials stipulated by Law 4/1994.

157. The Assistant Plant Manager will also have lead responsibility for maintaining a written Environmental Register with respect to environmental impacts as required under Egyptian and World Bank guidelines. The written records will identify the characteristics of discharges and emissions, details of periodic testing including results, procedures for follow-up environmental safety actions and the person in charge of this follow-up. Should any prescribed standards be breached, CEPC/TPP, through the Assistant Plant Manager, will immediately inform the EEAA and disclose the procedures being taken to rectify non-conformity.

158. Results of environmental monitoring as described above, shall be recorded and submitted to the EEAA, EEHC and to any other party (i.e. WB etc.) as required. The EEAA and WB are entitled to audit the project company in order to ensure conformity with environmental standards and requirements.

159. In addition, the project company must keep a record of any significant environmental incidents occurring at the plant including accidents and occupational illnesses, spills, fires and other emergencies. The Assistant Plant Manager will be responsible for ensuing that these records are maintained up to date and are available on site.

9.2 Environmental Training

160. The Project Company will ensure that the power plant is manned 24 hours a day, 7 days per week. All staff employed at the plant will be trained in the following:

- general operation of the power plant;
- specific job roles and procedures;
- occupational health and safety; and
- contingency plans and emergency procedures.

161. Training will include:

- induction training on appointment;
- specialist training (as required for their prescribed job role); and
- refresher training as required.

162. The training program will be designed to ensure that appropriate skilled staff are used to operate the power plant at all times. Aspects of occupational health and safety and emergency procedures are described below.

163. In addition to this environmental training for all staff employed at the plant, special environmental training will be given to the staff employed for the EMU. They will receive training in the following:

- day-to-day monitoring activities;

- monitoring the stack emissions;
- collection and analysis of air quality data;
- monitoring the water effluents;
- collection and analysis of water quality information;
- use of monitoring equipment, operation and maintenance;
- industrial hygiene;
- occupational health and safety; and
- emergency and contingency procedures.

9.3 Occupational Health and Safety

164. CEPC/TPP will establish and integrate policies and procedures on occupational health and safety into the operation of the power plant which meet the requirements of Egyptian and World Bank guidelines as given in Section 2 of the report. The policies and procedures will also be designed to comply with all manufacturers safety data sheets for chemical storage and usage, so as to provide a safe and healthy working environment.

165. Occupational health and safety programs will be supported by staff training for the power plant and the appointment of the Assistant Plant Manager. The training will include, but will not be limited to, the following:

- general area safety;
- specific job safety;
- general electrical safety;
- handling of hazardous materials;
- entry into confined spaces;
- hearing conservation;
- repetitive stress disorders;
- Code of Safe Practices;
- use of personal protective equipment; and
- first-aid.

166. The training will include induction courses when staff are first employed at the power plant, with specialist and refresher training as required by the job role. Training will be updated annually and occupational health and safety procedures will be included within the Operations Manual for the power plant.

167. The safety record at the power plant will be reviewed each month at a formal meeting, led by the Assistant Plant Manager, where the agenda items, comments and attendance will be recorded and kept on file.

168. In addition, periodic safety audits will be conducted to verify compliance with safe working practices, which will comprise physical inspections, review of plant records and interviews with staff. The audits will assign responsibility for any corrective action necessary to mitigate a potential hazard and allow the tracking of the completion of the corrective measure.

9.4 Emergency Procedures and Accident Response

169. Instructions on emergency measures necessary to safeguard employees and the wider environment will be prepared as part of the Operations Manual for the power plant.

Accident Response

170. As part of the preparation of emergency procedures and the plans for accident response arrangements, the project company will carry out the following:

- review industry-specific and Egyptian and World Bank standards and regulations;
- establish general guidelines on potential safety and accident risks;
- prepare job-specific operating instructions where appropriate;
- establish safety and security notices for hazardous materials;
- prepare specific emergency operating instructions;
- provide protective equipment (including clothing, air and ear protection etc.) as required;
- evaluate information and feedback from employees; and
- record and investigate all accidents, injuries and incidents.

171. Contingency plans and emergency procedures are being developed to cover events due to operational failures, natural causes and acts of third parties. The plans and procedures will cover, as a minimum, the following:

- fire;
- explosion;
- bomb alerts;
- leaks and spills of hazardous materials;
- structure or equipment failures;
- injuries and illnesses;
- risk from natural disasters (wind, sandstorm, earthquake); and
- third-party risks (potential impacts of an accident occurring at another industrial facility which may impact upon the power plant).

Oil Spill Contingency Plan

172. As Good practice and part of the ESMP, CEPC/TPP will prepare an Oil Spill Contingency Plan.

173. Light fuel oil will be delivered to the site by road and stored in:

- two 1,000 m^3 tanks for the light fuel oil (oil no. 2 / sollar).

174. These tanks are surrounded contained within separate retention area which is designed to contain 110% of one tank.

175. The plan will cover the following activities.

- delivery;
- handling;
- spills; and
- cleanup.

176. The plan will detail procedures, responsibilities, chains of command, information flows, monitoring and documentation. *Table 4* presents institutional arrangements for El-Tebbin power project.

10. IMPLEMENTATION SCHEDULE AND REPORTING

177. Environmental and social management and monitoring activities will be implemented (according to the ESMP), following the same project schedule, as all activities are mainstreamed in the project design. Achievements/problems will be reported in the project quarterly progress reports and should be timely addressed by the project management and the Bank.

11. CONCLUSIONS

178. The Project Company proposes to develop a new thermal power plant of total capacity 2x325MWe at the area of the existing Tebbin Power Plant on land owned by the CEPC Company. The existing old Tebbin power plant will first be dismantled and demolished. The site is an Industrial Setting and does not contain significant residential environmental sensitivity of importance.

179. The key environmental issues associated with the power plant are as follows:

- Emission of oxides of nitrogen to the air;
- Generation and disposal of liquid effluents including cooling water; and
- Emission of noise.

180. The Environmental and Social Impact Assessment has evaluated the potential environmental impacts during demolition, construction and operation of the proposed power plant. In particular, the potential impacts of the flue gas emissions to the air, generation and disposal of liquid effluents including cooling water; and the emissions of noise have been assessed using sophisticated modeling techniques, which include consideration of the ambient background environment and the characteristics of the releases or emissions, and predicts the potential impacts which may occur.

181. The assessment indicates that no significant environmental impacts will occur as a result of the construction or operation of the power plant and, when taken together, the overall environmental and social impact will not be significant.

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Contacts

182. Key persons contacted for comments or further information include the following:

- Chairman of the EEHC: **Dr. Mohamed Awad**
- Executive Board Member for Planning, Research and Service Companies Affairs: **Dr. Kamel Yassin**
- Chairman of CEPC: **Eng. Ahmed Imam**
- Managing Director for Environmental Management and Studies; EEHC: **Eng. Maher Aziz Bedrous**
- General Manager of SPEEDOTRANS: **Eng. Hussein Lotfy**

Annex I

CHANCE FIND PROCEDURES

Chance find procedures will be used as follows:

(a) Stop the construction activities in the area of the chance find;
(b) Delineate the discovered site or area;
(c) Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be present until the responsible local authorities and the equivalent take over;
(d) Notify the supervisory Engineer who in turn will notify the responsible local authorities and the General Authority of Antiquities immediately (within 24 hours or less);
(e) Responsible local authorities and the General Authority of Antiquities would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by the archeologists of the General Authority of Antiquities (within 72 hours). The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values;
(f) Decisions on how to handle the finding shall be taken by the responsible authorities and the General Authority of Antiquities. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance) conservation, preservation, restoration and salvage;
(g) Implementation for the authority decision concerning the management of the finding shall be communicated in writing by the General Authority of Antiquities; and
(h) Construction work could resume only after permission is given from the responsible local authorities and the General Authority of Antiquities concerning safeguard of the heritage.

These procedures must be referred to as standard provisions in construction contracts, when applicable, During project supervision, the Site Engineer shall monitor the above regulations relating to the treatment of any chance find encountered are observed.

LIST OF EIA AND SOCIAL ASSESSMENT TEAM MEMBERS

Position	Name
SPEEDOTRANS	
Project Manager	Eng. Hussein Lotfy
Air Quality Specialist	EDF Direction Production Ingenerie
Hydraulics Specialist	Hydraulics Research Institute (HRI)
Transportation Specialist	Egypt National Institute of Transport (ENIT)
Noise Specialist	M.B. Consultant
Ecologist	Dr. Ali Nasser Hassan
Geological Specialist	Enviro-Pro Consulting Firm
Air Quality Measurements	National Research Center
Water Quality Measurements	National Research Center
Socio-economic Specialist	Mansour Fouaad
Solid & Hazardous Waste Management Specialist	Milad Dimetry
Health & Safety Specialist	Dr. Ahmed Lotfy

EEHC Supervisor	
Head of Environmental Management and Studies Sector	Eng. Maher Aziz Bedrous

1. INTRODUCTION

SPEEDOTRANS, a private consulting firm (Egypt) was commissioned by the Egyptian Electricity Holding Company (EEHC) to prepare the technical documents and procedures required by the World Bank Group (WB) concerning the Environmental and Social Assessment of the Tebbin Power Project.

EEHC is seeking financial assistance from the WB for the construction and operation of this 2x325 MWe, dual fuel power plant. The proposed plant is designated as a Category A project under WB rules and a Category C project under the Egyptian environmental regulations and therefore requires a full Environmental Impact Assessment. Financing from WB is conditional upon obtaining the environmental clearance from both the Egyptian regulatory authorities and the WB.

1.1 BACKGROUND

1.1.1 The Power Plant

Cairo Electricity Production Company (CEPC), a company incorporated in Egypt and affiliated to the Egyptian Electricity Holding Company (EEHC) proposes to construct and operate a new thermal power plant at Tebbin, about 35km south of the city of Cairo on the east bank of the Nile river. The site is within an existing walled compound of the former Tebbin power plant. The overall proposed site area is approximately 100,000 m^2.

The proposed power plant will consist of two thermal units, each with a nominal electricity generating capacity of 325 megawatts (MWe), which will be known as New Tebbin Power Plant. The overall generating capacity of the power plant will be 650MWe. The power plant is intended to be operational by the end of 2009.

The power output from the proposed plant will be sold to the Egyptian Electricity Transmission Company (EETC).

The power plant will utilize natural gas as its primary fuel, and also have the capability to operate using mazout (heavy fuel oil). The ability to "dual-fuel" the power plant (with natural gas or mazout) will provide security of electricity supply in the event that gas supplies are unavailable for any reason. In addition, a small emergency generator, for the plant safe shut down, operating on sollar oil will also be provided on-site to drive key items of equipment within the power plant in the event of a power supply failure, and sollar oil will also be able to be used, if required, to operate the auxiliary boiler during start-up.

1.1.2 The Proposed Site

The power plant will be developed within the walled compound which now contains the old Tebbin power plant, which has seized to operate and ended to decommissioning on Monday, 8th June 2005.

Existing structures will be demolished, under strict environmental rules, and sold out to local contractors or disposed of according to stipulated regulations.

Construction laydown is planned to be accommodated within the Tebbin compound on, or in the vicinity of, the proposed site.

The site of the proposed power plant is shown on *Figure 1-1*.

1.1.3 Fuel Supply

Natural gas will be delivered to the power plant via an existing underground pipeline. The pipeline will be modified by GASCO to match gas requirements and link the power plant with the existing gas network system in the area.

The emergency fuel-mazout-will be delivered to the power plant from local oil refineries by existing pipeline. Only sollar, if required as an emergency fuel, will be delivered to the power plant from local oil refineries by road trucks. On-site storage will be provided for mazout in two large tanks on the northeastern part of the proposed site, with a smaller tank provided for sollar oil.

1.1.4 Water Supply and Cooling

The power plant will incorporate a direct (once through) cooling system using water abstracted from the Nile river. The abstracted water will also be used, following pre-treatment demineralization, to provide process water make-up in the boiler system. Potable water supplies will be drawn from the existing supply system for the city of Cairo at Tebbin District.

The main demand for water is due to the direct cooling system. The use of a direct cooling system maximizes the electrical efficiency of the power plant and, after use, virtually all of the water will be returned to the Nile river at a slightly elevated temperature compared to the abstraction. No evaporative cooling towers are required, hence there is no opportunity for water drift or the formation of visible plumes of water vapor or ground fogging.

To provide the cooling water, a pumping facility will be constructed on the western side of the proposed site adjacent to the bankline of the Nile river, and underground pipelines will be laid from the site across the bankline and

Figure 1-1

Location of the Proposed Site

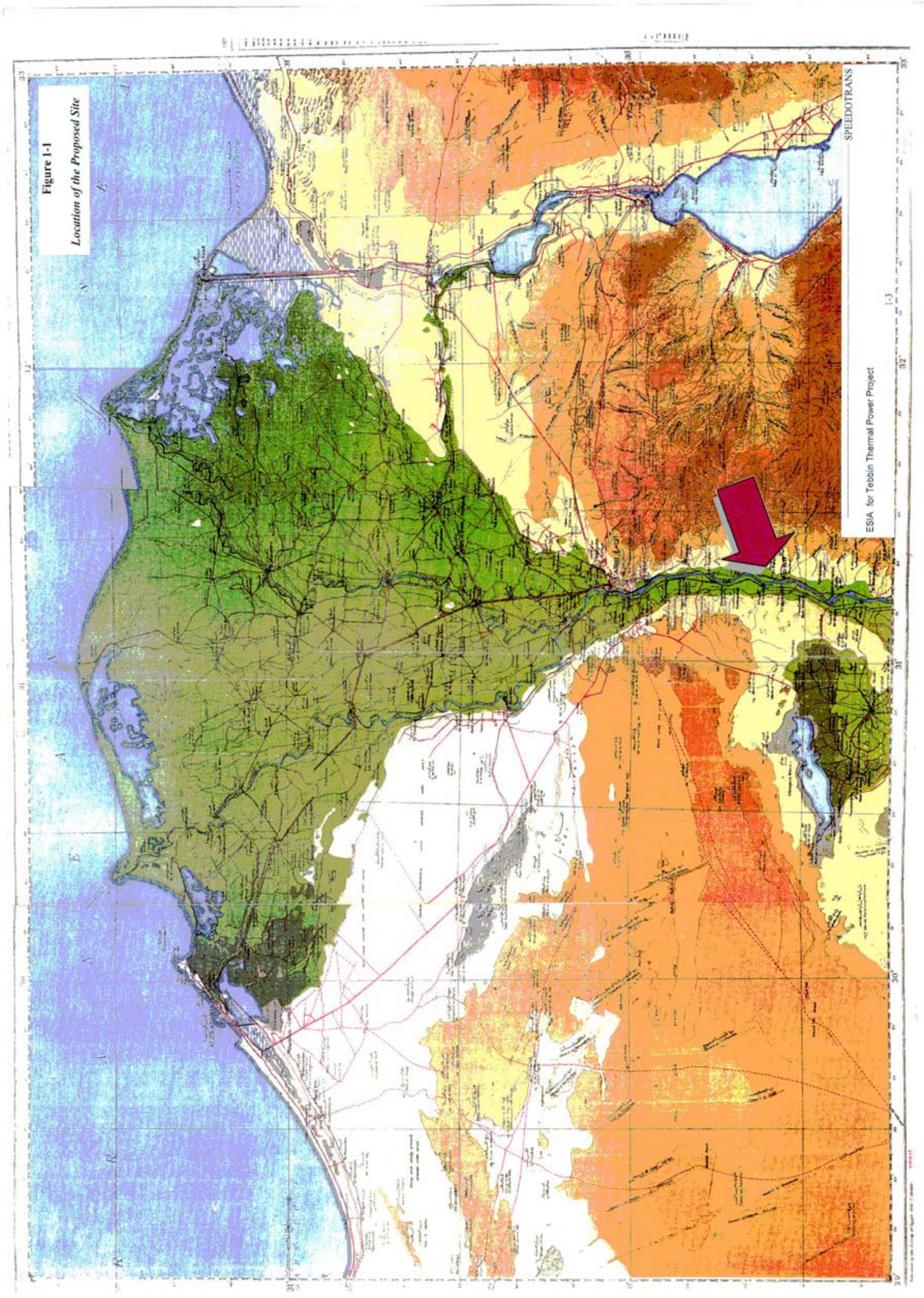


Figure 1-1
Location of the Proposed Site
SPEEDOTRANS
ESIA for Tebbin Thermal Power Project
1-3

out into the Nile river. Separate pipelines will be provided for water abstraction and discharge, with the intake and outfall points sufficiently separated to avoid re-circulation of warm water from the discharge back into the intake.

1.1.5 Electricity Supply and Transmission

The electricity generated by the proposed power plant will be exported via the 220 kV electricity transmission system which will be installed to serve the New Tebbin Units. The power plant will connect directly into the switchyard located next to the power plant area, through a tie transformers, and a new off-site overhead transmission lines will replace existing 66 kV transmission lines. Some short distance (≤ 5.5km) 220 kV cables will connect the power plant to existing substation using existing routing via replacing 66 kV underground cables. No land take or resettlement will be associated to the power interconnecting lines.

1.1.6 Access

The power plant has access from Cairo/Es-Saff Road. No new access road will be provided from the proposed site to the main road network.

1.2 ENVIRONMENTAL IMPACT ASSESSMENT OF THE PROJECT

1.2.1 Requirement for an Environmental Impact Assessment (ElA)

The "Guidelines for Egyptian Environmental Impact Assessment" published by the Egyptian Environmental Affairs Agency (EEAA) specify that a " *…thermal power plant with a capacity greater than 30MWe*" falls within the category C projects (previously: Category of "Black List Projects") which, due to their potential and substantial environmental impacts, must submit a full EIA to the competent administrative authority (EEHC) and the Licensing Authority (the Governorate of Cairo and the EEAA) in order to obtain permission for development.

1.2.2 The EIA Report

This Environmental and Social Impact Assessment report (ESlA report) presents the findings of an assessment of the likely environmental and social impacts associated with the demolition of the existing old power plant and the construction and operation of the new power plant and associated cooling water infrastructure. The ESIA report has been prepared to accompany the applications for consents from the Egyptian Government and local authorities to construct and operate the power plant. Also, the World Bank Group statutes and regulations require the World Bank to follow prescribed environmental procedures when involved with international assistance projects. For this, the ESIA report has been prepared to accompany the application for financing too.

1.2.3 Specified Information

The Egyptian Environmental Affairs Agency (EEAA) has published guidelines which require that certain information is provided in an EIA report (i.e. specified information).

Table 1-1 summarizes the required content of the ESIA report which is indicated by the EEAA guidelines, and establishes where the information is provided within the ESIA report. For information purposes, *Table l-1* also includes the equivalent requirements for an ESIA report from the World Bank.

Table 1-1

Location of Specified Information in the ESIA Report

EEAA Guidelins for Egyptian Environmental Impact Assessment	Wor1d Bank Guidance for Preparation of an Environmental Assessment	Section of the ESIA Report
1. ***Description of the proposed plant and process***	***Description of the proposed project:***	Section 4
• Location of all related sites • general layout • maps showing general setting • flow diagrams of operations • types of plant and equipment • raw material consumption • construction and operational activities • staffing • support facilihes • waste production and storage • emissions to the air • noise generation • required off-site investments • life expectancy	• location of the site(s), including directly linked investments • provision of off-site services (energy, water, transport) • process flow diagram • location of effluent discharge points • emssions to air • emission to water • pollution control technology/treatment systems • alterations during construction (land grading, clearance, road-building, etc) • employment • organization of environmental management staff and associated training. • occupational health and safety conditions, programs and training (noise, workplace air quality, hazardous areas, etc)	
2. *Description of the environment, including baseline conditions and any changes expected in the future prior to development:*	***Description of the baseline environment using graphical presentation where possible:***	Section 5
• geology, seismology, topography and soils • climate, meteorology and winds • air quality and existing sources of air pollution • surface water hydrology and flood risks • coastal features, • water quality, existing sources of water pollution and uses • flora and fauna, sensitive habitats and species of commercial importance • local communities, land use, planned developments, labor market, income distribution, goods and services, recreation and public health • cultural, archaeological and historical sites. • indigenous populations and traditional tribal lands	• climate and air quality • landform (topography, geology, soils) • hydrology, water quality, groundwater resources • ecology, flora and fauna • land and water resource uses • socio-economic conditions • archaeological, historical and cultural resources • environmental problems related to past or current industrial operations	

EEAA Guidelins for Egyptian Environmental Impact Assessment	Wor1d Bank Guidance for Preparation of an Environmental Assessment	Section of the ESIA Report
3. ***Review of legislative and regulatory considerations, including regulations and standards at national, regional and local levels:*** • environnemental quality • health and safety • protection of sensitive areas • protection of endangered species • siting • land use control	***Identification and outline of all applicable regulations and standards, including numerical standards:*** • environmental quality • health and safety • liquid effluents • emissions to air • solid waste management	Section 2
4. Determination of the potential impacts of the proposed plant, covering construction and operation, positive and negative, direct and indirect, immediate and long term impacts, including (but not limited to): • employment • wastewater effluents • thermal effluent • emissions to air • solid wastes • land use • infrastructure • exposure to disease • noise • traffic • socio-cultural behavior • Terms of Reference for future monitoring studies	***Description of potential impacts of the proposed plant, including all significant environmental, socio-economic, human health and safety impacts, covering construction and operation, positive and negative, direct and indirect, immediate and long term impacts:*** • identification of any significant impacts which are unavoidable or irreversible • description of impacts in terms of environmental costs and benefits, assigning economic values where feasible • characterization and explanation of information deficiencies in the assessment	Section 6 Annex E Annex G
5. ***Description of alternatives to the proposed plant, including the "no action" alternative, and comparison of potential environmental impacts, capital and operating costs, suitability for local conditions and monitoring requirements:*** • siting • design • fuels • raw materials • technoloey • construction techniques and phasing • operating and maintenance procedures	***Comparison of the impacts of alternative sites and processes, and key factors in decisions to select the proposed site and process***	Section 3

EEAA Guidelins for Egyptian Environmental Impact Assessment	Wor1d Bank Guidance for Preparation of an Environmental Assessment	Section of the ESIA Report
6. Development of a management plan to mitigate adverse impacts, including potentially significant construction and operational impacts and accidental events: • effect of the mitigation measures • proposed work program • budget estimates • maintenance • scheduling • institutional requirements • staffing and training requirements • support services • compensation for affected parties where no mitigation available	***Proposals for mitigation of any significant adverse impacts and plans for ongoing management:*** • description of feasible and cost-effective mitigation measures • budget estimates for capital and recurrent costs • institutional requirements • training requirements • workplans and schedules for mitigation measures • compensation for affected parties where no mitigation available	Section 7
*7. **Development of a monitoring plan covering the implementation of the mitigation measures and impacts during construction and operation, including budget estimates of capital and operating costs***	***Preparation of a detailed plan for monitoring to allow determination of rates and concentrations of emissions and waste discharges, occupational health and safety, effectiveness of mitigation measures, capital and operating costs, including (but not limited to):*** • stack emissions and ambient air quality • effluents released to surface water • accident frequency and severity • workplace temperature, noise and air quality • socio-economic conditions	Section 8 Annex F
8. Securing of inter-agency co-ordination and public/NGO participation, including keeping of records of meetings, other activities, communications and comments	***Consultation with local NGOs, affected communities and other affected groups including keeping of records of steps taken to consult local interested parties, consultation meetings, other activities, communications, comments, key concerns of local interested parties and actions taken to modify the project and EIA in response to public and community inputs***	Section 9 Annex A Annex B Annex C Annex D

EEAA Guidelins for Egyptian Environmental Impact Assessment	Wor1d Bank Guidance for Preparation of an Environmental Assessment	Section of the ESIA Report
9. ***Preparation of an Environmental Impact Assrssment (ElA) report, organized according to the following outline:*** • executive summary • policy, legal and administrative framework • description of the proposed project • description of the environment • significant environmental impacts • analysis of alternatives • mitigation/management plan • monitoring plan • inter-agency and public/NGO involvement • non-technical summary • list of references	***Outline of an Environmental Impact Assessment (ElA) report:*** • executive summary • introduction • policy, legal and administrative framework • project description • baseline data for the project site and area • environmental impact • comparison of alternatives • mitigation/environmental management plan • monitoring plan • references • record of consultations with affected parties	Sections 1-9 Annexes A-G
	References including full citations for published sources and details of unpublished information and personal communications	Section 1-9 Annexes A-G

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 PERMITS REQUIRED TO CONSTRUCT AND OPERATE THE POWER PLANT

The key Egyptian permits required for the construction and operation by CEPC of the proposed power plant are set out in *Table 2-1.* These permits set out and regulate the standards to which the power plant must be designed, constructed and operated.

Table 2-1

Key Permits Required for the Construction and Operation of the Power Plant

Permit	Permitting Authority	Relevant Legislation	Role of Permit
Construction Permit (for establishing a power plant project) [Secured]	Regulatory Body	Presidential Decree of the Arab Republic of Egypt, No. 326/1997, to Establish the Regulatory Body for Electric Utility and Consumer Protection	Authorization to construct the power plant project
Construction Permit (for Buildings) [Secured]	District of Tebbin, Cairo Governorate	Law 101 (1996), *"Law for Buildings"*	Authorization to construct the power plant building
Environmental Permit [to be obtained](1)	Egyptian Environmental Affairs Agency (EEAA), Ministry of State for Environmental Affairs in conjunction with the Cairo Governorate and Cairo Electricity Production Company (CEPC)	Law 4 (1994), *"Law for the Environment"*	Authorization of the environmental effects of development and operation of the power plant
Water Abstraction and Discharge Permit [to be obtained](1)	Egyptian General Authority for Shore Protection, Ministry of Irrigation and Water Resources in conjunction with the EEAA	Law 4 (1994), *:Law for the Environment" and* Law 12 (1984), *"Law for Irrigation and Drainage"*	Authorization to construct and operate the abstraction of cooling water and discharge of effluent
Stack Construction Permit [to be obtained](1)	Armed Forces Operations Authority, Ministry of Defense and Civil Aviation Authority, Ministry of Transport,	Defense Regulations Aviation Regulations	Authorization to construct a stack from military and aviation considerations
Operating Permit [Secured]	Regulatory Body	Presidential Decree of the Arab Republic of Egypt, No. 326/1997, to Establish the Regulatory Body for Electric Utility and Consumer Protection	Authorization to produce electricity

Notes:
(1) For these permits to be obtained, communications with the permitting agencies have been initiated.

In addition, a number of subsidiary permits will be required related to connection to, and use of, existing services and infrastructure, including the following:

- Electricity Supply Permit (if required) (Cairo South Electricity Distribution Company (CSEDC), Egyptian Electricity Holding Company (EEHC), Ministry of Electricity & Energy);

- Connection to Gas Pipeline, Utilization of Gas Supply and Alternative Fuel Storage Permit (Egyptian Natural Gas Holding Company (EGAS) and Egyptian General Petroleum Corporation (EGPC), Ministry of Petroleum);

- Water Supply Permit (Cairo Water Authority);

- Roadside Occupation (or Construction) Permit (General Authority for Roads and Bridges);

- Transport of Special Loads Permit (Central Administration for Executing and Maintaining Roads and Bridges, Ministry of Transport);

- Communications Network Permit (Cairo South Telephone Authority, Egyptian Company for Communications, Ministry of Communications and Information Technology);

- Carrier (Portable) Communication Devices Permit (Cairo South Telephone Authority, Egyptian Company for Communications, Ministry of Communications and Information Technology).

The status of these permits today is that all these permits are procedural and straightforward to be obtained.

2.2 RELEVANT ENVIRONMENTAL POLICY, LEGAL AND ADMINISTRATIVE ISSUES

The environmental policy, legal and administrative framework which is relevant to the permitting of the power plant comprises the following:

- Requirement to conduct an ESIA to accompany the development of the power plant.

- Regional development planning, which must be addressed in the development of the power plant, in particular:
    - land use planning and control;

- siting;
- protection of environmentally sensitive areas; and
- protection of endangered species.

- Environmental standards which must be considered in the design, layout, construction and operation of the power plant, including:
  - emissions to air;
  - generation and disposal of liquid effluents, including cooling water;
  - generation and disposal of solid wastes;
  - ambient environmental quality; and
  - health and safety.

Each of these aspects is reviewed in the following sections. In each case, both Egyptian and World Bank standards and guidelines are considered, to reflect the relevant national requirements and those which may be expected from international financial institutions.

2.3 REQUIREMENT FOR AN EIA

2.3.1 Egyptian Requirements for an EIA

The development of a new power plant can only commence if a permit has been granted by the appropriate Competent Administrative Authority (CAA). Egyptian *Law 4 of 1994, Law for the Environment* (hereafter referred to as *Law 4/1994*) stipulates that applications for a license from an individual, company, organization or authority, subject to certain conditions, require an assessment of the likely environmental impacts.

The Egyptian Environmental Affairs Agency (EEAA) is the authority responsible for determining the type of development that requires an environmental appraisal and the level of detail at which the study should be conducted. The EEAA publication "*Guidelines for Egyptian Environmental Impact Assessment"* stipulates that *"..... thermal power plant with a capacity greater than 30 MW"* falls within the category of "C Listed Projects". This category requires a full EIA to be submitted to the Competent Administrative Authority (CAA) or the Licensing Authority (which, for such type of project in the designated area, is the Cairo Governorate) in support of any application for a permit to develop a power plant). The EIA must analyze the impacts and specify what mitigation measures (if any) are necessary in order to minimize them.

Since the proposed power plant has a nominal generating capacity of 650MWe, a full EIA must be prepared and submitted to the Cairo Governorate, which will forward it to the EEAA for consideration prior to development of the plant. The Governorate is required to forward the EIA to the EEAA for review in order to obtain the environmental permits for the development of the power plant. The EEAA must provide the EEHC (the Competent Administrative Authority) with its opinion concerning the assessment within 60 days of its receipt. The EEHC will then communicate this result to the owner of the

establishment and will then be responsible for verifying and implementing the EEAA's proposals requirements. The owner has 30 days to appeal the result of the assessment.
The construction of electrical transmission lines and pipelines (of less than 50km length) on local levels, are considered to be "List B Project" according to the Guidelines for Egyptian Environmental Impact Assessment. For these developments, Egyptian regulations require the proponent to submit a Screening Form, possibly followed by a scoped EIA on certain identified impacts, to the relevant Competent Authority, which in this case is the EEHC and Ministry of Petroleum respectively. However, when such an infrastructure is associated with a "C Listed Project", it should be considered as part and parcel of the full EIA study report if it is addressed during the study (see associated infrastructure-Section 6.16).

2.3.2 World Bank (WB) Requirements for an EIA

The World Bank follows a policy which stipulates that all operations are carried out in an environmentally responsible manner and that projects must comply with appropriate World Bank guidelines or, if these have not been specifically developed, World Bank guidelines.

The World Bank sets out its procedures and policies with regard to conducting environmental assessment in *Operational Policy* 4.01: *Environmental Assessment* (October 1991) and its updates (1999) and other pertinent Guidelines. Annex E of the Policy identifies the process by which the level of investigation required in the environmental assessment is determined. It provides an illustrative list of Category "A" developments which require a full EIA, which includes thermal and hydro power projects.

Accordingly, if World Bank funding is sought, a full EIA for the power plant following World Bank guidelines must be conducted and submitted to the World Bank for consideration as part of any application for funding.

World Bank Environmental Safeguard Policies provide 10 potential issues that may need to be considered in an EA, depending on the specific characteristics of each project. *Table 2-2* summarizes the expected applicability of the potential Safeguard Policies to the Tebbin Power Plant Project. The Safeguard Policies identified as "applicable" are those which may be triggered and thus considered "Requiring Management". When the detailed design of the Tebbin Power Plant has been determined, the CEPC should prepare project-specific plans to manage these potential impacts.

No safeguard policies were triggered except for the Environmental Impact Assessment. *Table 2-2* shows potential World Bank environmental Safeguard Policies and El-Tebbin project applicability. The table justifies the applicability or lack thereof for WB Safeguard Policies.

Annex B to Operational Policy 4.01 provides an outline of the information that should be included in a full EA. This Environmental and Social Impact Assessment follows the scope of Annex B.

Table 2-2

Potential World Bank Environmental Safeguard Policies and El-Tebbin Power Project Applicability

No. Safeguard Policy	Applicability to Tebbin Project	Policy Triggered?	Justification
1. Environmental Assessment	Yes	Yes	• This policy applies to all projects requiring a Category A Environmental Assessment Under OP 4.01. • All environmental and Social aspects included in El-Tebbin project are adequately examined. • Tebbin project is not likely to have significant potential (reverse) environmental risks & impacts in its area of influence (impacts on the natural environment: air, water & land; human health & safety; physical cultural resources; and transboundary and global environment concerns).
2. Forest	No	No	• No forest areas exist.
3. Involuntary Resettlement	No	No	• No relocation or loss of shelters. • No loss of assets or access to assets. • No loss of income sources or means of livelihood. • The re-employment of workers program is voluntary and re-employed workers will keep all their benefits (salary, health insurance etc.) and will commute daily from their present locations. Incentives for workers to remain in the El-Tebbin colony are strong as the rent is heavily subsidized. The re-employment program will thus not result in any loss of income or physical resettlement. • All activities related to the construction of the new plant will take place within on CEPC land either on the site or on land directly adjacent to the site. i.e. no land acquisition. Not even temporary will result from the construction. • Experience from a number of similar power plants along the Nile river has shown that the impacts on fisheries of the discharge of warm water into the Nile have been positive. Consultations with the fishermen support this assertion. Impacts will be positive rather than negative, i.e. no loss of livelihood. • Transmission lines which will evacuate power generated by the Tebbin power plant will replace existing 66kV transmission lines. Some short distances $\leq$ 5 km will connect the power plant to existing substations via underground cables. No land take or resettlement will be associated to the power interconnecting lines.

Table 2-2 (Contd.)

Potential World Bank Environmental Safeguard Policies and El-Tebbin Power Project Applicability

No. Safeguard Policy	Applicability to Tebbin Project	Policy Triggered?	Justification
4. Indigenous Peoples	Yes	No	• The project does not affect the indigenous peoples in the project area.
5. Safety of Dams	No	No	• The project does not involve construction of a large dam. • The project is not dependent upon an existing dam.
6. Pest management	No	No	• Procurement of pesticides or pesticide application equipment is not envisaged. • The project will not affect pest management in any way.
7. Physical Cultural Resources	Yes	No	• Physical cultural resources are adequately examined. • The Tebbin project is not likely to have any significant impact on physical cultural resources.
8. Natural Habitats	Yes	No	• Natural Habitats are adequately addressed and examined. • The Tebbin project is not likely to have any significant impacts on natural habitats.
9. Projects in Disputed Areas	No	No	• The CEPC/EEHC is not involved in any disputes over an area with any of its neighbors. • The project is not situated in a disputed area. • Any component likely to be financed as part of the project is not situated in a disputed area.
10. Projects on International Waterways	No	No	• Cooling water abstracted from the Nile river (20-26m^3/sec.) is returned totally back to it. Actual water consumption is less than 0.07% of the abstracted water. • No disturbance to the Nile flow is expected either upstream or downstream. • Hydrological/hydraulic study is carried out and the study revealed that no impact is expected and the mixing zone is limited to 50m distance with 5^{o}C above ambient, which diluted to 3^{o}C at a distance between 100 and 150 m with full compliance with Egyptian Law 48/1983 and WB regulations. • MWRI is in full agreement with EEHC regarding its plan for water abstraction.

World Bank's *Pollution Prevention and Abatement Handbook-Part III* (July 1998), also, provides with principles of industrial pollution management, monitoring and air emission & effluent discharge requirements presented in the industry Guidelines including Guidelines for New Thermal Power Plants.

The following World Bank publications have been used for guidance in this ESIA:

- Guidelines for carrying out environmental and social studies of the project.
- Guidance Note A: Checklist for potential issues for an Environmental Impact Study (EIS).
- Guidance Note B: Content of the Environmental Impact Study.
- Guidance Note C: Preparing and Updating Environmental Management and Mitigation Plan (EMP).
- Guidance Note F: Preparing the Public Consultation and Disclosure Plan.

Guidance Note B (*Content of an Environmental Impact Assessment*) in the World Bank's *Procedure for Environmental and Social Review of Projects* (December 1998) summarises the scope of the EIA as follows:

"An environmental impact assessment report for a Category A project identifies and assesses the potential environmental and social impacts of the projects, evaluates alternatives, and recommends appropriate mitigation, management and monitoring measures. The report's scope and level of detail should be commensurate with the project's potential impacts".

World Bank sector-specific guidelines for thermal power plants present maximum emission levels for thermal power plants and cover issues such as liquid effluents, ambient and workplace air quality, stack emissions, ambient and workplace noise, solid and liquid wastes, general health and safety, and general environmental requirements. The guidelines emphasise the use of cleaner fuels wherever economically feasible and focus on the operational performance of controls as well as their design standards.

Concerning "Public Consultation Process", public consultation and disclosure for the Tebbin power project, as presented in Section 9 of this report, has been designed in accordance with World Bank policy and guidelines shown below:

- Guidance for the Preparation of a Public Consultation and Disclosure Plan (January 1996);
- World Bank Policy on Disclosure of Information (1997);
- Doing Better Business Through Effective Public Consultation and Disclosure, A Good Practice Manual (IFC, October 1998);
- Procedure for Environmental and Social Review of Projects (December 1998); and
- Public Consultation in the EA Process: A Strategic Approach. World Bank Sourcebook Update, May 1999.

Under the public consultation process required for Category A projects, the Project sponsor is required to consult with the public at least twice; once during preparation of the Terms of Reference (ToR) for the EIA (Scoping), and also after the draft EIA has been prepared and submitted for public open review. The World Bank requires that a Public Consultation and Disclosure Plan (PCDP) be prepared, setting out the basis of consultation activities during and after the EIA, together with a schedule for the disclosure of information. The PCDP for this project is included in Chapter 9 of this report.

Other international banks and financing institutions also follow a similar approach and use the World Bank guidelines as a benchmark for the environmental assessment of international power projects prior to provision of finance. Hence, an EIA of similar scope is likely to be required to obtain commercial funding for the power plant from international institutions.

2.4 SCOPE OF THE ESIA

The Egyptian Environmental Affairs Agency (EEAA) has published guidelines which require that certain information is provided in an EIA report (i.e. specified information).

Table 1-1 summarizes the required content of the EIA report which is indicated by the EEAA guidelines, and establishes where the information is provided within this ESIA report. For information purposes, *Table 1-1* also includes the equivalent requirements for an EIA report from the World Bank.

The requirements for the scope of the EIA under Egyptian and World Bank procedures, as described in Section l.2, include the following:

- description of the proposed power plant;
- description of the baseline environment at the site;
- identification of the environmental standards which will be applied to the project, including those applying to protection of ambient environmental quality and specific conditions on the construction and operation of the power plant;
- identification of potential environmental impacts associated with the project;
- description of alternatives to the power plant, in terms of options for electricity supply in Egypt, design of the power plant and operating system;
- development of proposals for mitigation and management of any potential environmental impacts;
- description of monitoring plans proposed to provide surveillance of the environmental impacts of the power plant during demolition, construction or operation;
- demonstration that consultations with interested parties have been carried out as part of the ESIA process.

In addition, both Egyptian and World Bank guidelines specify the broad organization of the ESIA report, requirement for a non-technical summary for local, especially public, information and clear referencing of sources of data used in the assessment.

2.5 REGIONAL DEVELOPMENT PLANNING

The guidelines for EIA produced by the EEAA specify that the power plant should demonstrate compliance with national, regional and local development plans with respect to the following key aspects:

- Land use planning and control;
- Siting;
- Protection of environmentally sensitive areas;
- Protection of endangered species.

The proposed site lies on land occupied originally by a power plant and will be used for development of new power generation facilities that replace the old ones by the EEHC/CEPC within the Tebbin power station complex, where old units are already prepared for demolition.

The site of the proposed power plant lies within the area covered by the Urban Development Plan – Cairo 1997 (UDP), which was developed by the Cairo Governorate for Land Use Planning and Urban Development (see *Figure 2-1*). This Plan has been updated and revised in 2000 to become the Comprehensive Development Long-Term Plan – Cairo 2017. The updated Plan currently available (see *Figure 2-2*) and, subsequently, the key policies and zoning of land uses relevant to the proposed site from the UDP for Long-Term Plan have been considered. According to consideration for this UDP, Tebbin area has been designated as an Industrial Domain. This identification has been adhered to the Tebbin area since mid 1950's.

2.6 INTERNATIONAL AND NATIONAL ENVIRONMENTAL STANDARDS/ GUIDELINES

2.6.1 Introduction

The Egyptian and World Bank environmental standards and guidelines relevant to the construction and operation of the power plant cover the following issues:

- Atmospheric emissions and ambient air quality.
- Liquid effluent discharges to the marine environment.
- Noise emissions and ambient noise levels.
- Solid waste management.
- Hazardous waste management.

Figure 2-1

Urban Development Plan (UDP)
for Greater Cairo Region, 1997 Update

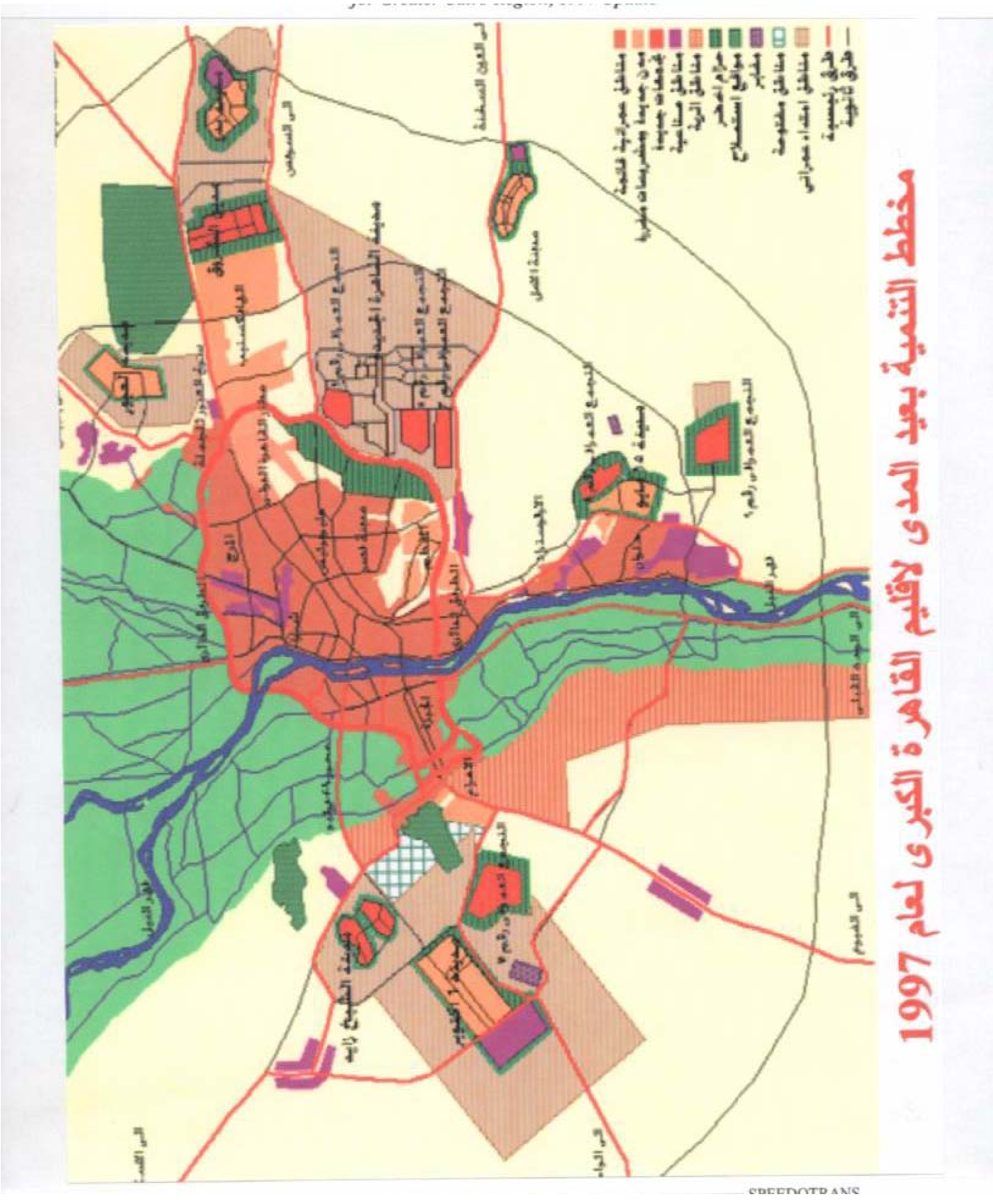


Figure 2-2 (A)

Long-Term Plan for Urban Development of Greater Cairo Region, 2000 Update

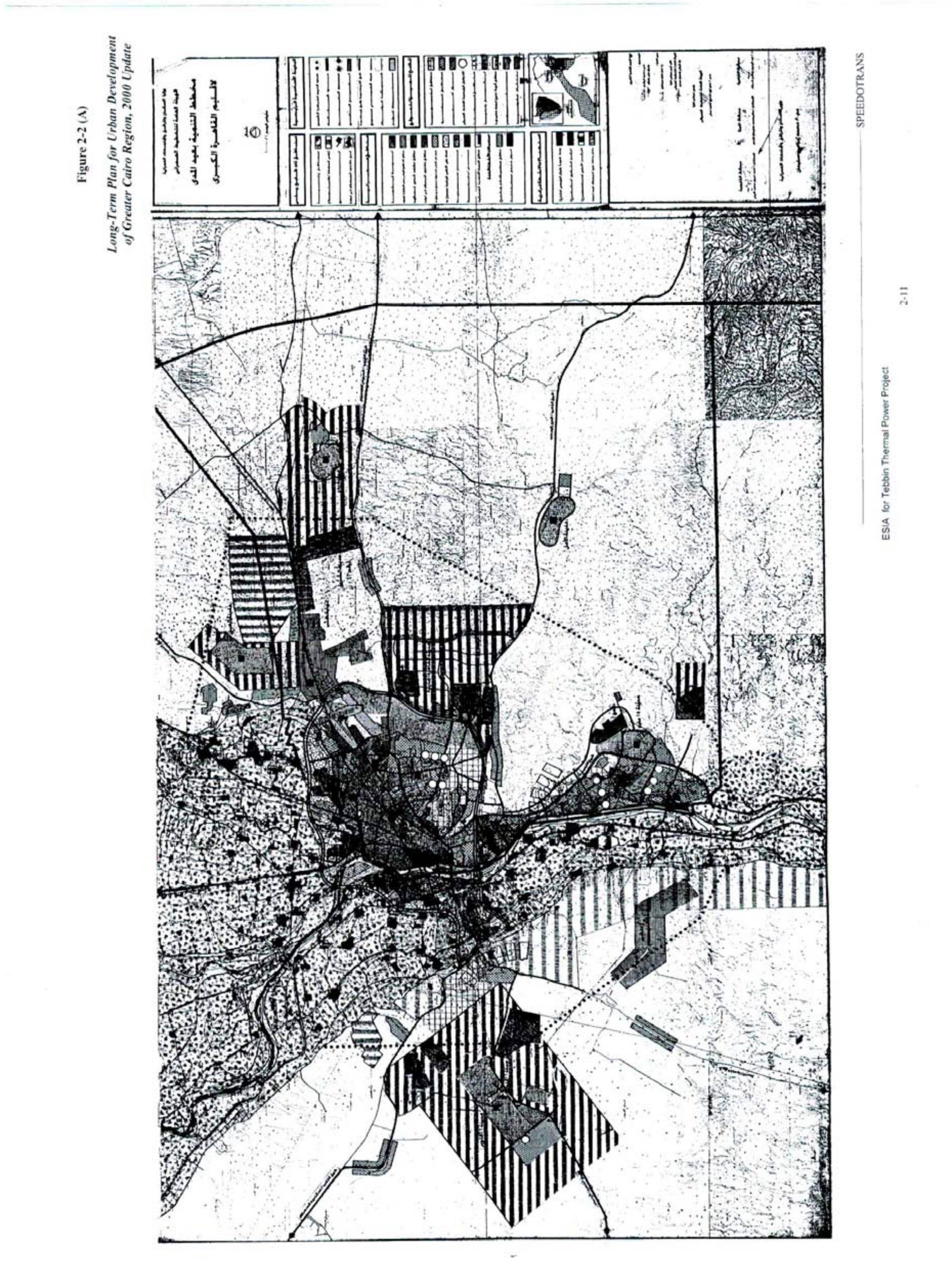
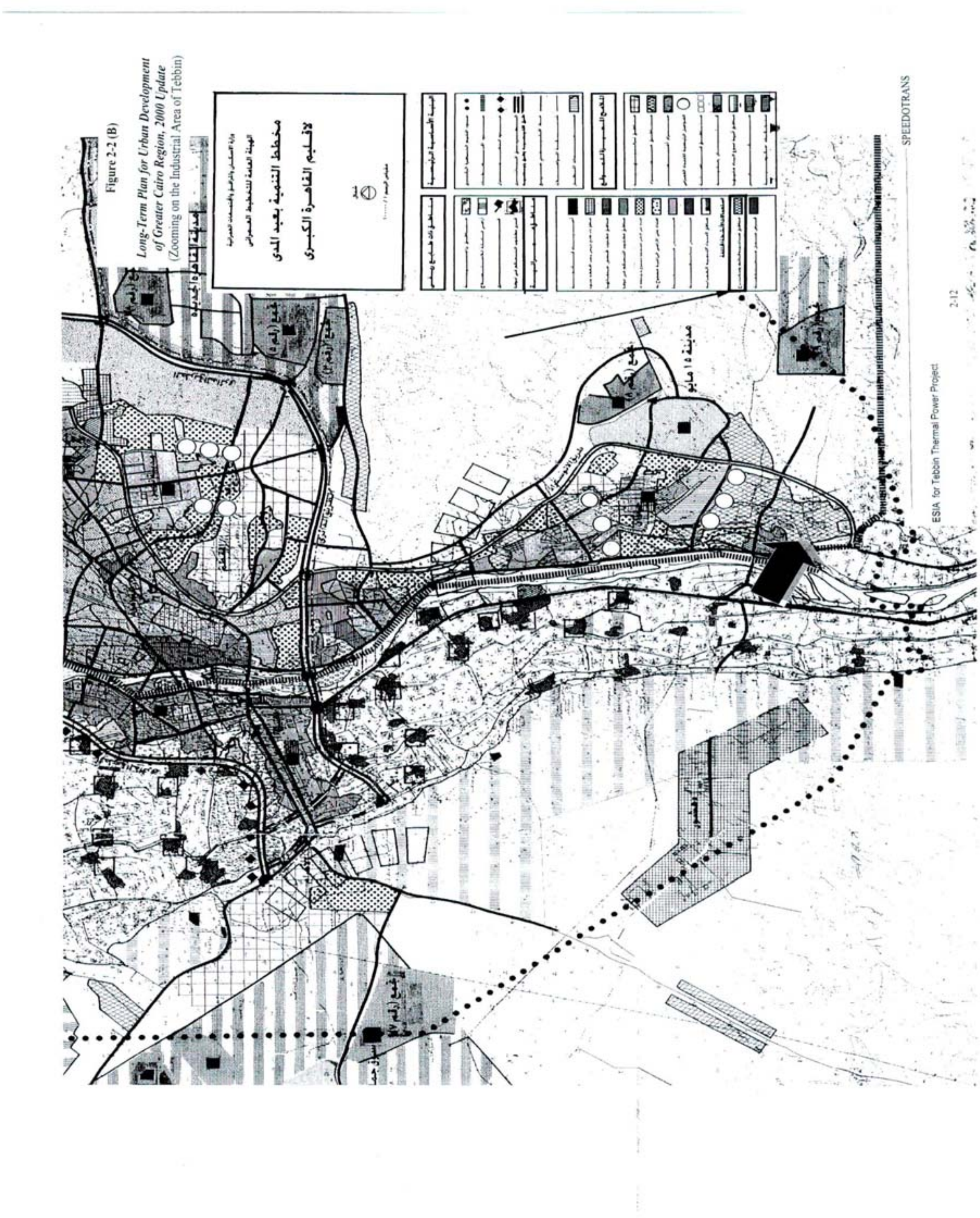


Figure 2-2 (B)

Long-Term Plan for Urban Development of Greater Cairo Region, 2000 Update
(Zooming on the Industrial Area of Tebbin)



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- Operation management: health and safety, air quality and noise levels.
- Construction management.
- Other environmental management issues.

The Egyptian standards have been drawn from the range of provisions in *Law 4/1994* and the *Prime Minister's Decree No 338 of 1995*, which promulgate the *Executive Regulations of Law 4.*

Also, Nile river protection standards have been drawn from provisions in *Law 48 of 1982* regarding the *Protection of the River Nile and Waterways from Pollution* and its Executive Regulations.

The Egyptian *Law of Labor 12/2003* follows a philosophy, which gives high consideration to *environmentally safe work and workers health inside workplace*. It stipulates that all operations are carried out in an environmentally safe manner and that workplaces must comply with appropriate health and safety guidelines.

The World Bank guidelines have been taken from the World Bank *Pollution Prevention and Abatement Handbook – Part III* (July, 1998). Supplementary to the guidelines set out in the WB/International Finance Corporation (IFC) *Pollution Prevention and Abatement Handbook,* reference has also been made to the World Bank guidelines as set out in the *World Bank Environment, Health and Safety Guidelines: Thermal Power Plants* (1994).

The following sections detail the requirements under both Egyptian and World Bank standards and guidelines.

2.6.2 Atmospheric Emissions and Ambient Air Quality

The Egyptian Government and World Bank have established ambient air quality standards applicable to power projects. The Egyptian standards and the World Bank guidelines on ambient air quality are shown in *Table 2-3*.

Table 2-3

Ambient Air Quality Guidelines (μgm^{-3})
(Maximum Limits as per the Law 4/1994, Executive Regulations, Annex 5)

Pollutant	Averaging Period	Egyptian Standards	WB Guidelines[1]
Nitrogen oxides (NOx)	1 hour 24 hours 1 year	400[2] 150 --	No Limit 150 100
Sulfur dioxide (SO_2)	1 hour 24 hours 1 year	350 150 60	No Limit 150 80
Carbon monoxide (CO)	1 hour 8 hours	30,000 10,000	- -
Thoracic particles (PM_{10})	24 hours 1 year	70 --	150 50
Total suspended particles	24 hours 1 year	230 90	230 80

Notes:
(1) World Bank Pollution Prevention Handbook, Thermal Power-Guidelines for New Plants, July 1998.
(2) NO_2: There are no NOx Egyptian Standards for ambient air quality.

The World Bank Group guidelines (World Bank Pollution Prevention Handbook, Thermal Power-Guidelines for New Plants, July 1998) refer to the concept of the "airshed". The airshed for a power plant is defined as:

"The local area around the plant whose ambient air quality is directly affected by emissions from the plant. The size of the relevant local airshed will depend upon plant characteristics (such as stack height) as well as local meteorological conditions and topography".

Where the airshed is degraded (i.e. has concentrations of pollutants which exceed World Bank standards) the World Bank power plants are subject to site-specific requirements that include offset provisions to ensure that there is no net increase in the total emissions of particulates and/or SO_2 within the airshed and the resultant ambient levels of NO_2 do not exceed the levels specified for moderately degraded airsheds[1].

(1) NO_2 exceeds 100 $\mu g/m^3$ and the 98^{th} percentile of 24 hour mean values of NO_2 over a year exceeds $500 \mu g/m^3$ in an airshed classified as having moderate air quality.

Egyptian standards and World Bank guidelines require the Developer to ensure that emission levels during construction and operation do not exceed set maximum limits for pollutant concentrations. Egyptian and World Bank guidelines for power plants on the maximum limits for pollutants in emissions to the air are shown in *Table 2-4.*

Table 2-4

Maximum Atmospheric Emission Guidelines (mg/Nm^3)$^{(a)}$

(Maximum Limits as per the Law 4/1994, Executive Regulations, Annex 6)

Pollutant	**Egyptian Standards**	**WB[(b)] Guidelines**
Nitrogen Oxides		
Gas	300	320
Oil	300	460
Sulfur dioxide	2,500	2,000 [(c)]
Suspended particles	200	50
Suspended ashes		
Sources in urban areas or near residential areas [(d)]	250	-
Sources far from inhabited urban areas [(e)]	500	-
Carbon monoxide	2,500	-

Notes:

(a) The Egyptian regulations for fuel burning sources (Law 4, Article 42) do not specifically state whether emission limits refer to emission under standard or actual flow conditions. For consistency with other standards it has been assumed that the limits refer to standard flow conditions.

(b) World Bank guidelines should be achieved for 95% of the operating time of a plant.

(c) Total SO_2 emissions from the power plant must not exceed 118 tone per day, calculated by World Bank approach of allowing 0.2 tpd per MWe for first 500 MWe and 0.1 tpd per MWe for each subsequent MWe. If two or more power plants are operating in the same airshed then the combined SO_2 emissions must not exceed 500 tpd.

(d) Law 4, Article 42 states that emissions of suspended ashes in urban / residential areas should not exceed Ringlemann Chart 1, which Article 42 states is equivalent to an emission concentration of 250 mg/m^3.

(e) Law 4, Article 42 states that emissions of suspended ashes far from inhabited areas should not exceed Ringlemann Chart 2, which Article 42 states is equivalent to an emission concentration of 500 mg/m^3.

Egyptian *Law 4/1994* also applies specific conditions to the burning of fuels in power plants, as follows:

- Fuel / air mixtures and the combustion process should provide full burning of the fuel.

- The use of mazout and heavy oil is prohibited in residential areas.

- The sulfur content of fuels is restricted to equal or less than 1.5% in or near urban and residential areas. The use of high sulfur content fuels is permissible in regions far from inhabited urban areas provided that suitable atmospheric factors are present and adequate distances are observed to prevent these gases from reaching residential and agricultural areas and watercourses.

- Emissions of carbon dioxide should be through stacks of sufficient height to ensure that the gases are dispersed before reaching ground level.

- Stack height should reflect the volumetric flow of flue gases. *Law 4/1994* states that for emission rates of 7,000-15,000kg/hr the stack height should be between 18-36m. If emission rates exceed 15,000 kg/hr, then the stack height should be at least 2.5 times the height of surrounding buildings.

World Bank guidelines reinforce the Egyptian requirement of minimum stack heights by requiring plants to use stack heights not less than the Good Engineering Practice[(1)] values unless impact analysis has taken into account building downwash effects.

2.6.3 Liquid Effluent Discharges

Decree No. 8 of 1983 promulgating the Implementary Regulations of the *Law 48 of 1982* regarding the *Protection of the River Nile and Waterways from Pollution* provides the standards set by the Ministry of Water Resources & Irrigation in collaboration with the Ministry of Health for permits to discharge treated industrial liquid effluents into the fresh water bodies and groundwater reservoirs (Article 61).

A selection of the standards, relevant to thermal power plants, is shown in *Table 2-5*. In addition, the table also presents the equivalent World Bank guidelines. It should be noted that World Bank guidelines relate to all liquid effluent discharges, not solely to those to the surface water environment.

(1) US Code of Federal Regulations Title 40, Part 51.100. Good Engineering Practice Stack Height = H + 1.5 L where H is the height of nearby structures and L is the lesser dimension of height or projected width of nearby buildings.

Table 2-5

Water Quality Standards and Specifications Mandated by the Egyptian Laws in Comparison with the World Bank Guidelines (mgl^{-1}) [(a)]

Parameter	Standards and Specifications Mandated by Law 48/1982 The maximum limits of constituents in treated industrial liquid effluents discharged to (Art. 61)		World Bank Wastewater Effluent Guidelines (1996)
	River Nile from its Southern Egyptian Border to the Delta Barrages	Nile Branches, main canals, branch canals, ditches & groundwater reservoirs	
Temperature (b)	35°C	35°C	3oC increase above ambient [(b)]
pH	6-9	6-9	6-9
Color	No Col. substance	No Col. substance	
Biochemical Oxygen Demand (BOD)	30	20	-
Chemical Oxygen Demand (COD) (Dichromate)	40	30	
Total Dissolved Solids	1200	800	
Fixed (Ash of) Dissolved Solids	1100	700	
Suspended Solids	30	30	50
Turbidity			
Sulfides	1	1	
Oils and Grease	5	5	10
Hydrocarbons, of oil origin			
Phosphates	1	1	
Nitrates	30	30	
Phenolates			
Fl uorides	0.5	0.5	
Aluminum			
Ammonia (Nitrogen)			
Mercury Compounds	0.001	0.001	
Lead	0.05	0.05	
Cadmium	0.01	0.01	
Arsenic	0.05	0.05	
Chromium, total	0.05	0.05	0.5
Copper	1	1	0.5
Nickel	0.1	0.1	0.5
Iron	1	1	1.0
Manganese	0.05	0.05	
Zinc	1	1	1.0
Silver	0.05	0.05	
Barium			
Cobalt			
Pesticides			
Cyanide			
Fecal Coliform Count (No. in 100ml)			
Dissolved Oxygen			
Organic Nitrogen			
Total Alkalinity			
Sulphate			
Synthetic Detergents	0.05	0.05	

Table 2-5 (Contd.)

Water Quality Standards and Specifications Mandated by the Egyptian Laws in Comparison with the World Bank Guidelines (mgl^{-1}) (a)

Parameter	Standards and Specifications Mandated by Law 48/1982 The maximum limits of constituents in treated industrial liquid effluents discharged to (Art. 61)		World Bank Wastewater Effluent Guidelines (1996)
	River Nile from its Southern Egyptian Border to the Delta Barrages	Nile Branches, main canals, branch canals, ditches & groundwater reservoirs	
Phenol	0.002	0.001	
Selenium			
Chemical Oxygen Demad (Permanganate)	15	10	
Total Heavy Metals	1	1	-
Total Residual Chlorine(c)	1	1	0.2 (c)
Total Coliform (MPN/ 100ml)			
Odour			
Tannin + lignin			
Carbon derivatives (chloroform)			

Notes:

(a) Units of mgl^{-1} unless otherwise stated.

(b) As per the Law 48/1982, the effluent should result in a temperature increase of no more than 5 ^oC at the edge of the zone where initial mixing and dilution take place. World Bank regulations state that "where this zone is not defined, use 100 m from the point of discharge when there are no sensitive aquatic ecosystems within this distance".

(c) "Chlorine shocking" may be preferable in certain circumstances, which involves using high chlorine levels for a few seconds rather than a continuous low level release. The maximum value is 2 mgl^{-1} for up to 2 hours, which must not be more frequent than once in 24 hours (and the 24 hour average should be 0.2 mgl^{-1}).

Table 2-5 also presents these standards:

Article 2: rules that *"wastes (under three forms to be drained … into waterways should have a permit from the MWRI"*

Article 3: assigns the Ministry of Health for analyzing samples.

Article 13: gives the Ministry of Interior the role of inspection.

Article 16: is about fines of not less than 500 pounds and not exceeding 2000 pounds.

Decree No. 8 of 1983 promulgating the Implementery Regulations of the *Law 48 of 182* (Executive Regulations), article 12: stipulates that the application for obtaining the license to discharge the treated industrial fluid wastes into waterways, shall be submitted to the Irrigation Inspector.

Article 5: rules that it is not licensed to discharge any human, or animal wastes, or wastewater drainage into potable water surface (the two benches of the River Nile & streams as well as feeders & canals of all levels).

Article 6: rules that it is prohibited to discharge wastewater, into potable water surface and underground water resources.

The Ministry of Water Resources & Irrigation may authorize discharging industrial fluid wastes which were treated into underground water reservoirs under some conditions. *Table 2-5* presents these standards.

Drainage of Liquid Wastes (Law no. 39 for 1962)

The term "sewage system" shall apply to installations which are prepared for collecting waste liquids from houses, factories, public, communicational & international establishment, and other, as well as leaking waters & rains, for the purpose of disposing in a sanitary, after purifying of them or without purification.

Article 7: rules *"liquid wastes from …… industrial …… may not be drained …… without a license …"*

Article 8: rules that *"liquid wastes which are licensed …… shall adhere to the standards & specification limits …"*

Article 9: rules that *" analysis shall be carried out on specimens of liquid wastes …… by the Ministry of Health …"*

Article 14: rules that *"liquid wastes may not be surface-drained except by virtue of a license from the department in charge of sewerage works …"*

Article 18: discussed the penalties for contravention to the provision of articles 3, 4, 13 and 14 (fine not less than 10 pounds), and to articles 6, 7, 8, 9, 11 and 12 (fine not less than 50 pounds).

Chapter 6(1): *Decree M.649 for 1962* sets the criteria & specifications that authorize liquid wastes to be drained into public sewers. Parameters are:

- Temperature not more than 40^oC.
- pH value less than 6 not more than 10.
- BOD not more than 400 particles per million.
- COD not more than 700 particles per million.
- Phenol not more than 0.005 particles per million.
- Sulphur dioxide not more than 1 particle per million.
- Lubricants, oils & resins not more than there 100 particles per million.
- Silver, mercury, cadmium, chrome, etc… not more than 10 particles per million (liquid wastes $50m^3$/day) or 5 particles per million (liquid wastes exceed $50m^3$/day)

Chapter 6(2): also sets the conditions and criteria that should be fulfilled by liquid wastes drained by surface irrigation or by irrigating cultivable land. In general sewage wastewater may not be disposed of by surface draining method until after obtaining permission from the concerned Health Authority and drained wastes should not be less than primary treated liquids.

2.6.4 Noise Emissions and Ambient Noise Levels

Law 4/1994 stipulates that a developer must ensure that an establishment is compatible with the character of its setting. Amongst other issues, this involves limiting the effect of combined noise from all site sources on the surrounding environment to acceptable ambient limits. Guidance levels for ambient noise is dependent upon the land use surrounding the site, and Egyptian ambient noise guidelines are set with respect to five different land use categories. The Egyptian ambient noise guidelines are shown in *Table 2-6*, together with the related land uses.

The World Bank ambient noise guidelines differ from those of the Egyptian Government in that they only differentiate between two land use categories, as presented in *Table 2-7.*

Table 2-6

Egyptian Ambient Noise Limits for Intensity in Different Land Use Zones
(Maximum Limits as per the Law 4/1994, Executive Regulations, Annex 7-Table 2)

Receptor	**Daytime (a) dB(A)**	**Evening (b) dB(A)**	**Night (c) dB (A)**
Industrial areas (heavy industries)	60-70	55-65	50-60
Commercial, administrative and "downtown" areas	55-65	50-60	45-55
Residential areas, including some workshops or commercial businesses or on public roads	50-60	45-55	40-50
Residential areas in the city	45-55	40-50	35-45
Residential suburbs having low traffic	40-50	35-45	30-40
Rural residential areas (hospitals and gardens)	35-45	30-40	25-35

Notes:
(a) Daytime from 7 am to 6 pm
(b) Evening from 6 pm to 10 pm
(c) Night-time from 10 pm to 7 am

Table 2-7

WB Ambient Noise Guidelines for Intensity in Different Land Use Zones

Receptor	**Maximum Allowable $L_{Aeq, 1\text{-hour}}$ dB(A) (a)**	
	Daytime 07:00 – 22:00	**Night-time 22:00 – 07:00**
Residential, institutional and educational	55	45
Industrial and commercial	70	70

Notes:
(a) Noise abatement measures should achieve either the WB guidelines or a maximum increase of background levels of 3 dB (A). Measurements are to be taken at noise receptors outside the project property boundary.

2.6.5 Solid and Hazardous Waste Management

Law 4/1994 stipulates that handling of hazardous substances and waste is prohibited unless a permit has been issued by the competent authority.

The handler of wastes must:

- possess a permit issued by the appropriate CAA to handle wastes;
- store and dispose of wastes in designated sites agreed with the CAA;
- maintain appropriate systems of storage, including packaging and labeling, containers and storage duration;
- operate appropriate transportation systems to authorized disposal sites;
- maintain a register of all hazardous wastes and disposal methods; and
- develop an emergency plan in case of spillages.

Further to the Egyptian guidelines, the World Bank requires that the individual/ company operating the power plant must ensure that:

- all hazardous materials are stored in clearly labeled containers;
- storage and handling of hazardous materials is in accordance with national and local regulations appropriate to their hazard characteristics;
- fire prevention systems and secondary containment should be provided for storage facilities, where necessary, to prevent fires or the releases of hazardous materials to the environment.

2.6.6 Occupational Environmental Management and Health and Safety

Workplace Air Quality, Temperature and Humidity

Egyptian regulations, including *Labor Law no. 12/2003* and its Executive Regulations stipulated by *Ministerial Decree no. 211/2003*, require that the owner of the power plant must ensure that air quality in the workplace is maintained within fixed limits. Accordingly, the owner is obliged to ensure the protection of the work force through implementing health and safety measures on-site, including by the choice of plant and equipment, process substances, types of fuels, ventilation of working areas or other air cleaning methods.

The World Bank requires that any individual / company managing or operating a power plant must:

- conduct periodic monitoring of the workplace air quality with respect to air contaminants relevant to employees tasks;

- maintain ventilation and air contaminant control, and provide protective respiratory and air quality monitoring equipment;

- ensure that protective respiratory equipment is used by employees when levels of welding fumes, solvents and other materials exceed international, national or local accepted standards.

Egyptian and World Bank threshold limit values for carbon monoxide, nitrogen dioxide, Sulfur dioxide and particulate in the workplace are provided in *Table 2-8.*

In addition to air quality, under *Law 4/1994*, the owner of the power plant must also ensure that temperature does not exceed maximum and minimum permissible limits, as set out in *Table 2-9.* In case of work in temperatures outside these limits, the owner must provide suitable acclimatization to workers and/or protective measures.

Table 2-8

Egyptian and WB Air Quality Guidelines in the Workplace

(Maximum Limits as per the Law 4/1994, Executive Regulations, Annex 8)

Atmospheric Pollutant	**Egyptian Guidelines** [(a)]	**WB Guidelines**
Carbon monoxide	55 mg/m^3	29 mg/m^3
Nitrogen dioxide	6 mg/m^3	6 mg/m^3
Sulfur dioxide	5 mg/m^3	5 mg/m^3
Particulate [(b)]	10 mg/m^3	10 mg/m^3

Notes:

(a) Egyptian air quality guidelines in the workplace are determined by exposure time. Readings provided are "mean time"- the limit to which workers are exposed during a normal working day.

(b) Inert and nuisance dust.

Table 2-9

Egyptian Maximum Air Temperature Limits [(a)]

(Maximum Limits as per the Law 4/1994, Executive Regulations, Annex 9)

Type of Work	Low Air Flow	High Air Flow
Light	30.0^{O}C	32.2^{O}C
Medium	27.8^{O}C	30.5^{O}C
Hard	26.1^{O}C	29.8^{O}C

Notes:

(a) In periods of high temperature, workers should be monitored. No worker should work be exposed to heat stress (above 24.5^{O}C for women and above 26.1 ^{O}C for men) for more than one continuous hour or one intermittent hour in every two, without acclimatization.

Workplace Noise

Law 4/1994 and the *Labor Law no. 12/2003* and their Executive Regulations restrict noise in the workplace to within limits of intensity and exposure time. Egyptian guidelines are shown in the following tables:

- *Table 2-10* presents occupational noise guidelines with respect to continuous exposure to noise below 90 dB (A);

- *Table 2-11* presents occupational noise guidelines with respect to permitted exposure periods to continuous noise in excess of 90 dB (A);

- *Table 2-12* presents occupational noise guidelines with respect to exposure periods to intermittent noise.

It has been assumed that these limits apply at worker positions and will be generally free field noise levels.

In addition to the Egyptian guidelines, the World Bank guidelines require that the individual/ company managing or operating a power plant must ensure that:

- Noise in work areas is reduced by using feasible administrative and engineering controls (including sound-insulated equipment and control rooms).

- Good maintenance practices to minimize noise production from plant and equipment.

- Personnel use hearing protection equipment when exposed to noise levels above 85 dB (A).

Table 2-10

Egyptian Guidelines for Maximum Permissible Limits of Sound Intensity Inside Places of Industrial Activity

(Maximum Limits as per the Law 4/1994, Executive Regulations, Annex 7-Table 1)

Receptor	Maximum Allowable Level of Sound (dB(A))
Work premises with up to 8 hour shifts with the aim of limiting noise hazards on hearing[(a)]	90
Places of work that require hearing signals and good audibility of speech	80
Places of work for the follow up, measuring and adjustment of operations with high performance	65

Notes:
(a) For periods extending longer than 8 hours lower noise limits will be defined

Table 2-11

Egyptian Guidelines on Periods of Exposure to Noise

(Maximum Limits as per the Law 4/1994, Executive Regulations, Annex 7-Table 1, contd.)

Noise Intensity (dB(A))	Period of Exposure per Day (Hours)
> 90-95	4
>95-100	2
>100-105	1
>105-110	0.5
>110-115	0.25

Table 2-12

Egyptian Guidelines on Permissible Limits Concerning Intermittent Noise Inside the Workplace

(Maximum Limits as per the Law 4/1994, Executive Regulations, Annex 7-Table 1, contd.)

Noise Intensity (dB(A))	Number of Permissible Noise Events During Normal Working Hours
135	300
130	1,000
125	3,000
120	10,000
115	30,000

Electrical Safety in the Workplace

The Egyptian Code of practice for electrical safety in power system, issued by the Egyptian Electricity Authority, as well as the *Labor Law no. 12/2003* and its regulations, require that any power plant management, and the World Bank requires that any individual/company managing or operating a power plant, must ensure that:

- strict procedures are provided and followed for de-energizing and checking electrical equipment before maintenance work;
- strict safety procedures are implemented, including constant supervision, when performing maintenance work on energized equipment;
- personnel training is provided on revival techniques for electrocution.

Working in Confined Spaces

The Egyptian Industrial Codes of practice, issued by the Egyptian Industry Authority, as well as the *Labor Law no. 12/2003* and its regulations, and the World Bank require that the individual / company managing or operating an industrial facility (such as a power plant) must ensure that:

- prior to entry and occupancy, all confined spaces must be tested for the presence of toxic, flammable and explosive gas or vapors and lack of oxygen;

- adequate ventilation is available in any confined working spaces;

- personnel working in confined spaces that may become contaminated or deficient in oxygen are provided with air-supplied respirators;

- observers are stationed outside when personnel are working in confined spaces which are likely to become contaminated or to be affected by a shortage of air supply.

General Health and Safety

The Egyptian concerned laws and regulations mentioned above and the World Bank require that the individual / company managing or operating an industrial facility (such as a power plant) must ensure that:

- sanitary facilities are well equipped with supplies and employees should be encouraged to wash frequently, particularly those exposed to dust, chemicals or pathogens;

- ventilation systems are provided to control the temperature and humidity of working areas;

- personnel working in high temperatures or humidity are allowed frequent breaks away from these areas;

- pre-employment and periodical medical examinations are conducted for all personnel and surveillance programs instituted for personnel potentially exposed to toxic or radioactive substances;

- personnel are protected by shield guard or guard railings from all belts, pulleys or gears and other moving parts;

- elevated platforms, walkways, stairs and ramps are equipped with handrails, toeboards and non-slip surfaces;

- electrical equipment is “earthed”, well insulated and conforms with applicable codes;

- personnel use special footware, masks and clothing when working in areas with high dust levels or contaminated with hazardous materials;

- employees are provided with appropriate protective equipment when working near molten or high temperature materials (protective equipment may include, amongst others, non-slip footwear, safety glasses, etc);

- employees wear eye protective measures when working in areas at risk of flying chips or sparks or where bright light is generated;

- employees wear protective clothing and goggles in areas where corrosive materials are stored or processed;

- appropriate eyewash and showers are installed in areas containing corrosive materials; and

- a safety program is implemented and regular drills are conducted.

Personnel Training

Law 4/1994 and *Labor Law 12/2003* stipulate that operators should be trained when using or handling any hazardous waste materials.

In addition, the EEAA Master Plan for Solid & Hazardous Waste Management and the World Bank require that the individual / company managing or operating an industrial facility (such as a power plant) must ensure that:

- employees are trained on the hazards, precautions, and procedures for the safe storage, handling and use of potentially harmful substances;

- training incorporates information from the "Material Safety Data Sheets" (MSDSs) for potentially harmful materials;

- personnel are trained with regard to environmental health and safety matters, including accident prevention, safe lifting practices, the use of MSDSs, safe chemical handling practices and proper control and maintenance of equipment and facilities.

Monitoring and Record Keeping and Reporting

Law 4/1994 (Articles 17 & 18) requires - for industrial facilities - the operator monitors the site in order to optimize performance. Direct measurement of emissions and atmospheric concentrations of pollutants dispursed with the exhaust gas is required. Averaging times for ambient air quality should be based on regular measurements.

Law 4/1994, also, stipulates that the owner of the power plant should maintain an Environmental Register of written records with respect to the environmental impacts from the establishment. The written records should identify the characteristics of discharges and emissions, details of periodic testing and its results, procedures of follow-up environmental safety, and the name of the person in charge of follow-up, The owner of the power plant, or its representatives, are responsible for informing the EEAA of any emitted or discharged pollutants deviating from prescribed standards and any appropriate procedures taken to rectify them.

Also, the World Bank guidelines require the operator monitors the site in order to optimize performance. Direct measurement of atmospheric concentrations of particulate matter, NOx and SO_2 and heavy metals in the exhaust emissions is preferable. Averaging times for direct emissions should be based on an hourly rolling average.

The World Bank guidance requires ambient air quality to be monitored at least at 3 locations where there is: a) least pollution expected; b) maximum pollution concentration expected; and c) sensitive receptors. The ambient air quality parameters that require monitoring for gas fired plants are NOx.

Law 4/1994, as well as World Bank guidance, also require the owner / operator to monitor the wastewater discharges. The parameters to be examined and sampling frequency are set out in *Table 2-13*.

Table 2-13

World Bank [(a)] Requirements for Monitoring Wastewater Discharges

Parameter	Proposed Monitoring Frequency
pH	Continuous
Temperature	Continuous
Suspended solids	Daily
Oil and grease	Daily
Residual chlorine	Daily
Heavy metals	Monthly
Other pollutants	Monthly

Notes:
(a) World Bank: Guidebook for Preparation and Review of EA, January 2000.

In addition, the EEAA and the World Bank require that the individual / company managing or operating an industrial facility (such as a power plant) must:

- maintain records of significant environmental matters, including monitoring data, accidents and occupational illnesses, and spills, fires and other emergencies;
- information from the above is reviewed and evaluated to improve the effectiveness of the environmental, health and safety program;

- submit an annual summary of recorded information to the EEAA (and to the World Bank).

2.6.7 Construction Management

Law 4/1994 requires that guidelines on environmental management and protection, including related to noise, land, marine and atmospheric pollution, waste management and health and safety must be adhered to during the construction process.

In particular, when handling and storing soils and wastes during construction, all organizations and individuals must ensure that storage and transportation is undertaken in such a manner to minimize release or dispersion into the environment.

2.6.8 Other Environmental Issues

Chemical Compounds

Law 4/1994 states that spraying of pesticides or other chemical compounds is prohibited except after complying with the conditions, norms and guarantees set by the Ministry of Agriculture, the Ministry of Health and the EEAA. The conditions for such use are as follows:

- notification to the health and veterinary units of the types of sprays being used and antidotes before spraying;
- provision of necessary first aid supplies;
- provision of protective clothing and materials;
- warning of the public in spraying areas;
- training of laborers conducting the spraying.

Other Chemicals

The EEAA and the World Bank require that the individual / company managing or operating an industrial facility (such as a power plant) must ensure that:

- use of formulations containing chromates is avoided;

- transformers or equipment that either contain polychlorinated biphenyls (PCBs) or use PCB-contaminated oil are not installed;

- processes, equipment and central cooling systems that use or potentially release chlorofluorocarbons (CFCs), including Halon, are avoided;

- storage and liquid impoundment areas for fuels and raw and in-process materials, solvents and wastes and finished products are designed in such a way to prevent spills and the contamination of soil, groundwater and surface waters.

2.7 INTERNATIONAL ENVIRONMENTAL COMMITMENTS

The following section identifies the global and regional environmental conventions of relevance to the proposed power plant, to which Egypt is party.

2.7.1 International Conventions

Global Conventions

- United Nations Framework Convention on Climate Change (UNFCCC).
- Kyoto Protocol of the UNFCCC.
- Convention concerning the Protection of the World Cultural and Natural Heritage.
- International Convention on Economic, Social and Cultural Rights.

Regional Conventions

- African Convention on the Conservation of Natural Resources.

Nature Conservation Conventions

- World Heritage Convention.
- Convention on Biological Diversity, UN (1992).
- Convention of Migratory Species of Wild Animals (Bonn Convention).
- Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention, 1971).

3. ANALYSIS OF ALTERNATIVES

3.1 CURRENT SITUATION ("NO ACTION" OPTION)

3.1.1 Electricity Demand

Egypt has a rapidly expanding economy that is dependent on the availability of reliable and low cost electric power. The annual average rate of growth of electricity demand in Egypt is expected to range between 6-7% during this decade. Peak demand is expected to rise from 14,735 MWe in 2003/2004 to 22,000 MWe by 2010 and installed capacity is expected to increase from 18,119 MWe to 25,000 MWe during the same period.

In 2003/2004, about 99% of the population was served by the Egyptian electricity grid. Of total demand of 94.91 TWh on the interconnected system, about 15% was met by hydropower, principally the High Dam and Aswan 1 & 2, and the remaining was met with thermal plants, of which 92% were supplied from natural gas and 8% heavy fuel oil.

The rate of growth in demand for electricity is forecasted to continue at the aforementioned level for the next 5 years before gradually decreasing to a growth rate of 5.7% per year over the subsequent 10 years.

In order to meet the forecasted demand, the Ministry of Electricity & Energy (MEE) estimates that an additional 10,000 MWe of new generating capacity will be required during the next ten years.

3.1.2 Electricity Generation and supply

Currently, the Egyptian Electricity Holding Company (EEHC) holds 14 affiliate companies: 5 for power generation, one for electrical energy transmission and 8 for electricity distribution. The Egyptian Electricity Transmission Company owns and operates the high voltage electricity transmission system, and the Electricity Distribution Companies own and operate the electricity distribution system. High voltage electricity transmission system through medium voltage transmission system consists of over 30,000 km of 500 kV, 220 kV, 132 kV, 66kV and 33 kV transmission lines. Further expansion of the transmission system is also planned.

The Five Electricity Generating Companies supported in 2003/2004 almost 18,000MWe of installed capacity. This resulted in 94.913 TWh of generated energy. Over 19 million customers have access to electricity supply, representing about 99% of Egypt's population.

Table 3-1 shows the breakdown on existing installed capacity by fuel/process type.

Table 3-1

Installed Capacity Corresponding to Fuel Type, 2003/2004

Installed Capacity	MWe	% age
Steam	11,610	64.5
Gas	1,019	5.7
Combined Cycle	2,605	14.5
Hydro	2,745	15.3
Wind	140	
Total	**18,119**	

Source: Arab Republic of Egypt-Ministry of Electricity and Energy/Egyptian Electricity Holding Company, Annual Report-2003/2004.

3.1.3 The "No Action" Option

The no action alternative will result in the demand for electricity exceeding supply, with an increasing deficit as demand increases in future years. A lack of a secure and reliable electricity generation and supply system has significant social and economic implications, since it will:

- constrain existing and future economic development and investment through lack of energy resources to meet industrial demand;
- restrict socio-economic development through lack of electricity supply, or poor reliability and shortages in electricity supply for domestic users, community and other public facilities and public services;
- inhibit provision of public health and social services.

As a result, the "no action" option is not a viable or acceptable alternative to the proposed project.

3.1.4 Planned Additional Capacity and the Tebbin Power Plant

The EEHC has established a generation expansion plan which is intended to achieve the following:

- meet future demand for electricity;

- maintain and improve generation and transmission reliability; and
- introduce new technologies.

The expansion plan also corresponds to the national Government's development aspirations and growth poles of economic and industrial expansion throughout the country. As part of this plan, the EEHC has identified Tebbin power project to help implement its expansion in generation capacity. Hence, the proposed project is compatible with and, indeed, a fundamental part of the EEHC generation expansion plan to meet existing and future demand for electricity.

3.2 ALTERNATIVE TECHNOLOGIES AND FUELS

3.2.1 Selection of the Proposed Technology

The EEHC has an objective to provide a secure, reliable electricity generation and distribution system for Egypt. A key element in meeting this objective is to establish a diverse range of technologies to avoid over-reliance on any particular fuel or technology, which may adversely affect the ability to provide electricity or meet the fluctuations in demand which occur on a day-to-day or seasonal basis.

The EEHC generation expansion plan includes provision of the following:

- gas/oil-fired steam units;
- gas/oil-fired combined cycle units;
- gas/oil-fired simple cycle combustion turbine units;
- pumped storage;
- wind farms; and
- integrated solar-thermal generating units.

Other possible options include "importing electricity", "rehabilitation of existing power plants", "transmission and distribution investment" and "IPPs".

These technological alternatives constrained by the following:

- ***Importing electricity:*** Egypt is interconnected to Libya and Jordan and is exporting electricity to both countries. Interconnection to Libya has a capacity of 300 MWe, and that of Jordan has a capacity of 350 MWe, which will be increased to 450 MWe in 2006. Libya and Jordan are currently paying 4 US¢/kWh for the Egyptian power supply. As they are net importers, there is currently not much scope for electricity imports to

Egypt from the interconnected networks. In addition, the cost of electricity in both countries is much higher than that of Egypt, making it an uncompetitive alternative. There is currently no south border connection to Sudan, although there is an ongoing discussion in the context of the Nile Basin Initiative (NBI) whereby Egypt could potentially import hydroelectric power starting in 2010-2012, if the price is competitive. However, considering the abundance of natural gas and thus the low cost electricity provision in Egypt, it will be difficult for imported electricity to be competitive.

- ***Renewable energy*:** The cost of wind based electricity 2.1 US¢/kWh with current grant financing for wind projects, which is higher than the cost from natural gas thermal plants: combined cycle (1.7 US¢/kWh) and steam cycle (1.85 US¢/kWh). Therefore, renewable energy is not competitive unless further subsidies are provided.

- ***Rehabilitation of existing power plants:*** EEHC has concluded that the rehabilitation option is cost effective in seven of its existing power plants, and these sites have already been or will be rehabilitated. However, these efforts are not enough to cope with the growing demand for electricity. The Tebbin power plant (3 steam units of 15 MWe) is too old (1958 vintage) and not appropriate to rehabilitate.

- ***Transmission and distribution investments*:** EEHC has developed a transmission and distribution (T&D) development plan and the T&D system is optimized for the current load requirements and generation capacity. To meet the demand growth for the fast track period and medium term expansion, a T&D investment plan has been developed. New electricity generation capacity is required in the network; therefore, strengthening of T&D capacity alone will not replace the need for the generation capacity. Furthermore, T&D losses are at a relatively low level, around 10% on average, and reducing the losses further would not free up the amount of electricity supply required.

- ***BOOTs/IPPs*:** Three BOOT projects (650 MWe each) have been built in Egypt in recent years. The government is encouraging private sector participation in order to attract private investment. However, given the worldwide reduction in investor's interest in the power sector, private financing for power generation in the near term is unlikely.

Consistent with the generation expansion plan, the EEHC has stipulated that the Tebbin should be gas/oil-fired steam units of a net 2 x 325 MWe generating capacity. The reasons for the selection of this technology are as follows:

The steam cycle (SC) technology, which fires natural gas as a main fuel and mazout as a back-up fuel, has been used for decades in Egypt. The plant efficiency is around 40% with 300 MWe size drum type sub-critical steam cycle. The investment cost of SC plant, based on recent Egyptian experience, is around $ 530/kWe (EPC basis with multiple packages). The application of large scale (750MWe) gas turbine combined cycle (CC) technology, which fires natural gas as a main fuel and diesel fuel as a back-up fuel, has just started. Plant efficiency exceeds 50% and the investment cost, based on recent Egyptian experience, is around $300kWe (EPC basis with multiple packages). Given that CC plants show lower investment cost and higher plant efficiency, there should be a distinguished rationale to justify why the SC technology has been selected for the proposed project. The reasons are the following:

- *Operational flexibility*: The EEHC plans to operate large scale (i.e., 750 MWe) CC plants at 100% full flat base-load with a possibility of reducing operations to 50% once a week. This is because the cycling capacity of large-scale CC plants is still to be confirmed (frequent start and stop, and partial load operation capacity). Consequently, SC plants are required to take the role of reducing the load, while CC plants keep 100% full load. EEHC therefore sets the maximum proportion of CC in the generation mix to be 30-35%. As a result, the Electric Generation Expansion Analysis System (EGEAS) model selected the proposed El-Tebbin SC plant as the most viable option based on this generation mix criteria. If the CC technology were selected, it would exceed the limit of CC in the generation mix, requiring CC plant cycling operation beyond what it is capable of.

- *Grid stability*: SC turbine has bigger inertia and is therefore more stable to network disturbances. When the CC ratio is too high in the generation mix, CC may overreact to the disturbances and interfere with each other, which could cause load instability.

- *Unforeseen risk of new technology*: Applying a new technology to the Egyptian specific climate and environment may have unforeseen risks. For example, recently, dust and humidity caused a quick filter pressure drop in the Cairo North plant, commissioned in May 2004, which was not expected when the CC plant was designed.

- *Fuel flexibility*: SC plants use mazout as a back-up fuel, easily available domestically, while CC plants use imported diesel oil that is more expensive. Even though the back-up fuel is not expected to be used often, the SC plant has lower back-up fuel cost.

- *Local manufacturing capacity*: In Egypt only 30% of CC plants are manufactured locally, in comparison to about 40-45% of SC plants manufactured locally. Therefore, the use of SC technology creates more local employment and requires less foreign exchange.

Given this rationale, existing and planned generating capacity using gas/oil-fired combined cycle units is already considered sufficient by the EEHC and further reliance on this particular technology is not preferred for reasons of security of supply, response to demand and economics. As shown in Table 3-1, almost 14% of installed capacity in 2003/2004 was provided by combined cycle technology. The new combined cycle units at both Cairo North and Nubaria will add more 3000 MWe to the installed capacity within the next 2 years. Also, declared combined cycle additions of both new Kureimat and new Talkha will increase the combined cycle capacity by another 1500 MWe within the same period. The EEHC is implementing a process of meeting and generating increased demand through the provision of conventional steam generation plants in order to generate sufficient demand to install further CCGT capacity in the future. This will result in increased potential to incorporate more CCGT capacity.

Hence, with the current policy to limit CC to 30-35% in the generation mix (as identified by EGEAS), and with urgent need of supply capacity with load following capability, SC technology has been identified as the most viable option for the Tebbin project. This will ensure operational flexibility, network stability, fuel flexibility, local job creation, and avoid unforeseen risks of applying new technologies too rapidly in Egypt.

3.2.2 Alternative Fuels

Natural gas has been selected as the main fuel for the power plant. Compared to other fossil fuel generating technologies, gas fired steam generators have a relatively low emissions of carbon dioxide (CO_2), moderate emission levels of nitrogen oxides (NOx) and the lowest emission levels (almost traces) of sulfur dioxide (SO_2) and particulates.

The greenhouse effect is caused by the build-up of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and chlorofluorocarbons (CFCs) in the atmosphere. Water vapour and ozone (O_3) can also act as greenhouse gases. For power generation processes, CO_2 is the key emission of concern, as methane and CFCs are not emitted by power plants and none of the other greenhouse gases are emitted in sufficient quantities from power generation to be considered important in terms of the greenhouse effect.

A comparision of the efficiency and CO_2 emissions from natural gas-fired steam generators compared to other technologies and fuels is provided in Table 3-2 below.

Table 3-2

Comparison of CO_2 from Alternative Technologies for Power Plants

Technology	Generating Efficiency (%)	CO2 Emissions (g per kWh)
Steam Generators - gas fired	36%	520
Combined Cycle Gas Turbine - gas fired	50-58%	360-420
Combined Cycle Gas Turbine - oil fired	Not available	600
Steam Generators - coal fired	42-48%	Not available
Pressurised Fluidised Bed - pulverized coal	42-45%	740-840
Integrated Coal Gasification Cycle - coal-gas fired	40-45%	750-1,000
Conventional Coal without FGD - pulverized coal	38-40%	820-950
Conventional Coal with FGD - pulverized coal	36-40%	800-980

Source: EDF Port Said East SAE: EIA for Port Said East BOOT Steam Power Plant, Final Report, October 2000.

The efficiency of the proposed steam power plant is 30-40% with natural gas, with associated CO_2 emissions of about 54kg/s. This compares with the efficiency of a typical CCGT power plant of 53-54%.

Emissions of carbon dioxide are estimated to be up to 1600 kilotonnes per year (expressed as CO_2). This assumes that the plant operates for the whole year and consumes around 65 tonnes of gas per hour. The emissions of CO_2 from fuel burning in Egypt amounted to around 118,262 kilotonnes in 2002/2003 (Ref: Energy in Egypt, 2002-2003; Organization for Energy Planning). Fuel combustion will account for most of Egypt's CO_2 emissions from all sources. Hence, the power plant as proposed will emit up to around 1.3% of the total Egyptian CO_2 emissions in 2002/2003. This is an upper estimate as the plant will not operate 100% of the year or at full load 100% of the time.

Natural gas, which is the main fuel to be used in the Tebbin plant, contains very low concentrations of sulfur or particulate matter, therefore the potential for emissions of SO_2 and particulates from the electricity generating process are also very low. Fuel oil however, leads to greater emissions of SO_2 and particulates, due to the relatively high sulfur content of these fuels and the generation of ash during their combustion.

Natural gas fuel also has the significant benefit of being able to be delivered by an existing pipeline.

Therefore, the selection of natural gas as the main fuel for the Tebbin power plant offers a range of environmental advantages over alternative fuels.

Light fuel oil, which is less polluting than the chosen heavy fuel oil or mazout, is not readily available in Egypt and its use would incur significant economical impact on the project.

3.3 ALTERNATIVE DESIGNS OF THE POWER PLANT

There are a wide variety of potential designs for the proposed power plant which consider technical, economic and environmental issues. Key design features of the power plant which are related to environmental impacts are summarized in *Tale 3-3*.

On the basis of the key design features selected for the power plant summarized in *Table 3-3*, together with general good practice included within its overall design and layout, fuel and chemical storage facilities and pollution monitoring equipment, the power plant offers a range of environmental benefits whilst minimizing its potential site-specific impacts on the environment and ensuring safe, secure and efficient operation.

3.4 ALTERNATIVE SITES

The site location was allocated to the Egyptian Electricity Authority, EEA (today EEHC) by the Egyptian Government (Ministerial Decree no. 402 of the year 1958, issued on 29 September 1958), and EEHC has given rights of use of the site to CEPC.

3.4.1 Identification of Candidate Sites

Three sites were considered for the proposed project, namely Safaga, Damietta and El-Tebbin. Relatively, the Tebbin was preferred to Safaga and Damietta sites mainly because of the higher cost for connection to cooling water, make-up water and the electricity network due to the greater distance to the load centers.

The key criteria used in the evaluation of the alternative sites by the EEHC were as follows:

- *Economic factors*:
  - capital costs;
  - operation and maintenance costs;
  - requirement for natural gas;

- requirement for cooling water;
- demand loads for electricity; and
- requirement for electricity transmission lines/sub-stations.

- *non-economic factors*:
  - potential environmental impacts;
  - site development

Potential environmental impacts have been examined for all sites. Screening level assessment during feasibility study indicated that the level of environmental impacts will be relatively constant for all the three sites.

According to the Investment Map and Land-use Map of Egypt, the site has been designated since 1958 to power generation. Much of the land around has already been developed with significant heavy industry facilities. As a result, the Tebbin area has been identified as the centre of load for current and future electricity demand in the region.

Compared to other alternative sites, the Tebbin site was found to be the most effective site for the following reasons:

- Minimal additional infrastructure requirements are needed.
- A workers colony is not required during construction as the power plant will use the local workforce from Greater Cairo area and the surrounding towns and villages.
- Desirable benefits for development of the site area.

In addition, the power plant will be constructed and operated on a land originally dedicated for power generation activity, thus it will not include any land take. Also, the power plant site will bring socio-economic benefits to the Greater Cairo Region, through employment opportunities, supply contracts and the effects of project expenditure within the local economy.

The key findings of the consideration of alternative sites are summarized in *Table 3-4*. The consideration of alternative sites by the EEHC indicated that Tebbin has no significant disadvantages and has several beneficial aspects and desirable site development characteristics. Therefore, El-Tebbin was selected as the preferred site for the power plant.

Table 3-3

Key Design Alternatives for the Tebbin Power Plant

Item	Discussion of Alternatives	Selected Design
Stack Configuration	The two generating units and the auxiliary boiler in the power plant each require an exhaust for combustion gases. Alternative configurations are: • three separate stacks, • one single stack for both units and one stack for the auxiliary boiler, • one single stack with three flues, • one single stack with one flue. The single stack will have a larger diameter than separate stacks, but will improve dispersion through buoyancy effects. The visual appearance of the power plant will change with stack configuration.	The power plant is primarily designed with one single stack containing two flues, which improves the buoyancy and dispersion of the emissions. This also minimizes the visual impact.
Stack Height	The stack can be a range of heights. Dispersion is improved by increasing the stack height, but engineering requirements, e.g. structural support and foundations, and associated costs are also increased with stack height. Clearly, the higher the stack the greater the visual impact, but the higher the stack the better dispersion of atmospheric emissions.	The stack height was primarily defined as 152 m via atmospheric modeling carried out for Tebbin power plant by EDF in July,-August 2005 which is in excess of the Good Engineering Practice (GEP) stack height.
Air Pollution Control	There is a range of technologies which may be used to minimize emissions from the power plant, which can be divided into two categories: • fuel combustion controls; • "end-of pipe" gas cleaning. The most effective approach is to control combustion of the fuel such that the production of the emissions is minimized, obviating the need to use gas cleaning equipment (which addresses the results rather than the source of emissions). End- of-pipe solutions are also expensive compared to combustion controls. The use of Heavy Fuel Oil will result in SO_2 emissions and particulates.	The boilers will be equipped with low-NOx burners, minimizing the emission of NOx which is the key pollutant associated with combustion of natural gas. Detailed design will also consider further NOx reduction techniques, such as flue gas re-circulation. Air pollution control systems will ensure compliance with the EEAA emission standards for power plant. Heavy Fuel Oil will be used in emergencies only and for a period not exceeding 2% of operating time.

Item	Discussion of Alternatives	Selected Design
Cooling System	There are 3 generic cooling systems which may be used: • direct (once-through) water cooling; • indirect water cooling using evaporative cooling towers; • air cooling via air cooled condensers. Direct water cooling maximizes the generating efficiency of a power plant, but requires large quantities of cooling water and the construction of intake and outfall infrastructure. A cooling tower system (closed system) uses less water, but is associated with lower generating efficiency and visible plumes of water vapor which causes salt drift and can cause ground fogging. Although cooling towers use less water they result in a net water loss which needs to be compensated by makeup. Air cooled condensers (closed system) have the lowest generating efficiency but do not use water, although noise and visual impacts are higher than for the other options.	Direct water cooling will be used, which maximizes generating efficiency, minimizes visual impact and noise and the potential for visible vapor plumes or ground fogging. A sustainable water supply is available from the Nile river and the intake and outfall structures can be constructed without significant environmental impacts.
Cooling Water Intake and Outfall Structures	The cooling water intake and outfall may have a range of alternative designs, which affect dispersion of the thermal plume: • Relative locations on the Nile bed (which control potential re-circulation of warm water into the intake). • Design (flow rate, flow velocity, height above Nile bed, orientation, .. etc).	The cooling water intake and outfall infrastructure is located such that there will be no effects on the operation of the power plant through re-circulation of warm water from the cooling water discharge into the intake structure. The orientations, flow rates and flow velocities of the intake and outfall are designed to avoid scour of the Nile bed and change to sedimentation. The height of the intake and outfall above the Nile bed are designed to avoid any potential interference with Nile navigation. The intake orientation, flow rate and velocity are designed to minimize entrainment of fish and other aquatic organisms. Fish screens are also fitted to the intake.

Item	Discussion of Alternatives	Selected Design
		The outfall is designed with a diffuser system which encourages rapid dispersion of the thermal plume and minimizes the potential effects of temperature rise on fish or aquatic organisms.
Effluent Treatment and Disposal	There is a range of technologies which may be used to treat effluent from the power plant. The main effluent characteristics of concern are pH, suspended solid material and oil/grease residues. These characteristics may be treated by: • pH adjustment by acid/alkali addition; • filtration of suspended solids; • interception of surface oily substances; The available options for disposal of the plant's treated effluent are to a mains sewer, an existing wastewater treatment plant, or a local watercourse. Otherwise, the only available discharge route will be direct to the Nile. The plant includes a wastewater treatment facility.	The treatment system consists of modules for treating wastewater streams generated by the power plant. This is achieved by selectively combining some of these waste streams and providing treatment as required prior to routing to the disposal system. Eff1uent treatment systems will ensure compliance with the Egyptian and World Bank discharge standards for power plants.
Use of Water Treatment Chemicals	There is a range of proprietary water treatment chemicals available for use in power plants. The approach to the use of water treatment chemicals is determined by the quality of the raw feedwater, requirements of the power systems to operate safely and efficiently and management of the power plant. The use of water treatment chemicals is inherent in the operation of the power plant, although how the chemicals are used can be controlled.	The use of water treatment chemicals will be reduced to the minimum required to achieve safe and efficient operation of the power plant. The control of the use of water treatment chemicals will include consideration of the type of chemical used (Chlorine will be added to the cooling water system to control bacterial and algal growth instead of sodium hypochlorite), dosing regime and control of residual concentrations in the process effluent and cooling water discharge.

Table 3-4

Key Findings of the Consideration of Alternative Sites

Site	Key Findings
Safaga	Remote, "greenfield" site, hence a new colony for workers would be required with potential socio-economic conflicts. Extensive infrastructure requirements needed, resulting in higher costs and potential environmental impacts.
Damietta	Relative to Tebbin site, significant infrastructure requirements needed, resulting in higher costs and potential environmental impacts.
El-Tebbin	Minimal additional infrastructure would be required. Cost-effective site for development (first lowest of the three alternative sites). A workers colony is NOT required as the project will use the local workforce from Greater Cairo area.

4. DESCRIPTION OF THE PROPOSED PROJECT AND THE EXISTING FACILITY

4.1 PROJECT INFRASTRUCTURE

The development of El-Tebbin Power Plant will consist of the infrastructure presented in *Table 4-1 and Table 4-2*. The proposed site of the power plant and the easements for the associated infrastructure are shown on *Figure 4-1*.

Table 4-l

Main Infrastructure for Tebbin Power Plant

Infrastructure	Brief Description	Comment
Power plant	650 MWe power plant comprising two Steam Turbine units each of 325 MWe capacity, using natural gas as the main fuel and mazout (oil no. 6) to be used in emergency situations for limited hours.	Power plant is the subject of this EIA report.
Cooling water supply	Abstraction and return of cooling water from/to the Nile river through intake concrete pipe and discharge one.	Cooling water supply is the subject of this EIA report.
Fuel supply	Natural gas supply via an existing gas pipeline routing and the emergency fuel mazout oil by an existing oil pipeline extending from the tank yard of the Petroleum Pipelines Company across Cairo/Es-Saff Road to the power plant site. Light fuel oil supply by trucks.	A gas reducing station will be used for the new units. Supply of emergency and start up fuels (heavy and light fuel oils) by an existing pipeline (mazout) and trucks (sollar) and included in this review.
Power evacuation	Direct connection by overhead transmission line into 220kV power transformers and 220kV new switchyard.	New short off - site transmission line is required to evacuate power generated and included in this review.
Potable water supply	Potable water supply line of the existing plant will be used. It connects the power plant with the existing water supply network outside the plant. Potable water storage tanks will be used to support the plant needs.	Same existing line will be used, rehabilited or renewed. No separate EIA report is necessary. Only Screening Form B may be used as required by the EEAA.
Sewer Line	A Sewer discharge line from the plant lift stations to the project sewer treatment plant will be constructed. Then treated wastewater will be disposed of into the wastewater network outside the plant.	New connection line is required. Therefore, a separate screening Form B may need to be handled by relevant authority as required by the EEAA.
Site access road	Access via an existing road.	No new road is required. Therefore no separate EIA report is necessary.

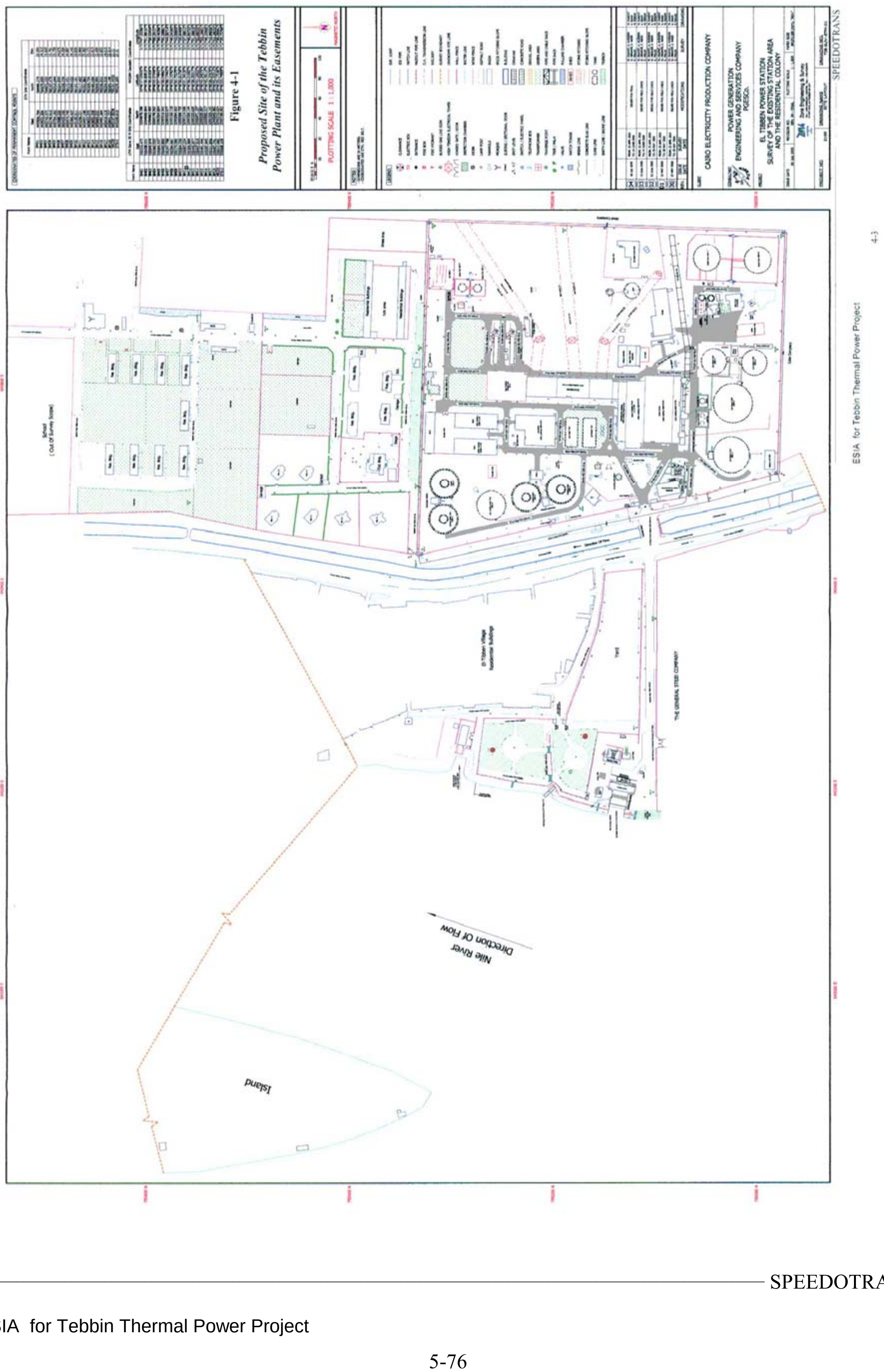
Table 4-2

Supporting Infrastructure

Infrastructure Type and Brief Description
• Logistic buildings, including administration building, offices, workshop, warehouse, laboratory, and gate house. • Gas handling facilities, for metering and control of gas delivery. • Fuel feeding system for both natural gas and alternate fuel. • Handling system needed for the periodic maintenance of the equipment. • Fire fighting facilities including Nile water emergency supply. • GIS switchgear with 220 kV outgoing feeder lines. • Ventilation and air conditioning. • Chemical laboratory. • Communication system. • Site drainage, site lighting and perimeter wall (3m high).

Figure 4-1

Proposed Site of the Tebbin Power Plant and its Easements



4.2 DESIGN OF THE EL-TEBBIN POWER PLANT

4.2.1 Overview of El-Tebbin Power Plant

The preliminary design, layout and engineering aspects of the proposed power plant is being developed by PGESCo (project engineer) on behalf of the EEHC/CEPC.

The design of the plant is based on high quality electric utility standards and uses proven technology and equipment. The plant has been designed to produce low cost power without compromising quality, reliability or availability.

The plant will consist of the infrastructure presented in *Table 4-1 and 4-2.*

The project will include the following main components:

- Conventional steam power plant, comprising two generating units primarily fired by natural gas, at approximately 7 bar gauge at the interface, but also designed to run on mazout (heavy fuel oil) in emergency situations as a secondary fuel. Each unit will consist of one outdoor boiler for steam generation and one steam turbine generator (STG) providing 325 MWe (nominal) electrical generation capacity per unit at the 100% of the STG output case. Each STG will be fed by steam from the respective steam generator (boiler);

- Circulating water system, with the main pumps and associated piping, the intake and discharge structures, the screening system, the chlorination system and the cathodic protection system;

- Heavy fuel oil and light fuel oil storage tanks;

- Intermediate water storage, the demineralization plant and the make up water system; and

- Power will be generated at the manufacturer's standard voltage and stepped up through main transformers to be connected to the new 220 kV switchgear.

Provisional layout drawing of the proposed power plant is provided in *Figure 4-2*. The final layout of the power plant and detailed design will be completed by PGESCo and Cairo Electricity Production Company's (CEPC's) Contractors who will construct the power plan. However, main components illustrated in the provisional layout drawing include the following:

- Boiler Unit 1A.
- Boiler Unit 1B.

- Reboiler.
- Auxiliary Boiler.
- Steam Turbine Unit 1A.
- Elec. Bldg. Unit 1A.
- Elec./Control Bldg. Unit 1B.
- Main Transformer Unit 1A.
- Main Transformer Unit 1B.
- Aux. Transformer Unit 1A.
- Aux. Transformer Unit 1B.
- Switchgear Area.
- Diesel Generator.
- Switchgear Control Room.
- Stack Module 1.
- Fuel Gas Receiving/Reducing Station.
- Mazout Fuel Oil Unloading Pumps.
- Sollar Oil Transfer Pumps.
- Mazout Fuel Oil Storage Tank 1.
- Mazout Fuel Oil Storage Tank 2.
- Sollar Oil Unloading Pumps.
- Mazout Oil Heaters/Transfer Pumps.
- Sollar Oil Storage Tank.
- Water Treatment Area.
- Circulating Water/fire Water Pump House.
- Circulating Water Electrical Equipment Bldg.
- Chlorine Tank/Pump.
- Condensate Water Tank.
- Circulating Water Discharge Structure.
- Circulating Water Seal Well.
- Demineralized Water Storage Tank.
- Waste Water Treatment Plant.
- Administration Building.
- Warehouse / Work Shops.
- Security Office.
- Fire Station.
- Hydrogen Generation Building.
- Bottled Gas Storage/Gen. Area.
- Foam Equipment.
- Black Start Facility.

The power plant is designed to operate as a base load unit with the STG operating in sliding pressure mode up to approximately 60% load and at fixed pressure for higher loads.

Key features of the design of the power plant could be summarized as follows:

- The conventional Steam Turbine Generator power plant will have the capability to be fired by dual fuel, using either natural gas or mazout in emergency case.

- The power plant will operate by a once-through cooling system. Supply and return cooling water will be from/to the Nile River.
- River water will be utilized in the steam generation system after filtration and demineralization prior to its use.

4.2.2 Design and Layout of the Power Plant

The proposed design and layout is being developed with regard to the following factors and considerations:

- Technical requirements for construction, operation and maintenance.
- Design of a safe power plant taking account of the relative locations of equipment and the relationship of the overall plant to the environment, particularly sensitive receptors to environmental impacts.
- Compliance with regulatory requirements.
- Presence of existing services.
- Provisions and mitigation measures to avoid or minimize any potential environmental impacts.
- Primary access and secondary roads to operate the power plant.

In general, the site can be split into three main components, namely:

- main power production area, approximately in the central east part of the site which incorporates the Steam Turbine Generators, Boilers, stack and the power transformers;
- fuel handling and fuel gas reducing station area on the northern part of the site, which includes storage tanks for the mazout and sollar oils, and ancillary management facilities (including loading/unloading area, fuel heating and pumping units);
- main cooling water intake and outlet pipelines, demineralization unit and pump house on the western side of the site.

The outline design and layout used as the basis for the assessment incorporates all of the key features of the power plant and, where appropriate, conservative assumptions have been made to ensure that all potential environmental impacts are considered and evaluated.

4.3 PROCESS DESCRIPTION

4.3.1 Electricity Generating Process

The steps in the generating process, typical for each power generating unit, at the power plant are illustrated in *Figure 4-3*, and the key features are as follows:

- The key inputs to the generating process comprise natural gas or mazout oil, which will be delivered to the site via underground pipelines (gas or mazout), together with air and water.

- Natural gas (or mazout oil when natural gas is unavailable) will be mixed with air and combusted to generate steam from demineralized water to drive two turbines serving electrical generators. The combustion of the fuel is supported by injection of air. The process results in the generation of electricity and also produces hot exhaust gases.

- The steam is cycled from the boilers through the turbines to condensers. The condensers are cooled by a direct cooling system, abstracting water from, and discharging the used effluent to, the Nile river. The condensate is then returned for recirculation within the boilers.

- The final exhaust gases will be discharged to the atmosphere via two flues housed in a single stack in accordance with emission standards set by the EEAA. The main by-products from combustion of natural gas are carbon dioxide (CO_2), water vapour, carbon monoxide (CO) and nitrogen oxides (NOx). Sulfur dioxide (SO_2) and particulates, which are typically associated with coal and oil combustion, will not be produced other than in trace quantities during natural gas firing. When mazout oil is used instead of natural gas (during emergency for only less than 2% of the total operating hours allover the year), SO_2 and particulates will also be key emissions from the power plant.

4.3.2 Operating Modes

Under normal operating circumstances, the power plant will run according to one of the following modes:

- one steam turbine on full load, one boiler firing natural gas;
- two steam turbines on full load, two boilers firing natural gas; or
- boiler start up: under black start conditions light fuel oil may be fired.

In emergency circumstances (where gas is unavailable), the plant will operate as described above but using heavy fuel oil (mazout) in place of gas. Emergency operation using heavy fuel oil will occur for no more than 7 continuous days, i.e. 170 hours per year and only if gas is unavailable.

In case of a total blackout, the power plant will operate as follows:

- emergency diesel engines will supply power to the auxiliaries via the auxiliary transformer; and
- the black start turbine generator will be used for starting the plant.

4.3.3 Grid Connection

The electricity produced by the unit generator will be fed into a step up main transformer. The output is delivered into the 220 kV switchyard for connection with the EETC system. Electricity is evacuated off site by high voltage transmission line (220 kV). The interconnection point is the transmission line terminal to the gantry of the 220 kV GIS switchyard. EETC will construct and operate double circuit 220 kV transmission line between the plant and the substation.

4.3.4 Fuels

Natural Gas

Natural gas will be transported to the site via a GASCO owned and operated gas pipeline. The interconnection point is at the reducing gas station located at the north-eastern site boundary. The delivery natural gas pressure is between 9 and 11 bar gauge at the interface. At the outlet of the reducing gas station, the gas pressure is around 8 bar and the flow rate is about 80,000 Nm^3/h. The average gas consumption is estimated as about 60,000 kg/hour. The design characteristics of the natural gas are given in Table 4-3(a) below.

Fuel Oil

The heavy fuel oil will be delivered to the site via an existing oil pipeline extending from the tank yard area of the Petroleum Pipelines Company across Cairo/Es-Saff Road to the southwest of the power plant site. Mazout is supplied to the tanks at the tank yard area with underground pipelines from the Musturud Refinery, east of Cairo.

Light fuel oil will be transported to the site by road tankers.

Heavy and light fuel oil will be stored on site in:

- two, 15,000m^3 tanks for heavy fuel oil,
- one, 2,000m^3 tank for light fuel oil.

The heavy and light fuel oil tanks are situated in two separate retention areas designed to retain 110% of the storage capacity.

It should be noted that sollar oil may also be used to fuel the emergency generator or the auxiliary boilers. However, the use of this fuel will be very limited: sollar oil will only be used in the event of an emergency requiring the operation of the emergency generator or as a stand-by alternative to natural gas for start up using the auxiliary boiler. Therefore, the use of sollar oil is not considered in the EIA.

The characteristics of the fuel oil which will be used by the power plant as a back up fuel are summarized in *Table 4-3(b)*.

Table 4-3 (a)

Characteristics of the Fuel Gas to be Used by the Power Plant (Minimum Specifications of the EEHC)

Composition	Rich, Mol %	Lean, Mol%
N_2	0.97	0.85
CO_2	2.87	2.15
C1	78.58	88.21
C2	10.79	8.22
C3	4.84	0.55
IC4	0.77	0.01
NC4	0.94	0.01
IC5	0.12	0.0
NC5	0.09	0.0
C6+	0.04	0.0
Total	100	100
M.WT.	19.72	17.2
Relative density @ 1 atm, $60^{o}F$, kg/m^3	0.683	0.596
Density @ 1 atm, $60^{o}F$, kg/m^3	0.835	0.728

Quality of Gas

The quality of gas delivered to the Tebbin plant at the delivery point shall at all times be free from dust, gums, oils, impurities and other objectionable substances and shall:

Figure 4-2

Provisional Layout Drawing of the
Tebbin Power Plant

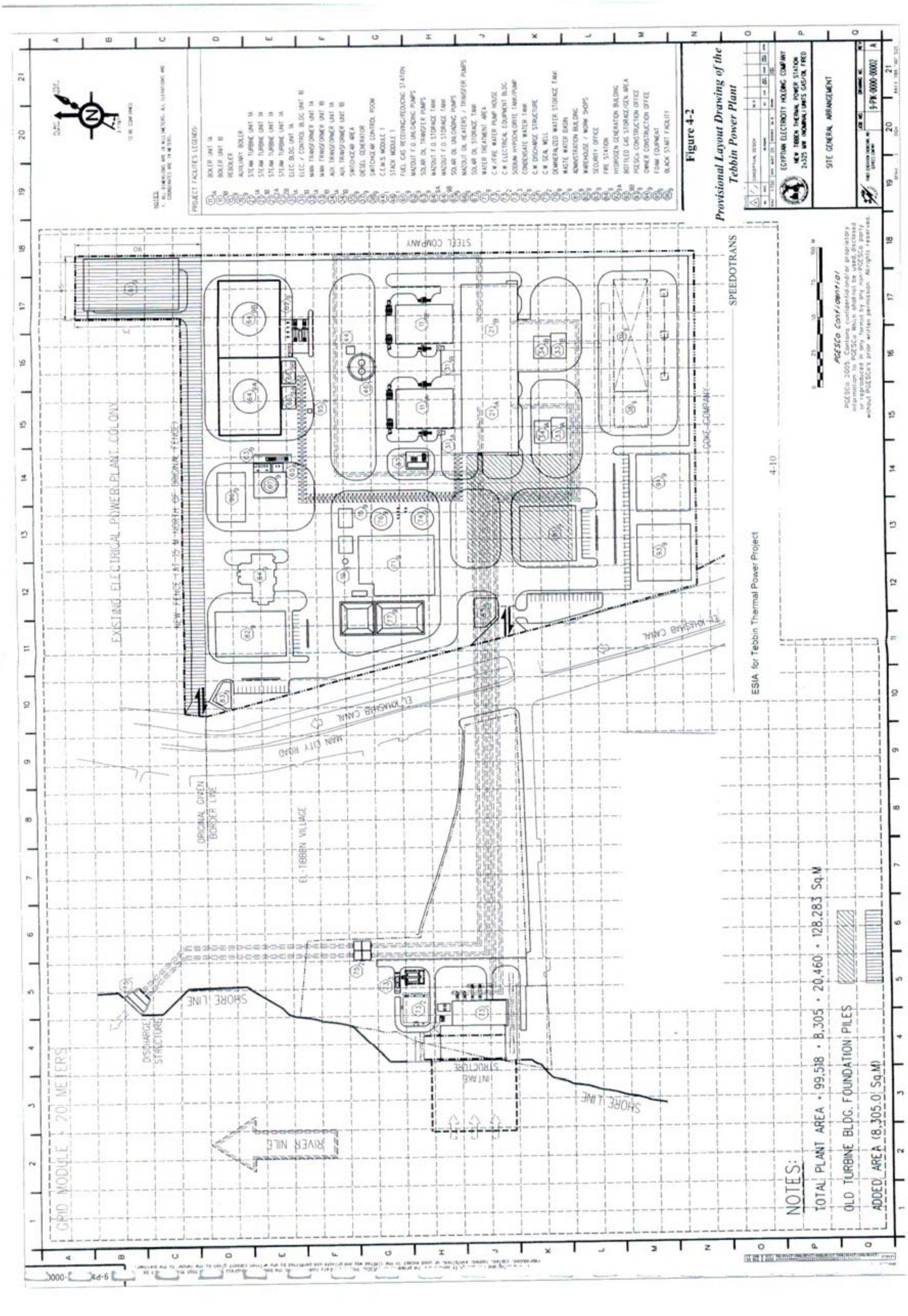
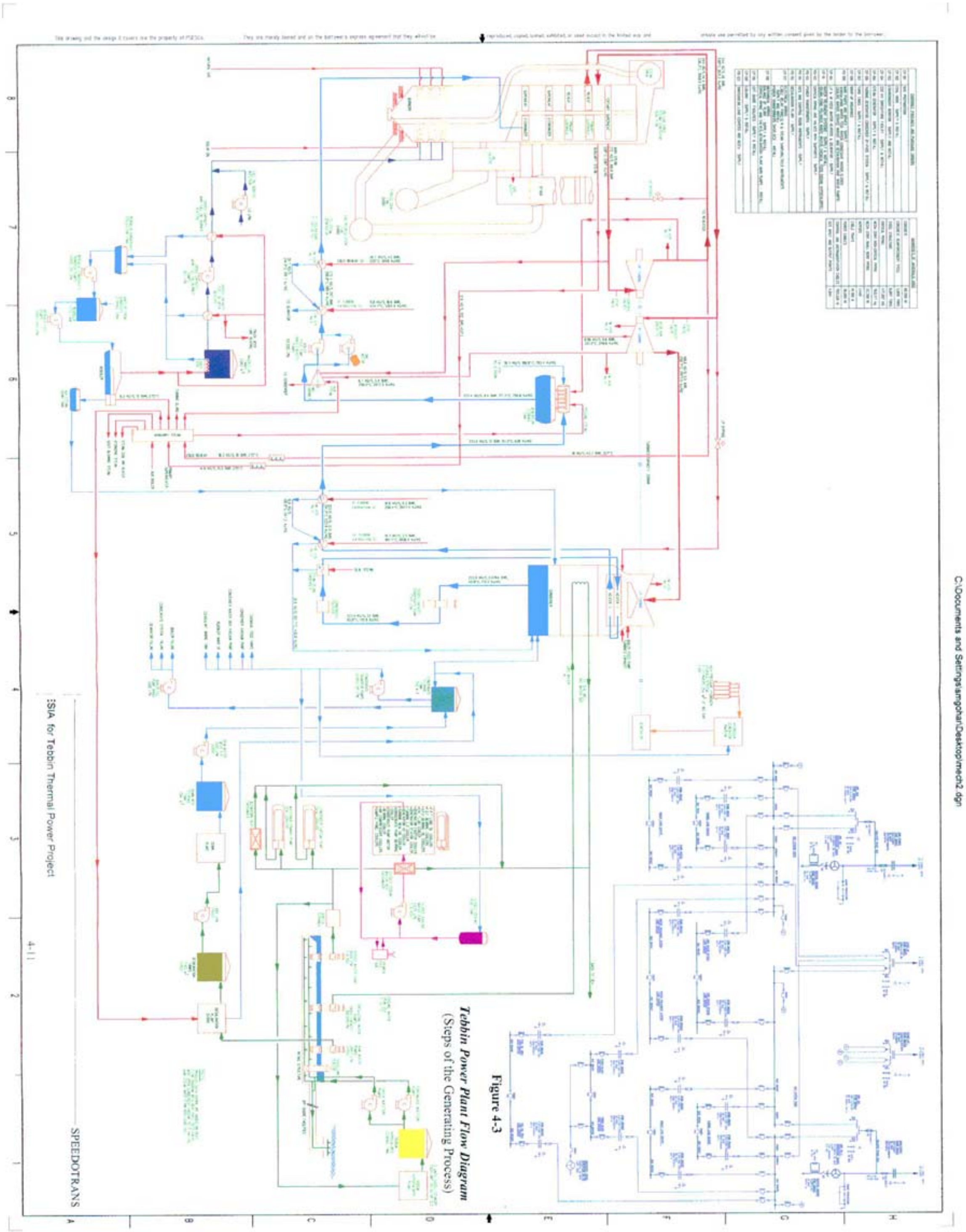


Figure 4-2
Provisional Layout Drawing of the Tebbin Power Plant
SPEEDOTRANS
ESIA for Tebbin Thermal Power Project
4-10
STEEL COMPANY
COKE COMPANY
EL KHASHAB CANAL
MAIN CITY ROAD
EL-TEBBIN VILLAGE
SHORE LINE
INTAKE STRUCTURE
DISCHARGE STRUCTURE
RIVER NILE
GRID MODULE = 20 METERS
NOTES:
TOTAL PLANT AREA = 99,518 + 8,305 + 20,460 = 128,283 Sq.M
OLD TURBINE BLDG. FOUNDATION PILES
ADDED AREA (8,305.0 Sq.M)
SITE GENERAL ARRANGEMENT

Figure 4-3

Tebbin Power Plant Flow Diagram
(Steps of the Generating Process)



- Contain a maximum of zero decimal one mole percent (0.1%) of oxygen.
- Contain a maximum of three decimal zero mole percent (3.0%) of carbon dioxide.
- Contain a maximum of eight (8) parts per million by volume hydrogen sulfide.
- Contain a maximum of one hundred and fifty (150) milligrams of total sulfur per standard cubic meter with average mercaptans of fifteen (15) milligrams as sulfur per standard cubic meter.
- Have a water dew point below zero degrees Celsius (0°C) at a pressure of seventy (70) kg/cm^2 gauge.
- Form no hydrocarbon condensates or hydrates above five degrees Celsius (5°C) at any pressure below the delivery pressure.
- Have a gross calorific value within the limits of not less than nine hundred and eighty (980) BTU per SCF and not more than one thousand, one hundred and eighty (1180) BTU per SCF.

Table 4-3 (b)

Characteristics of the Fuel Mazout Oil to be Used by the Power Plant (Minimum Specifications of the EEHC)

Parameter	Value
Specific weight @ 15°C	0.945 t/m^3
Viscosity @ 38°C, @ 50°C	38 Engler, 22.6 Engler
Freezing point temperature	13°C, max
Flash point temperature	70°C, min
Moisture content	1.0%
Ash content	0.3%
Sulfur content	2.5% to 5.0% max
Carbon content	85%
Hydrogen content	10.7%
Oxygen content	Not present
Nitrogen content	Not present
Vanadium content	0.002% to 0.003%
Net heating value	39,767 kJ/kg
Higher heating value (HHV)	42,111 kJ/kg
Molecular weight	19.41
Density gm/liter @ 16°C, 1 bar)	0.8213
Higher heating value, kJ/kg	49,788

All fuel which is stored on-site will be stored in dedicated tanks within bunded areas with controlled drainage facilities (as described above) .

4.3.3 Operational Use of Raw Materials

Water Consumption

The water balance for the power plant is outlined in *Figure 4-4*. At 100% load, the water resources to be used at the plant are as follows:

- River water for the condenser cooling system.
- River water for Steam Generators make-up and other process uses, after filtration, treatment and demineralization as appropriate.
- potable water fiom the Tebbin water supply.

The total volume of water used in each process is shown in *Figure 4-4*. This water will be abstracted from the Nile river to meet the power plant cooling water and process requirements.

Consumption of Process Chemicals

Table 4-4 provides a list of process chemicals which will be used by the power plant. The main use of process chemicals at the power plant will be for pretreatment of Nile water, control of pH and oxygen scavenging in the Steam Generators system and prevention of biofouling in the intake Nile water pipes and the condenser cooling system.

In addition, a range of oils, detergents and solvents will also be used at the power plant in small quantities for general plant operation and maintenance, eg lubricating oil, hydraulic control fluid, detergent and paints and solvents.

All chemicals will be stored in suitable containers, tanks or vessels and in bunded areas with controlled drainage facilities.

Figure 4-4

Preliminary Plant Water Balance Diagram

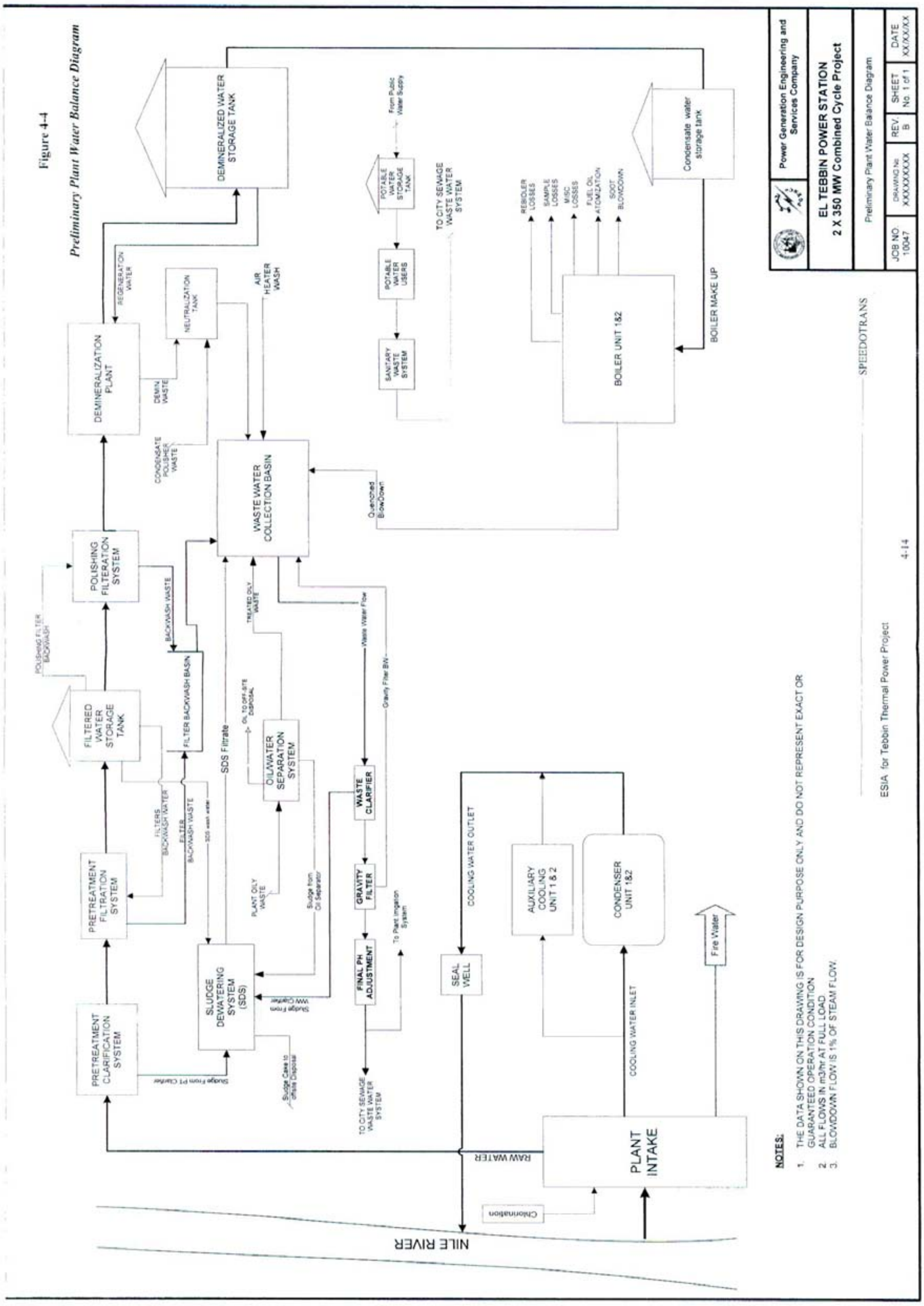


Table 4-4

Provisional Inventory of Process Chemicals[(1)] to be Used at the Power Plant

Substance	Rate of Use (kg per hour)	On-site Inventory and Storage
Circulating Water Chemical Feed System		
Chlorine	267.2	25 tonnes 25x1-tonn containers
Boiler Water Pretreatment System		
Coagulant (aluminum sulfate or equivalent)	5.6	1.0 m^3 solution 40x25 kg bags
Polyelectrolyte	0.2	0.3 m^3 solution 40x25 kg bags or 4 m^3 2x2m^3 portable totes
Boiler Water and Feedwater Chemical Feed System		
Ammonium Hydroxide (28%NH_4OH or equivalent)	0.9	20x2081 drums or 4m^3 2x2m^3 portable totes
Oxygen scavenger (35%N_2H_2 or equivalent)	0.3	10x2081 drums or 4m^3 2x2m^3 portable totes
Sodium phosphate compounds (di-or tri-phosphate or equivalent)	0.4	0.5 m^3 solution 40x25 kg bags or 4m^3 2x2m^3 portable totes
Boiler Water Demineralization System		
40-50% sodium hydroxide (caustic soda)	10.8	19m^3 tank
93-96% sulfuric acid	7.2	32m^3 tank
Condensate Polisher		
40-50% sodium hydroxide (caustic soda)	9.5	0.25 m^3 measuring tank *plus* bulk storage with demineralization system
93-96% sulfuric acid	7.7	0.25 m^3 measuring tank *plus* bulk storage with demineralization system
Closed Cooling Water System		
Corrosion inhibitors (sodium nitrite, molybdate-based or equivalent)	Infrequent 5kg every 3 months	6x2081 drums or 4m^3 2x2m^3 portable totes
Wastewater Treatment System		
40-50% sodium hydroxide (caustic soda)	0.3	0.25 m^3 day tank *plus* bulk storage with demineralization system
93-96% sulfuric acid	0.2	0.25 m^3 day tank *plus* bulk storage with demineralization system
Coagulant (aluminum sulfate or equivalent)	1.4	0.25 m^3 day tank *plus* bulk storage with demineralization system

Notes:

(1) All process chemicals will be sourced by local licensed dealers and will be handled according to instructions and precautions described in the Safety Data Sheets.

4.3.4 Cooling System

Cooling Water Abstraction and Discharge

The power plant will utilize a direct cooling system using water abstracted from the Nile river. The conceptual preliminary locations of the cooling water infrastructure (intake/outfall pipelines and associated pumping station) are shown on *Figure 4-2 (layout of the Proposed Plant).*

The key features of cooling system are as follows:

- Raw water will be taken from the Nile river through an intake structure and treated and screened by a trash rack and travelling screens system to remove solid materials prior to use. The water will then be transferred to the power plant by two 2.5 meter diameter pipes. Two 2.5 meter diameter pipes will return the water from the power plant to the Nile river through a seal well and outfall structure.

- The outfall will be positioned and designed to avoid re-circulation of warm effluent cooling water from the discharge into the intake for Tebbin Power Plant.

- The outfall will be designed to provide optimum velocity discharge into the Nile environment in order to create efficient mixing and reduce the potential for a thermal plume of water at elevated temperature compared to ambient river water. In addition, the velocity should be in compliance with the maximum limits for the river cross velocity in accordance with the requirement of navigation authority. At the exit of the outfall, the temperature of the used cooling waters will be elevated by approximately $8^{o}C$ above the ambient river water temperature, however the cooling water temperature rapidly decreases due to mixing until it reaches the allowable temperature rise at the border of the mixing zone.

The design of the cooling system will take into account the results of the analytical and physical models to assess the dispersion of the discharge of used cooling water in the Nile river. In particular, the location, orientation and flow rate of the outfall will be designed to ensure that the increased temperature of the discharge will not have any significant thermal effects on the Nile environment and that there will be no increase in temperature at the intake to the cooling system for Tebbin Power Plant (and, therefore, will not affect the operation of its cooling system and, consequently, will give satisfactory results regarding both the *"Law for the Environment" (Law 4/1994)* and the Nile Protection Law *(Law 48/1982)* as well as navigation requlations).

4.3.5 Supporting Infrastructure

In addition to main items of plant and equipment used to generate electricity and to the cooling water system, the following supporting infrastructure will form part of the power plant:

- Gas handling facilities, for the metering and control of gas delivery.
- Electrical connection (cable) to a tie transformer at the Tebbin Power Plant 220 kV switchyard.
- Storage tanks for mazout and sollar oils.
- Raw water treatment system for boiler feedwater make-up.
- Wastewater treatment.
- Site services.
- Security/visitor gate house.
- Administration building.
- Lighting.
- Workshops and stores.

4.3.6 Life Expectancy of the Power Plant

The design life for the power plant and the associated infrastructure is 30 years.

With careful maintenance and replacement and refitting of equipment within the power plant as required, the life expectancy of the power plant may be safely extended beyond 30 years if required (eg to 35-40 years).

4.3.7 Off-site Information Requirements

The development of the Tebbin power plant design will include the provision of its own cooling system using water abstracted from the Nile river, which is considered within this EIA report.

The power plant may also require the provision of the following infrastructure which will be subject to separate permits and, if required, ElAs:

- gas pipeline;
- potable water pipelin; and
- sewer pipeline.

The only other off-site infrastructure required to serve the power plant is the electricity transmission system, which will be available from the development of interconnection network of the power plant. The development of the power plant will include a tie transformer and connection cable to link to the 220 kV switchyard, which are both considered within this EIA report.

4.4 OPERATIONAL RELEASES TO THE ENVIRONMENT

4.4.1 Pollution Control Systems and Abatement Technology

The power plant will include a range of measures designed to avoid or minimize releases to the air, water or land (solid wastes). These measures are summarized in *Table 4-5*.

Table 4-5

Summary of Pollution Control and Abatement Systems

Release	Pollution Control/Abatement System
Air Emissions	Under normal operating conditions, the plant fires natural gas which is the cleanest fossil fuel available. Heavy fuel oil (mazout) is used only as an emergency fuel (for max. of 170 hours per year) and light fuel oil is used only at start-up period. 152 m high stack which is in excess of Good Engineering Practice. The boiler is fitted out with “Low NOx” burners for gas and fuel oil operation, in order to reduce NOx emissions. The stack height has been designed in order to optimize the pollutant dispersion.
Noise Emissions	The steam turbine generator set is enclosed in a building. All the outdoor equipment is designed to respect 85 dB (A) at 1 meter according to Egyptian noise level requirements.
Emissions to Water	Oil effluents are collected and treated in an oil/water separator before discharging. Sewage effluent is collected and treated in a sewage treatment system before disposal into the wastewater network outside the plant. Water used in the main water cooling system (open system) is not polluted by chemicals. The circulating water temperature increase does not exceed 8^{o}C (3^{o}C at the mixing zone) in normal conditions. The auxiliary cooled water system is designed as a closed cooling system and no water will be discharged from it. The residual heat of the auxiliaries (diesel, auxiliary boiler, generator stator, etc.) is transferred to the main water cooling system (open system).
Generation and Disposal of Solid Wastes	A natural gas power plant does not produce significant amounts of waste. All solid wastes are stored on-site before being evacuated by a licensed contractor.

4.4.2 Operational Releases from the Power Plant

During operation, the key releases into the environment from the power plant will comprise the following:

- exhaust gases, which will be emitted to the atmosphere from two flues and normally comprise (during natural gas firing) oxides of nitrogen (NOx), CO_2 and CO (SO_2 and particulates (PM_{10}[(1)] and TSP[(2)]) will also be emitted when mazout oil is being used) - details of the guaranteed releases are set out in *Table 4-6*;

  Although the power plant may also use sollar oil to fuel an emergency generator or the auxiliary boiler, the circumstances when this fuel may need to be used are rare. Hence, the potential emissions from the use of sollar oil will be low and are not considered within the EIA of the power plant.

- noise emissions from the turbines and associated plant;

- liquid effluent, including cooling water, sewage water, waste and rain water as set out in *Table 4-7*;

- solid wastes, including solids removed from the cooling water system, sludge from tanks and interceptors, boiler sludge, and general office and canteen waste, as set out in *Table 4-8*, all of which will be disposed of at suitably licensed waste disposal sites.

- ***Materials Handing***

  During normal plant operation, range of products will be delivered to the power plant. Bulk materials (such as natural gas and heavy fuel oil) will be imported by pipelines and others (such as machinery, diesel, lubrication oil, chemicals, spare parts) will be delivered by road in shipments of drums, packages or road tankers. These shipments will be logged and appropriately stored as required under Egyptian and World Bank requirements and guidelines.

(1) PM_{10} : Thoracic Particulate Matter (size < 10 µm).
(2) TSP : Total Suspended Particulates.

Table 4-6 (a)

Principle Boiler Emissions to Air
[Ceiling Values of both the Egyptian & the W.B. Standards
(whichever stringent) will be Guaranteed per Design Process]

Emission Concentration (mg/Nm^3)$^{(1)}$	**Natural Gas**	**Fuel Oil**
- NOx - SO_2 - PM_{10} - TSP	$\leq$ 300 $mg/Nm^{3\ (2)}$ $\leq$ 300 mg/Nm^3 $\leq$ 50 mg/Nm^3 $\leq$ 50 mg/Nm^3	$\leq$ 300 $mg/Nm^{3\ (2)}$ $\leq$ 2000 mg/Nm^3 $\leq$ 50 mg/Nm^3 $\leq$ 50 mg/Nm^3

Notes:
(1) Values taken at 3% O_2 in dry fumes and for 100% load.
(2) 300 mg/Nm^3 at 6% of O_2 in fumes.

Table 4-6 (b)

Auxiliary Boiler and Emergency Diesel Emissions (light fuel oil)
[Ceiling Values of both the Egyptian & the W.B. Standards
(whichever stringent) will be Guaranteed per Design Process]

Pollutants	**Emission Concentration (mg/Nm^3)**
- NOx - SO_2 - PM_{10} - TSP	$\leq$ 300 mg/Nm^3 $\leq$ 2000 mg/Nm^3 $\leq$ 50 mg/Nm^3 $\leq$ 50 mg/Nm^3

It should be noted that in Tables 4-6, all parameters normalized to standard conditions: 273°K, 101.3 kPa, 3% oxygen, dry gas emission rates are presented for 100% load as a worst case on a per unit basis assuming 1000 hour per year forced outage, 7590 hours firing gas, 170 hours firing mazout.

Table 4-7

Inventory of Liquid Effluents Generated by the Power Plant (Conceptual)

Release	Source	Maximum Flow Rate at 100% Load	Discharge Route
Cooling water	Direct coo1ing system	93,600 m^3 per hour	Via circulating water discharge structure (CWDS)
Boiler blowdown	Boiler system	17.2 m^3 per hour	To wastewater basin and then to discharge system(1) after treatment
Backwash from boiler water filtration	2nd stage filtration system for boiler feed	9.3m^3 per hour	To wastewater basin and then to discharge system(1) after treatment
Oil/water interceptor effluent	Oil/water interceptor system	10m^3 per hour	To wastewater basin and then to discharge system(1) after treatment
Domestic sewage	Domestic system associated with offices, canteen, washrooms, etc.	3m^3 per day	Sewage treatment plant and then to the city sewer system (city wastewater network)
Wastewater neutralization effluent	Wastewater neutralization tank of demineralization system	2m^3 per hour	Sewer network
Operational site drainage	Hardstanding areas of operational plant, bunded areas, transformer compound and fuel oil handling areas	Intermittent	Sewer network
Rainwater run-off	All other areas, via storm sewer and stormwater balancing pond	Intermittent	Sewer network

Notes:

(1) Discharge system includes tertiary water treatment and then two discharge pathways: City sewer system and plantation irrigation network. Any excess volumes other than those to be permitted to use sewer network will be discharged to an irrigation drain.

Table 4-8

Inventory of Solid Wastes Generated by the Power Plant (Conceptual)

Solid Waste	Source	Maximum Generation (ton per year)	Discharge Route
Wastewater basin sludge	Build-up of solid residues in wastewater treatment system	Very low (<1 ton per year), requiring disposal once every 5 years	Licensed dump site (1)
Sewage sludge	Sludge produced by sewage treatment plant	Very low (<1 ton per year), requiring disposal once every 3 months	City sewer network on day-to-day basis
Tank sludge	Solid residues which build-up in fuel and process chemical storage tanks	Negligible	Licensed dump site(1)
Interceptor sludge	Drainage interceptors used to remove solids and oils and grease from effluent	Very low (< ton per year), requiring disposal once every 6 months	Licensed dump site(1)
Boilersludge	Solid residues which Build up in the boiler system	300-400 kg per year	Licensed dump site(1)
Commercial waste	Offices, canteen and staff facilities	Negligible	Licensed contractors
Trash Rack and Travelling Screen Wash	Trash rack and travelling screen	Variable	Sanitary landfill site

Notes:
(1) Dewatering and pressing processes will be applied to all wastewater sludges before disposal.

4.5 OPERATIONAL MANAGEMENT AND STAFFING

4.5.1 Process Control

The power plant will be controlled from a central control room, which will contain all the process control computing facilities. All main plant variables will be displayed on "mimic displays", which will reflect the current operational status of the plant.

Safety measures, controls and instrumentation will be provided through distributed control system (DCS), which will continuously monitor operating conditions and be capable of automatically initiating shutdown if required. Hence, process control will have a high integrity and operator intervention will not be required to guarantee the safety of the power plant.

4.5.2 Operational Organization

The Operation and Maintenance (O&M) of the power plant will be performed by the Project Company, CEPC. There will be personnel dedicated to the Operation and Maintenance services for the power plant.

The organization of the Plant is headed by a management group, including a Plant Manager and one assistant in charge of environment, safety and quality control.

Plant Manager

The Plant Manager will be responsible for the general management of the O&M activities of the plant. His duties will include the obligation to ensure that the plant is satisfactorily operated and maintained.

Assistant Plant Manager

The Assistant Plant Manager is in charge of environment, safety and quality assurance, specifically:

- for environment and safety, he is responsible for the formulation and implementation of fire fighting, safety and environmental and social management policy; and

- for quality assurance, he is responsible for ensuring that all operating procedures and standards are correctly applied for the day-to-day operation and maintenance of the plant. He will also develop and produce standards, policies and procedures.

Operations Manager

The Operations Manager is responsible for the operation of the plant. The Operation Department is responsible for:

- receipt, preparation and handling of fuel;
- management of the water system including water supply, water treatment and cooling water, general purpose water and wastewater treatment;
- laboratory operations;
- steam and power generation;
- grid liaison;
- emission control equipment; and
- environmental monitoring.

Maintenance Manager

The Maintenance Manager is responsible for the maintenance of the power plant and his department is responsible for providing maintenance service for the power station equipment and structures.

4.5.2 Staffing

The power plant will employ approximately 500-600 people.

The power plant will be manned for 24 hours per day, 7 days per week. During a normal working day, 330-400 employees will be on-site. During night-time and holidays, 60-72 employees will be on-site.

In addition, specialist contractors will be employed for specific tasks, such as modifications to the plant, equipment overhauls, etc.

4.5.3 Staff Facilities

The power plant will include facilities for its staff in a multiple stories building adjacent to the main power plant buildings. These facilities will comprise office accommodation, lavatories, a prayer room and conference rooms.

4.5.4 Staff Training

All staff will undergo integrated training in the following:

- general operation of the power plant;
- specific job roles and procedures;
- occupational health and safety; and
- contingency plans and emergency procedures.

The staff training will comprise:

- induction training on appointment;
- specialist training (as required for the prescribed job role); and
- refresher training as required (typically annually).

The training program will be designed to ensure that appropriate skilled staff are available to operate the power plant at all times.

4.5.5 Operational Expenditure

The typical annual operational expenditure at the power plant will be around US$4 million (as a 20-year average), although during periods when major maintenance is carried out the expenditure could rise to over US$7 million in a particular year. It is expected that 70% of the operational expenditure will be spent locally, on labor, consumables, equipment repair, general maintenance, etc. The payroll (including benefits and overtime) is expected to be approximately US$ 1.9 million per year.

4.6 OPERATIONAL ENVIRONMENTAL HEALTH AND SAFETY

The environmental, health and safety (EHS) plan for the operation of the power plant is described in *Section 8*.

The design, construction and operation of the power plant will comply with the applicable requirements of Egyptian and World Bank guidelines related to environment, health and safety (*see Section 2*). The health and safety of the workforce and the local population and protection of the environment are of paramount importance in the design and operation of the power plant.

As part of the procedures which will be implemented, personnel shall receive training in safety procedures and safety awareness. Appropriate safety measures shall be observed for all operations. Where appropriate, the necessary protective clothing shall be provided.

A detailed record will be kept of any injuries and accidents and a monthly report will be prepared with the aim of undertaking corrective action to prevent them from reoccurring.

Routine inspections shall be carried out on particular items of equipment according to specified schedules. Only approved equipment will be used. The plant will be maintained in a state of safe operation and repair such that it is in accordance with all relevant statutory regulations and environmental requirements. This will include staff training plans, shut down plans, emergency response plans, emergency contacts etc. which will be adopted during both the construction and operation of the plant.

The operational environment, health and safety plan will include provisions to monitor compliance with the key provisions of the Egyptian and World Bank guidelines listed in *Table 4-9*.

Table 4-9

Key Components of the Operational Environmental, Health and Safety (EHS) Plan

Issue	Provisions within the Operational Environmental, Health and Safety Plan
Atmospheric emissions and ambient air quality	• Ambient air quality standards. • Emission limits. • Specific conditions for fuel use.
Liquid effluent discharges	• Discharge limits. • Specific conditions for development on the Nile bankline.
Noise emissions and ambient noise levels	• Noise emission limits applicable to land use zone.
Solid and hazardous waste management	• Specific conditions on storage and handling of hazardous waste.
Occupational environmental management and health and safety	• Ambient air quality standards for the workplace. • Ambient temperature standards for the workplace. • Noise limits for the workplace. • Specific conditions on electrical safety in the workplace. • Specific conditions on working in confined spaces. • General conditions on health and safety. • Specific conditions on personnel training. • Specific conditions on record-keeping and reporting.
Use of chemical compounds	• Specific conditions on the use of related chemicals.

4.7 CONSTRUCTION ACTIVITIES AND PROGRAM

4.7.1 Construction Program and Schedule

The construction program is planned to be completed within 37 months. *Figure 4-5* gives the milestone summary schedule of the Tebbin power project.

The key phases and activities within the construction program are shown in *Table 4-10*. The normal hours of working for construction are shown in *Table 4-11*.

4.7.2 Construction Materials

Preliminary estimates of the main construction materials which will be required to construct the power plant, excluding specialist plant and equipment, are set out in *Table 4-12*.

Figure 4-5

Mileston Summary Schedule
of El-Tebbin Power Project

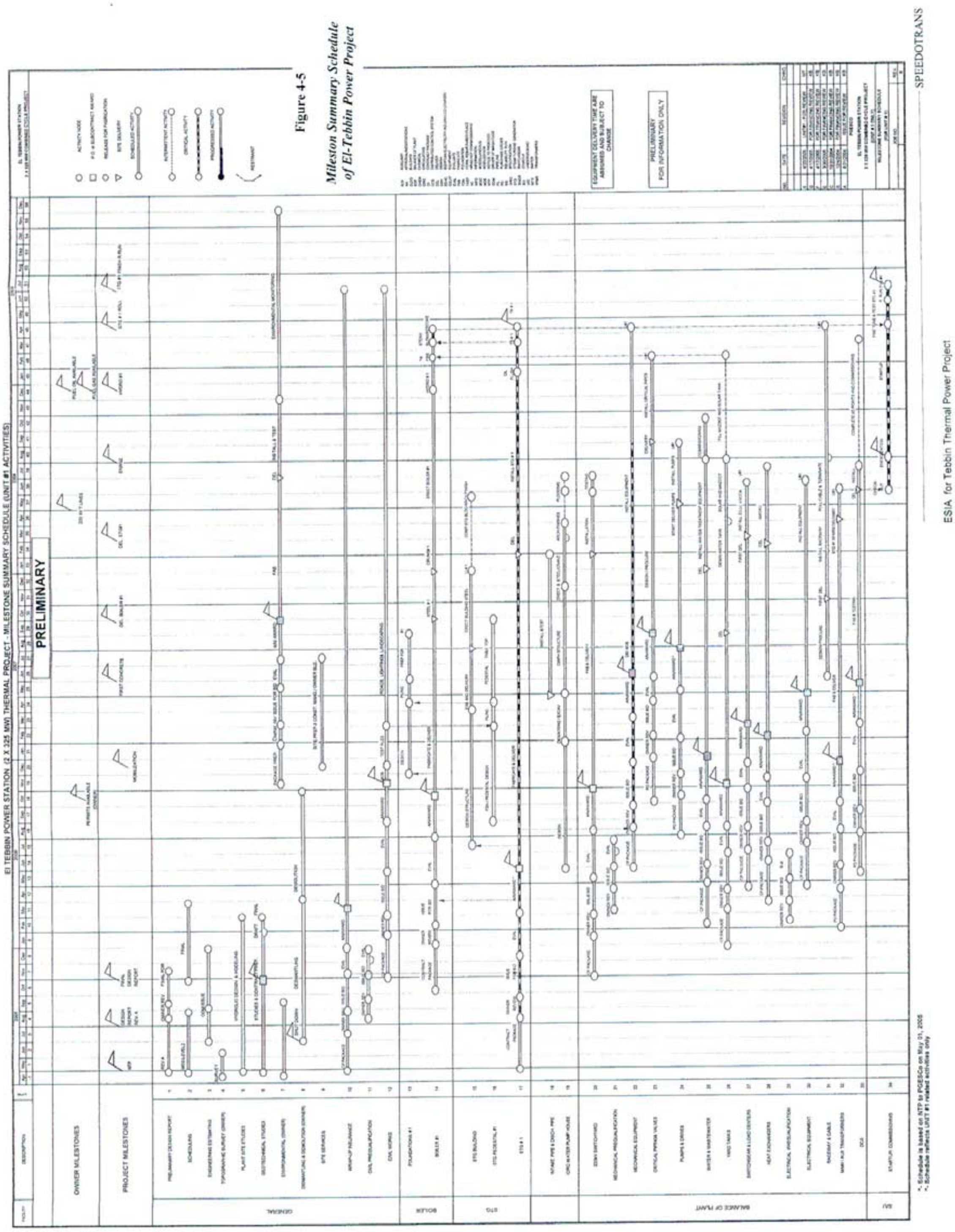


Table 4-10

Summary of Construction Activities

Activity	Description of Activities	Indicative Timing from Mobilization
Construction Start and Site Set-up	Mobilization, establishment of site offices, installation of temporary utilities, site survey.	Months 1-3
Preliminary Works	Establishment of temporary facilities, topsoil stripping, excavation, construction of site roads access, drainage, services, fencing.	Months 1-6
Earthworks, Piling and Foundations	Piling, establishment of base slabs, footings, pits and tanks.	Months 5-15
Steelwork	Construction of steel frames for buildings and support of plant.	Months 10-22
Major Plant Installation	Installation of boilers, steam turbine generators, etc.	Months 12-37
Cooling Water System	Trenching and laying of on-land pipelines, pump house, sub-river intake and outfall heads.	Months 3-23 Subject to adjustment
Mechanical and Electrical Installation	Installation of pipework, pumps, compressors, cooling water ducts, power cabling and switchgear process controls, HVAC, pumps, motors, fans heat exchangers.	Months 16-31
Ancillaries	Installation of switchgear, transformers, gas transfer facilities, cooling water intake and outfall, water treatment plant, workshop, stores and administration buildings.	Months 10-28

Table 4-11

Normal Hours of Working for Construction

Day of Week	Hours of Normal Working
Saturday-Thursday	07:00-03:00 hours (1)
Friday	No work
Holy Days and Holidays (2)	No work

Notes:

(1) Holy Days and Holidays include Christmass Day, Eid-E1-Fitr, Sham El Nessim, Sinai Day, Labor Day, eid-El-Adha, Moslem New Year, Revolution Day, Prophet's Birthday (El-Mawled EI-Nabawy), Armed Forces Day.

(2) Construction work between Saturday and Thursday will be undertaken in two 10 hour shifts.

Table 4-12

Preliminary Estimates of Construction Materials

Construction Material	Quantity (tonnes, unless otherwise stated)
Cement powder	10,100
Fine aggregates (1)	26,300
Coarse aggregates (2)	39,500
Reinforcing steel	3,300
Structural steel	6,200
Potable water	220,000m^3
Raw water	30,000m^3

Notes:

(1), (2) Sourced by licensed contractors from designated quarries.

4.7.3 Construction Workers

The PGESCo/EEHC will seek to utilize qualified contractors with demonstrated performance in the construction of power plants and of construction projects in the region. Wherever practicable, local employment opportunities will be maximized.

The construction workforce is anticipated to be typically 1200-1500 people, rising to 2000-2500 people during the peak construction periods.

Most fabrication will take place prior to delivery to the site and all erection of structures and installation of equipment will use local craft labor, including the following professions:

- engineers;
- boiler makers and installers;
- carpenters;
- cement masons;
- electricians;
- iron workers;
- millrights;
- pipeftters;
- teamsters;
- laborers; and
- welders.

It is likely that the majority of the craft labour will be employed from Cairo and Giza, with approximately 10-15% originating from close to the proposed site.

4.7.4 Construction Traffic

Construction activities will generate heavy traffic. Construction work will be carried out in two shifts: 0700-1700 hours and 1700-0700 hours.

In the first stage of construction, the main traffic generated will be from civil works activities (concrete materials, reinforcement, earth moving equipment, construction materials, paint, steel structure, concrete pipes etc.).

In the second stage, heavy equipment will be transported on site. Oversize transport will also be used for the transport of special equipment such as turbines, stator alternators and condenser bundles.

The anticipated levels of construction traffic accessing the Tebbin Site are summarized in *Table 4-13* and the section below.

Table 4-13

Summary of Traffic Generated During Peak Construction

Vehicle Type	Day Shift (07:00-17:00 hours)		Night Shift (07:00-17:00 hours)	
	Hourly	**Daily**	**Hourly**	**Daily**
HGV(1)	10	100	5	20
Car/LGV(2)	43	86	23	46
Minibus	39	78	21	42
Abnormal Load(3)	2	4	0	0
Total	94	268	44	88

Notes:

(1) Assume that all HGVs travel to and from the site during the daytime shift.

(2) Assume that 75% of the constructicn workers wil1 travel by contract bus at an occupancy rate of 10 per vehicle. The remaining 25% of the work force will travel to and from the site by car at an occupancy rate of 3 per car.

(3) The timing of deliveries of abnormal loads will be agreed with the Competent Authority; however, it is assumed that these deliveries will occur during the night shift to minimize road congestion. There will be approximately 35 abnormal loads during construction.

Heavy Goods Vehicles (HGVs)

The volume of HGVs traffic will vary throughout the construction period During peak HGV activity, it is expected that there will be approximately 100 HGV loads, i.e. 200 HGV movements, each day. Throughout the whole construction period, the average number of HGVs travelling to and from the site is expected to be 10-30 HGV loads or a maximum of 60 HGV movements on the road network each day.

In addition to these, approximately 35 abnormal loads are anticipated to arrive at the plant over the construction period. It is unlikely that any more than two such loads (i.e. four individual movements) would be necessary on any day during the construction of the power plant.

4.7.5 Construction Safety

The Contractors will be required to develop and implement a construction Quality Control Program. A key part of the Quality Control Program will be a Health and Safety Plan, which the construction contractor(s) will be required to comply with as a condition of contract.

4.7.6 Fire Protection

The site fire protection system will be to NFPA (National Fire Protection Association, the American Standard) codes.

The fire protection water supply and storage system provides water under pressure to the site protection system, which then supplies water to the fire hydrants, hose stations and fixed water suppression systems within buildings.

Water for fire fighting will be supplied by the on-site water feed unit and stored in the water tanks. 1,100m^3 of water volume in each tank is reserved for fire fighting purposes. Systems will be fitted to ensure that this reserve is maintained. Two pumps will then provide water to the following major components of the fire protection system:

- underground yard piping and valves;
- fire hydrants and accessories spaced approximately 60 meters apart around the power plant; and
- hydrant hose reels.

The location of equipment on site ensures that all parts of the site are within 30m of fire protection facilities.

Fire protection equipment will include fixed water suppression systems, standpipes and hose stations, portable water and CO_2 extinguishers, independent fire detection systems, and fixed foam suppression systems (for light fuel oil tank and transformers).

4.7.7 Environmental Management During Construction

The Project Company recognizes that construction activities need to be well-managed and controlled to avoid potential environmental impacts from noise, dust, odor, effluent, traffic and other forms of disturbance by construction workers and fixed or mobile plant.

Each subcontractor who operates on site will be responsible for the tidiness of its own working areas as well as for the transport and correct disposal of all its waste, scrap and spills, in accordance with all local laws and regulations.

The construction activities will incorporate Environmental Monitoring Plan and a range of mitigation measures to minimise the potential for environmental impacts to occur (*see Section7 of this ESIA report*).

4.8 DESCRIPTION OF THE EXISTIN POWER PLANT

4.8.1 Layout of the Existing Facilities

Figure 4-6 depicts a general view for the existing facilities Layout where components of the old Tebbin power plant are shown in their respective locations within the plant boundaries. *Figure 4-7* gives some focus on the land dimensions and locality of equipments. *Figure 4-8* presents the layout of the existing facilities associated with the layout of the residential colony. *Figure 4-9* shows selected views of buildings that will be demolished.

4.8.2 Main Station Items

The Tebbin site comprises the following power generating technology items:

Gas Turbines

- 2 x 23 MWe Gas Turbine (France Manf. – Alsthom)
- 2 x 30 MVA Generator 11 kV

Transformers

- 5 Unit TR. 11/66 kV
- 2 Station TR. 66/3.3 kV
- 3 Unit Aux. 10.5/3.3 kV
- 7 Aux. TR. 3,300/400 V
- 2 Aux. TR. 11,000/400V
  Manufacture Ganz – Banz – Budapest – Hungry

66 kV building

- 3 Unit transformer 11/66 kV
- 2 Station transformer 66/3.3 kV
- 3 Unit Aux. transformer 10.5/3.3 kV
- 3 Aux. transformer 3,300/400 V
- 14 Circuit breaker 66 kV

Circuit Breakers

- 14 Min. oil C.B. 66 kV Delle 1958
- 2 C. B.66 kV (Marline – Gerain)
- 3 Expansion Solution C.B. 10.5 kV
- 38 Expansion Solution C.B. 3.3 kV
- 2 Min. Oil C.B. 11 KV

Water Treatment Equipment

- 4 Clarifier 3,000 m^3/h each
- 4 Sand filters flow rate 30 m^3/h

Figure 4-6

Existing Facilities Layout

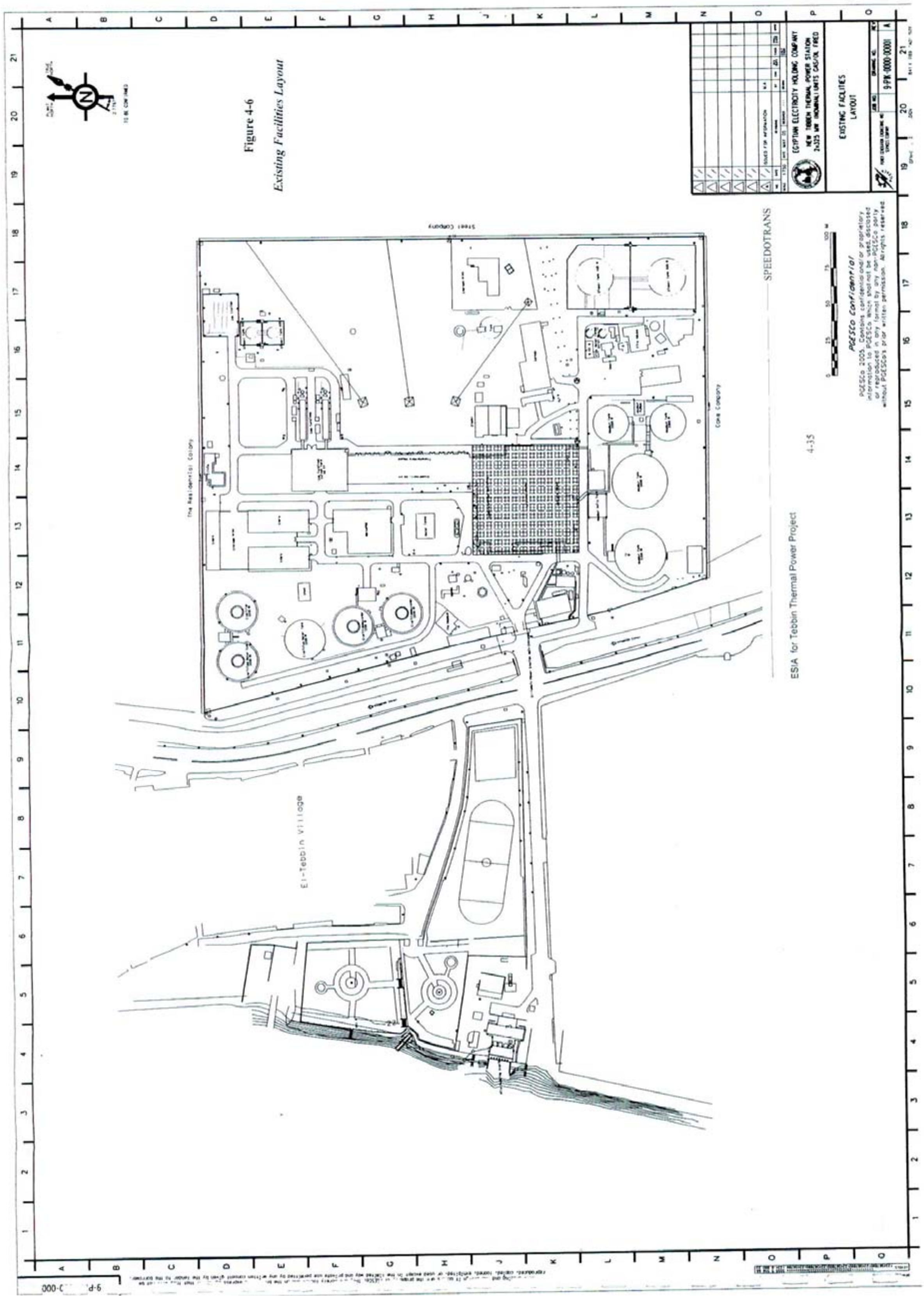


Figure 4-7

Components of the Old Tebbin Plant

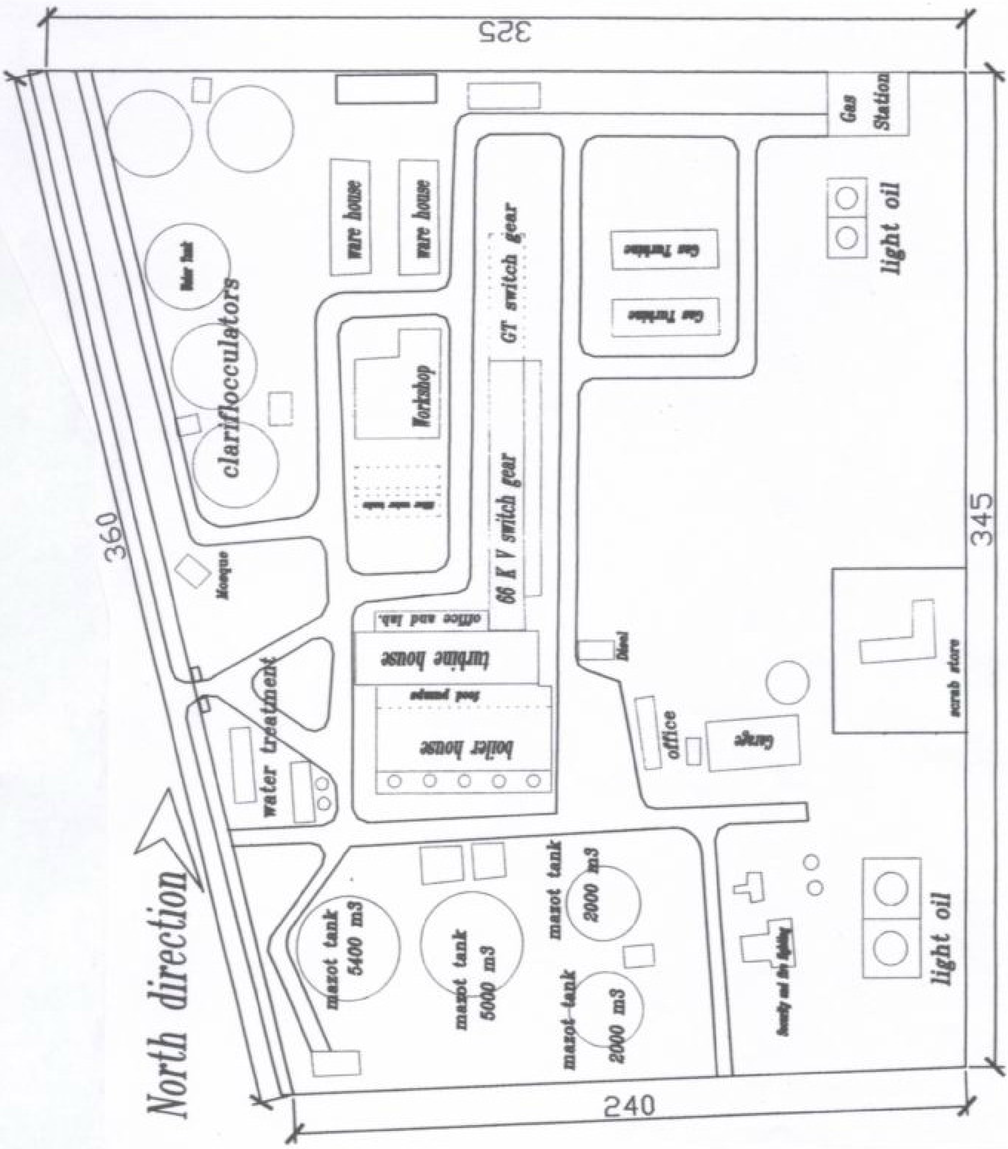


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Figure 4-8

Layout of the Existing Facilities and Residential Colony

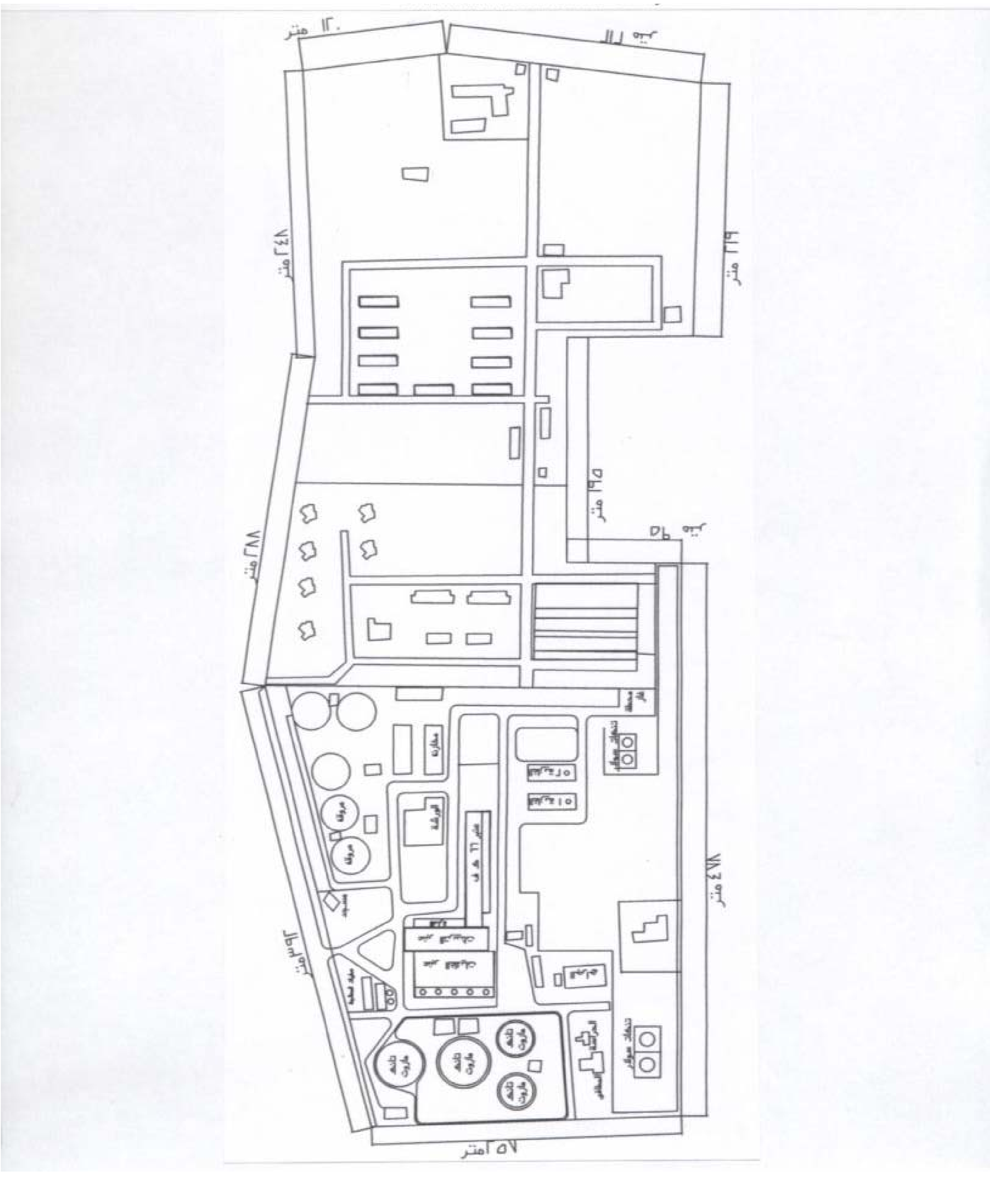


Figure 4-9

Selected Views of Buildings
that will be Demolished

Boiler Feed Water Treatment

- 1 Demineralization flow rate 30 m^3/h (USA Manuf.)
- 1 Demineralization flow rate 2x10 m^3/h (hung. Manuf.)

Sanitary Wastewater

- The station uses Cairo sanitary network for both sanitary and waste water.

Steam Generation Equipment

- 4 Boilers Hungarian Manufacture
  - Live stem continuous flow rate max 75 t/h
  - Live steam pressure 37 bar
  - Live steam temperature 450°C
    (use heavy fuel oil)

- 1 Boiler Polish Manufacture
  - Live stem continuous flow rate max 55 t/h
  - Live steam pressure 37 bar
  - Live steam temperature 450°C
    (use heavy fuel oil)

- Instrument air compressors 3 x 1250 l/m
- Fuel "heavy oil" pump station 3 x 20 t/h

Steam Turbines Equipment

- 3 Steam turbine (15 MWe/h) each
- 3 Condensers capacity 63 ton/h
- 2 Steam feed water pumps 80 ton/h
- 3 feed water heat exchanger group (5 Heat exch./Group)
- 1 Crane (56/10 ton) for Turbines
- 1 Crane (3 ton) for feed pumps
  (Lang – Hungarian Manufacture 1956 for above Equipments)
- 6 Electric water pumps – 80 t/h 215 kWe
- Generators 20 MWA 10.5 kV (Ganz – Hungarian Manufacture)
- 2 Diesel Engine – Power 300 kWe – 380 Volt

Cooling System Equipment

- 4 Cooling water pumps (capacity 4500 t/h) each
- 4 Row water pumps (capacity 900 t/h) each
- 4 Cooling water screen (capacity 10,000 m^3/h) each
- 2 Cooling water pipeline (Dia. 1,500 mm, long 250 mm)
- 2 Cooling water pipeline (Dia. 500 mm, long 250 mm)
- Nile pump building

Storage and Service Fuel Tanks

- Heavy oil storage tank
  - 2 Heavy oil storage tank (2,000m^3) each
  - 1 Heavy oil storage tank (5,000m^3)
  - 1 Heavy oil storage tank (5,400m^3)
- 2 Heavy oil service tank 50 m^3
- 1 Heavy oil service tank 150m^3
- 1 Light oil service tank 50m^3
- 2 Distillate oil storage tank 4,000m^3
- 2 Distillate oil service tank 400m^3
- 2 Storage water tank 50m^3

Table 4-14 provides with some other details on storage and service fuel tanks.

Main Building

- Administration building
- Boiler building
- Turbine building
- 66 kV building

Clarification Area

- 4 Clarifier (3,200m^3) each
- 1 Water storage tank (3,000m^3)
- 2 Sulfate injection building
- 4 Sand filter and its building
- 2 Water storage underground (600m^3) each

Other Facilities

- Central workshop building
- Warehouse buildings
- Security fire fighting and transportation buildings
- All batteries are Alkali-type, contained in Sealed containers

Table 4-14

Storage & Service Fuel Tanks

No	Fuel Tank	Installed Capacity m^3	Dimensions (m)		Tank Type
			Height	Diameter	
1	Heavy oil storage tank No (1)	2,000	5.7	26	Concrete
2	Heavy oil storage tank No (2)	2,000	5.7	26	
3	Heavy oil storage tank No (3)	5,000	5.4	38	
4	Heavy oil storage tank No (4)	5,400	6.9	35	
5	Heavy oil service tank (1, 2)	2x50	5	4	Steel
6	Heavy oil service tank (3)	150	6	6	
7	Light oil service tank	15	4	2.5	
8	Distillate oil storage tank No (1)	4,000	9	25	
9	Distillate oil storage tank No (2)	4,000	9	25	
10	Distillate oil service tank No (1)	400	9	6	
11	Distillate oil service tank No (2)	400	9	6	

4.8.3 Works of Heat Insulation

Heat-insulation materials made from mineral wool. Its coverings equipped by aluminium sheet and they are fitted up to the following places:

- Side walls of the boiler, to the inner side of the warm trussing assorounding of the drum area, to the outside sheet construction formed on the bottom of the boiler.
- Pipes and its armourings (Ganz Danubius SCP offices description of heat-insulation at pipes and armoures outside of walls, NO-5-72-750-00002).
- Pipes of the flue gases.
- Ljungstrom for warm air.
- Pipes for cold air from the knee brace in front of the silencer to the air-heater including the evading pipes.
- Ventilator for cold air.
- Outside surface of the burning box.
- Pipes of fuel (insulated together with steam line).

4.8.4 Applied Materials

Heat-insulation materials of the following technical prescriptions of G.D.S.C.P. Office: NO 5-72-750-00001, NO5-72-750-00002, NO5-73-750-00001, NO5-79-750-00001, NO5-79-750-00002.

Materials for heat-insulation are the following:

- PV-100-AVM type of mineral wool mats from 40 mm – to 120 mm thickness.
- PV – E type mineral wool pipesection for pipe diameters from 32 mm to 176 mm pipethickness from 40 to 100 mm.
- Pipe diameter PV-E type mineral wool pipesection from 32 mm to 176mm pipe thickness from 40 to 100 mm.
- TR 13/63 type aluminium trapezoidal sheet.
- F-3-13/60-20/100 type aluminium angle unit.
- 99.5% fk. Quality aluminium single-plate.
- Galvanized wire; - band steel.

It should be noted that both types of mineral wool insulation are free from asbestose.

4.8.5 Transformers Oil

Oils used in the existing Tebbin plant transformers are “Diala B” type. *Table 4-15* gives main specifications of “Diala B” oil.

Table 4-15

Specifications	Measuring Method	Measurement
Specific Weight at 15.5^{o}C	ASTM D 1,298	0.8702
Kinematic Viscosity at 40^{o}C	ASTM D 445	11.2
Open Flash Point	ASTM D 92	166
Color Degree	ASTM D 1,500	5.5
Surface Viscosity, dyne/cm	ASTM D 971/60	-
Corrosion on Copper Tape	ASTM D 130	-
Humidity	13-S 148	-
Suspended Solids	ASTM D 2,273	-
Total Acidity, mg POH/gm Oil	IP 1/64	0.16
Strength of Electrical Insulation, kV/2.5 mm	IEC 156	82
Power Factor	ASTM D 924	-
Resistance	ASTM 1,169/74	-

It should be noted that none of the transformers or circuit breakers existing in the plant use BCPs.

4.8.6 Dismantling and Demolition

The CEPC Board of Directors – convened on 25th May 2005 – made resolution to approve of stopping and salvaging El-Tebbin steam power plant as of the First of July 2005 and exclude its book value from the assets record and have its capital liability & damages account deferred to the fiscal year 2005/2006 in such value provided that the preparatory works for dismantling and selling the supplies according to the certified rules in preparation of vacating the site for the commencement of the new power plant project, which consists of two steam units of 325 MWe in capacity-according to the Ministry of Electricity & Energy plan.

An advertisement has been put out in the official paper regarding selling the station supplies and pulling down the facility as scheduled on 15th – 16th June 2005.

The Board made its resolution no. (131) dated 8/6/2005 to form a sorting-out and clustering committee to be publicly auctioned with sealed envelopes no. (2006/2005/1) on the session dated 5/7/2005.

The contractors-who had bought the "Specifications Book"-made a visit to the site to examine the supplies and buildings in preparation of presenting their tenders in the auction, which has been advertised (Auction session dated 5/7/2005 at North Cairo Trading Center).

The Iron & Steel Egyptian company was contacted on 18/6/2005 to make the necessary action for removing the extended parameters holding the matter in priority as the procedures for implementing the new station had already begun. On 28th June 2005 the dismantling works for the overhead furnaces' gas line extending from the Iron & Steel company into the station-already commenced by technicians from the Iron & Steel company.

Specifications Book included 7 Items for the supplies and buildings to be dismantelled, sold or demolished. These 7 Items are given below.

First Item : Metallic Tanks

1- Zero Level

No.	Name of Type	Unit	Quantity
1.	Turbine condenser contains 4700 cupper pipe, length 5 meters, diameter 22 mm.	N	3
2.	Condensate pump 80 m^3/hour	N	6
3.	Motor condensate pump 60 kw, 380 V.	N	3
4.	Motor condensate pump 75 kw, 380 V.	N	3
5.	Oil tank for turbine with two pumps	N	3
6.	Oil cooler with filter.	N	6
7.	Air cooler generator, 360 cupper pipe.	N	12
8.	Air remover with cooler.	N	6
9.	Feed water heaters contain (7 heater with different size)	N	3
10.	Feed water pumps	N	2
11.	Steam turbine header.	N	3
12.	Filters water pump 50 m^3/hour, 5 bar	N	3
13.	Water treatment pump 10 m^3/hour, 7 bar	N	5
14.	Pump motor, 10 kw, 380 V.	N	8
15.	Potable water tank 25 m^3/hour, motor, 7kw, 380 V.	N	2
16.	Water treatment tank 3 m^3.	N	2
17.	Circuit breaker 10.5 kv	N	3
18.	Transformer generator 10.5 kv / 150 V	N	3
19.	Generator unit pay	N	3

2- Zero Level

No.	Name of Type	Unit	Quantity
1.	Circuit breaker 3.3 kv, 800 Ampere.	N	54
2.	Circuit breaker 380 V.	N	46
3.	Steel air tank 1.5 bar, $2m^3$ by basement	N	1
4.	Cupper bar	group	1
5.	Group battery 220V, 180 column X 1.2V	group	1
6.	Cables (3.3 KV power house)	group	1

3- Level 6.5 meter

No.	Name of Type	Unit	Quantity
1.	Steam turbine 15 MW.	N	3
2.	Generator 10.5 kV, 20 M.V.A.	N	3
3.	Feed pump 80 m^3/hour, 50 bar.	N	6
4.	Feed pump steam turbine, 80 m^3/hour.	N	1
5.	Motor feed pump 215 kw, 3.3 kv.	N	6
6.	Turbine indicator board.	N	4
7.	Higher crane 56/10 ton.	N	1
8.	Higher crane 3 ton.	N	1

4- Level 15 meter

No.	Name of Type	Unit	Quantity
1.	Feed water tank 40 ton	N	3
2.	Inject tank hydrazine and phosphate, $2m^3$/one	N	4
3.	Inject pump hydrazine and phosphate by motor.	N	6

- First item includes all pipes, joints, valves, equipment and all preparation inside house.
- First item includes also all cables, distribution boards which to be located limit of building, which can't be removed before coordination with handling over committee.

Second Item : Materials inside Turbine House

No.	Name of Type	Unit	Quantity
1.	Poiler (capacity 75 ton / hour)	N	4
2.	Poiler (capacity 55 ton / hour)	N	1
3.	Induced fan for turbine by motor	N	5
4.	Forest draft fan	N	5
5.	Rotary air heater	N	4
6.	Poilers stakes (height 30 meter inside and outside house).	N	5
7.	Air storing capacity 6 m^3.	N	2
8.	Fuel inject station consist (2) mazout heater and (3) fuel inject pump by motor and solar pump.	group	2
9.	Water pump by motor with different capacity.	N	3
10.	Water store with different capacity.	N	8
11.	Operating and control board for boilers	group	1
12.	Lifting equipment	N	1

- Second item includes all pipes, joints, valves, equipment and all preparation inside house.
- Second item includes also all cables, distribution boards which to be located limit of building, which can't be removed before coordination with banding over committee.

Third Item : Materials inside Turbine House

1. Basement House 66 kV

No.	Name of Type	Unit	Quantity
1	Different cables inside basement house 66 kV.	group	1

2. Zero Level

No.	Name of Type	Unit	Quantity
1.	66 kV oily switch	N	16
2.	Transformer current	N	90
3.	Connect / disconnect pay	N	18
4.	66 kv switch mechanism	N	16
5.	Battery 220 V, 180 column X 1.2 V	group	2
6.	Battery charge 380 V	N	2
7.	Air compressor pressure 21 bar	N	2
8.	D.C current pays by bars	N	8
9.	Steel air tank, 11.5 bar capacity 2 m^3.	N	2

3. Transformers

No.	Name of Type	Unit	Quantity
1.	Transformer 800 KVA / 3.3kv / 380 V	N	3
2.	Transformer 20 MVA / 10.5 kv / 66 kv	N	3
3.	Transformer 28 MVA / 10.5 kv / 66 kv	N	1
4.	Transformer 3.2 MVA / 10.5 kv / 3.3 kv	N	3
5.	Transformer 3 MVA / 66 kv / 3.3 kv	N	2
6.	Coil main transformers	N	3

4. Level 3.5 meter

No.	Name of Type	Unit	Quantity
1.	Static feeder for generator poles	N	3

5. Level 6.5 meter

No.	Name of Type	Unit	Quantity
1.	Isolating switch	N	40
2.	Earthing switch	N	12
3.	Control panel	group	1
4.	66 kV busbars, 18 pay	group	1

Fourth Item : Tasks of Water Treatment Processes

1- Clarifiers

No.	Name of Type	Unit	Quantity
1.	Electric crane (5) ton	N	2
2.	Bridge of clarifier turning with motor	N	4
3.	Tank of water treatment additives (5) m^3 with turner	N	6
4.	Compressor of filters washing	N	1
5.	Pump of washing filters (75) m^3/h with motor	N	2
6.	Pump (50) m^3/h, (6) bar with motor (380)V	N	2

2- Removal of Salts Process (2x10) m^3/h

No.	Name of Type	Unit	Quantity
1.	Steel cation tank (1.24)m^3. lined	N	2
2.	Steel anis tank (2,06)m^3. lined	N	2
3.	Tank of washing and transportation (1,2)m^3. lined	N	1
4.	Acid measuring steel tank (0,16) m^3. lined	N	1
5.	Soda measuring steel tank (0.16)m^3. lined	N	1
6.	Acid storage steel tank (5.6) m^3. lined	N	1
7.	Soda storage steel tank (5.6) m^3. lined	N	1
8.	Treatment water storage steel tank (32)m^3. lined	N	2
9.	Activation pump (6) m^3 with motor (380)V	N	2
10.	Washing and transportation pump (15) m^3 with motor (380) V	N	1
11.	Acid elevation pump (9) m^3/ h with motor (380)V	N	2
12.	Soda elevation pump (9) m^3/ h with motor (380)V	N	2
13.	Control and operation board	N	1
14.	Metallic structure for hanger	N	1

3- Salt Rem.

No.	Name of Type	Unit	Quantity
1.	Katyon laminated steel tank	N	1
2.	ANYON laminated steel tank	N	1
3.	Acid Tank capacity 15 ton	N	1
4.	Soda Tank Capacity 15 ton	N	1
5.	Treatment water laminated steel tank capacity 40 ton	N	2
6.	Gas remover tank	N	1
7.	Water pump 30 m^3/hr with motor 380V	N	2
8.	Reactivation pump with motor 380V	N	2
9.	Soda transmission pump with motor 380V	N	2
10.	Gas remover Fan with motor 380V	N	2
11.	Water lefting pump with motor 380V	N	2
12.	Air capacity, 12 bar	N	1
13.	Operation and control unit	N	1
14.	Hanger steel skeleton	N	1

The Fifth Item : Metallic Tanks

1- Normal Sollar and Mazout Tanks

A- Consumption tanks

S.N	Capacity m^3	Tank Type	Fuel Type
1	50	Sheet iron	Mazout
2	50	Sheet iron	Mazout
3	150	Sheet iron	Mazout
4	15	Sheet iron	Normal Solar

B- Shipping tank units of mazout: include (3) mazout pumps , 30 ton/H all pipis , valves among all tanks and the cables connected by mentioned equipment.

2- Special Sollar Tanks

A - Tanks

S.N	Capacity m^3	Tank Type	Fuel Type
1	4000	Sheet iron	Special Solar
2	4000	Sheet iron	Special Solar
3	400	Sheet iron	Special Solar
4	400	Sheet iron	Special Solar

B- Transportation pumps of sollar, (5) pumps and pipe line of Solar between storage tanks and consumption

3- Water Tanks

S.N	Capacity m^3	Tank Type	Number
1	50	Sheet iron	1
2	50	Sheet iron	1

- All tanks of mazout have mazout residues contain impunities and water.
- All tanks of solar have solar residues contain impunities and water
- The fifth item including all pipes, Joints, valves, equipment and all preparation.
- The fifth item including all cables distribution bounds which to be located limit of building, which can't be removed Before coordination with handing over committee.

S.N	Name of Type	Unit	Quantity
1	Cooling water pump has capacity of 4500 m3/H with motor 340 (K.W), 3.3(K.W)	N	4
2	Troubled waters pumps has capacity of 900 m3/H with motor 75.(K.W), 380 (V)	N	4
3	Baffiers washing pump has capacity of 75 m3/H water motor	N	2
4	Moving and fixed baffiers	N	4
5	Manual crane on bars	N	2
6	Transformer 500 (K.V.A), 3.3 K / 380 V	N	2
7	Key inside voltage cell 3.3 (K.V)	N	9
8	Compressor with motor	N	2
9	Electric upper crane in store house pumps	N	1
10	Valves of removal cooling water and troubled waters back solar house pumps	G	1
11	Group of control boards baffiers Gross operation	G	1

- The Sixth item including all pipes, Joints, valves equipment and all preparation inside store house.

- The fifth item including all cables distribution boards which to be located limit of Building, which can't be removed Before coordination with handing over committee.

The Seventh Item : Nonious Tasks

First : Diesel unit emergency:

S.N	Name of Type	Unit	Quantity	Notes
1	Emergency Diesel 300 (K.W)	N	2	

Second : Isolated Valves of Cooling Water

S.N	Name of Type	Unit	Quantity	Notes
1	Isolated valve of cooling water 1500 mm	N	2	
2	Insolated valve of troubled waters.	N	3	

4.8.7 Advance Preparedness

Electrical Works

The Overhead Lines:

- Insulating (4) lines (Kafr El-Elw-Helwan Cement-Iron & Steel (1)-Iron & Steel (2) on 2/6/2005).

- To postpone insulating lines (South of Tebbin (1), South of Tebbin (2), North of Es-Saff (1), North of Es-Saff (2)) as the gas-run units are still in operation.

Securing Electricity Supply for the Station & Residential Colony

- Addressing the Cairo South Electricity Distribution Company to supply the station and its residential colony from the medium-voltage grid. The following items have been undertaken:

  - On 20/6/2005 (2) Aluminium cables of 3x240 mm^2 and 300 meter in length, were extended.

- On 29/6/2005 (2) transformers with a capacity of 500 KVA each, were supplied.

- Transfer the residential city supply to be on no. (1) supplier, disconnect the supplier (2) and get the 500 KVA transformer out of the chamber to be painted and prepared at the request of Cairo electricity distribution company-Helwan branch.

- Isolate the electricity supply from the steam stations' equipment.

Taking Stock of the Valuable Supplies and Collecting Salvage at Site

- Contacting all stations to benefit from the station's warehouse stock and existing equipment and releasing all the types that had been identified by the stations-after being examined-through transfer orders (please find attached here a statement of the station/s warehouse stock movement).

- Collecting the salvage and supplies from different places at the station to be put out for sale.

- Identifying the supplies of value to the station's equipment (air compressors, oil refining machines, U.P.S), make lists of them and send them to the stations for use.

Miscellaneous Supplies (of Value) to be Displayed for the Company Sites or Transferred to Wadi Houf Stores

First: Mobile Air Compressors

	Type	Unit	Quantity
1	Air compressor with the tank in various capacities	No.	7

Second: Oil-refining Machines

	Type	Unit	Quantity
1	The new oil-refining machine for the turbines	No.	1
2	The old oil-refining machine for the turbines	No.	1
3	The oil-refining used machine for the transformers and switches	No.	1

Third: U.P.S

	Type	Unit	Quantity
1	U.P.S. devices – a source for securing supply of 3kV. A/220V	No.	7

Fourth: XLPE Cables

	Type	Unit	Quantity
1	XLPE Cables 1x50 mm^2	M	550

Sixth: The Pumps

	Type	Unit	Quantity
1	Water-processing pump a capacity of 9.6 m^3/hour with 380 volts engine	No.	2
2	Water-processing pump-a capacity of 20m^3/hour-pressure 5 B.A.R. with the engine	No.	1

The Main Workshops

- Some machines have been released by transfer orders to the 10th of Ramadan workshops.

- Some machines have been released by transfer orders to North Cairo training center.

- Coordination with the different company sites to release the machines that are of use to them, is going underway.

4.8.8 Environmental and Safety Requirements

Basic environmental protection measures have been incorporated in the “Specifications Book” for the Contractors to take necessary actions to during dismantling and demolition processes for protecting the environment and human health.

Principal environmental precautions included the following:

- The demolition contractor will be responsible for the safety of people working with him in demolition work who are under his supervision and may not use any explosives in demolition works and take all the necessary precautions for the safety of the neighboring residential areas.

- Demolishing the station’s building and taking the entire waste outside the site to designated landfill locations.

Description of works:

Demolishing & breaking the main building at the station, removing debris and taking it out to the public dumps.

The breaking and removal is carried out all the way until the top of wedges or end of surface foundations.

The contractor shall be obliged to provide all the necessary equipment, tools and machinery, which are required for demolition works and take the necessary safety for workers during work.

He also obligated to deliver the digging level clean & leveled, and no ditching work is to be made for leveling as instructed by the supervising engineer.

The contractor shall be obliged to lift and remove the remains of the unfit water-mixed fuel oil existing in tanks and Sewers.

The Refineries Area:

Demolishing and breaking the station's refineries and the debris to the public dumps taking.

The demolishing & breaking works should be carried out all the way down to the foundations of refineries or tanks.

The Nile Pumps Area:

Demolishing & breaking the buildings situated at the Nile pumps area, removing debris and taking it out to public dumps.

Demolition should be carried out all the way down to the ward ground level with no demolition debris falling into the Nile or inside the ward trenches.

The Garage, Security and Fire-extinguishing Area:

Demolishing & breaking the building in the station's garage area, removing debris and taking it out to the public dumps.

Breaking & removal works should be carried out all the way down to the foundations of the said building.

The Workshop Area:

Demolishing & breaking the workshop building, removing debris and taking it out the public dumps including bases of machines and equipment remaining at all workshop.

Breaking and demolition works should be carried out all the way down to the end of concrete foundations.

The Warehouses' Area:

Demolishing & breaking the warehouse buildings, removing debris to the public dumps including and buildings within the warehouse parameter.

Breaking and demolition all the way down to the end of concrete foundations.

5. DESCRIPTION OF THE ENVIRONMENT

5.1 GENERAL SETTING OF THE SITE

The Tebbin site is located within an existing walled compound of the former Tebbin power plant. It is situated on a 10 hectare wedge-shaped piece of land located in an industrial area characterized by many heavy industries. On the north side of the site is the power plant's residential colony, followed by Maadi/Helwan highway. Across this highway is the Tebbin Institute for Metallurgical Studies and the Tebbin water treatment station. On the south side of the site is the Coke Factory surrounded by a wide industrial area comprising, among others, iron and steel products, sandy bricks factory, concrete bricks factory, clay bricks factory, fertilizers factory and welding factory. The east side of the site is occupied by the first Iron & Steel Heavy Industry established in Egypt by late fifties, which gave the area its industrial character since around half century. Actually, the Tebbin old power plant was originally built at that location for benefiting of the hot flue gases exhausted from the Iron & Steel factory as a heat recovery facility for power generation. Next to this factory is Tebbin and Helwan substations bounded from the north by El-Qawmiyyah cement factory and from the east by a wide flat desert. On the west side of the site, immediately parallel to the western fence from outside, runs a small-narrow waterway for land irrigation called El-Khashab canal followed, to the west, by a two lane, two direction Cairo/Es-Saff Road. Across this road is a flat longitudinal land of a width ranges between 200 and 300 m along the east bankline of the Nile river, where the existing power plant's intak and discharge structures for cooling water circulation are located. To the south of the intake structure is an industrial compound including facilities of the General Company for Metals, the Petroleum Pipelines Company and the Central Workshops of Tebbin Transport. On the north side of this strip of land is a residential spot, called El-Tebbin village, developed mostly by workers of the Tebbin industries. The road on the west side of the site is congested with traffic. The general site location is shown in *Figure 5-1, A, B & C (*Landsat image of the Greater Cairo Region).

The site consists of flat land, which is owned by the Cairo Electricity Production Company (CEPC), approximately 97,500 m^2, within a total allocated area of 276,000 m^2 wedge-shaped piece of land including the land area required for building the power plant. Localized map of the proposed site is shown in *Figure 5-2*.

The site is located some 35 km southeast of Cairo. The site is delimite by Latitude: 29^o 46 N and Longitude 31^o 17 E and the elevation is about 22 m above sea level.

The land is identified by boundary lines determined by the coordinates of the proposed site, given in *Figure 5-3*, which indicates the following corner points:

East	North

BM-01	643509.794	784986.276
BM-02	643632.006	784978.859
BM-03	643743.572	784973.333
BM-04	643749.919	785187.479
BM-05	643754.195	785316.044
BM-06	643588.326	785324.859
BM-07	643435.160	785328.339
BM-08	643474.745	785172.431
BM-09	643366.427	785099.022
BM-10	643195.511	785101.191
BM-11	643258.221	785117.483
BM-12	643497.196	785332.883
BM-13	643633.370	785329.734
BM-14	643652.298	785480.698
BM-15	643665.032	785549.595
BM-16	643481.364	785556.832
BM-17	643419.119	785334.529
BM-18	643641.227	785555.149

The employee housing area consists of villas and apartment buildings. A school within an uncultived plot of land follows apartment buildings and ended by Maadi/Helwan Highway.

Topographically, the area generally has a gentle slope ranging in elevation from 22m to about 25m above sea level on the Nile flood plain (cultivated and urban areas) while the maximum elevation ranges from 600 m at the highest waterdivide to about 100m. The surface of the study area is highly affected by fault system oriented mainly NW-SE. It results in a number of elongated parallel and dissected cuestas and some isolated hills. Five main highs are formed on one line trending NW-SE, which is the same trend of the fault system in the area (see topographic map *Figure 5-7 (A)*). These highs from southeast to northwest are: G. El-Hai (530m), G. El-Maskhara (474 m), El-Halawana High (259 m), El-Qurna High (229 m) and G. Hof (314 m).

The project area lies within the hyperarid climatic province of Egypt characterized by a mild winter and hot summer. Assuming equilibrium with average air temperature at Cairo, the river water at Tebbin is estimated to have an average high temperature of 29^{o}C (84^{o}F) in July and August, and an average low temperature of 14^{o}C (57^{o}F) in January and February.

Land cover on the site consists primarily of bare sand, with scattered low-growing vegetation. Only the northern part of the power plant site is characterized by dense vegetation coverage, despite the fact that it is located in a heavily industrialized location (see *Figure 5-4*). Plant species in the plant area consists of two groups: first includes some very common wild Egyptian flora that colonizes neglected areas inside and outside the power plant, the second includes cultivable trees and shrubs whose life spans extend to at least 20-40 yeas. The most important trees inside the powe plant area are: *Bombax sp., Pinus sp.,* and *Washingtonia sp.* These trees are considered a historic treasure that will be preserved as part of the renovation plan of the Tebbin power plant.

The main transport infrastructure links the Cairo South area to the country main ports facilities is principally based on road network. The site is accessible through, at least, nine main highways; out of which, most importantly: Cairo-Alexandria desert road, Cairo-Alexandria agricultural road, Cairo-Damietta road, Cairo-Ismailia -Arish road, Cairo-Ismailia-Port Said road, the Maadi-Helwan-Ain El Sukhna highway and Cairo-Suez highway. The road network is supplemented by rail systems to the north of the site.

The site is located within a totally urban/urbanized landscape with heavy industrial and infrastructure facilities (see *Figure 5-5*) such as Iron & Steel and cement industries in the Tebbin and Helwan area and the fresh water treatment facility to the north direction of the power plant site.

There are no significant habitats within the project's area of influence. Vegetation, an important ecological indicator, is found far from this area although some small patches may be present. The only and most important ecological feature is the Nile river that runs as a corridor to the west of the project site.

Accordingly, similar to most urban areas around the globe, the project area appears to have little ecological significance and low biodiversity due to the immense alteration of the natural ecology. Such areas are considered a man-made environ. In these areas only those plants and animals that tolerate urban pressures and that can live close to man are found.

No archaeological resources are known in this zone. Local archaeological authorities have been consulted, where they confirmed that the whole area around the site proved that no historic resources exist.

The water resources in the project area are mainly: the surface water supply which is provided from the Nile river at a distance of about 200m west of the station site, and the ground water in Nile Valley aquifer system which is composed of sands and gravels with interbeds of clay lenses. According to the hydrological map of Cairo, Scale 1:100,000 (RGW, 1989) the main water bearing formation consists of Quaternary graded sand and gravel. The recharge to the ground water aquifer is usually seepage from the Nile. The aquifer is highly productive and the water level ranges from 16m to 20m. The Total Dissolved Solid (TDS) values range between 1000 and 2000 ppm.

The proposed site lies within the administrative boundary of the Cairo Governorate. The Cairo Governorate has produced its Long Range Urban Development Master Scheme for the Greater Cairo Region for implementation assessment and updating proposals (May 1997) within the framework of the

National Urban Policy. This document represents a necessary evaluation in order to propose adaptation or modification, that present situation and foreseeable evaluation could demand. It analyzes recent urban evaluations in Greater Cairo as regards Master Scheme objectives & strategy and provides recommendations for possible modification of Greater Cairo Master Scheme and for better efficiency in day-to-day implementation. New development plan is published in the investment map of Egypt setting out proposals up to the year 2017. Greater Cairo Region Master Scheme, 2000 update is shown in *Figure 5-6*. Both of the ivestment map of Egypt and the Greater Cairo Region Master Scheme, 2000 update designate Tebbin and Helwan area for industrial activities.

Figure 5-1(A)

Location Map of the Proposed Site within the Egyptian Context

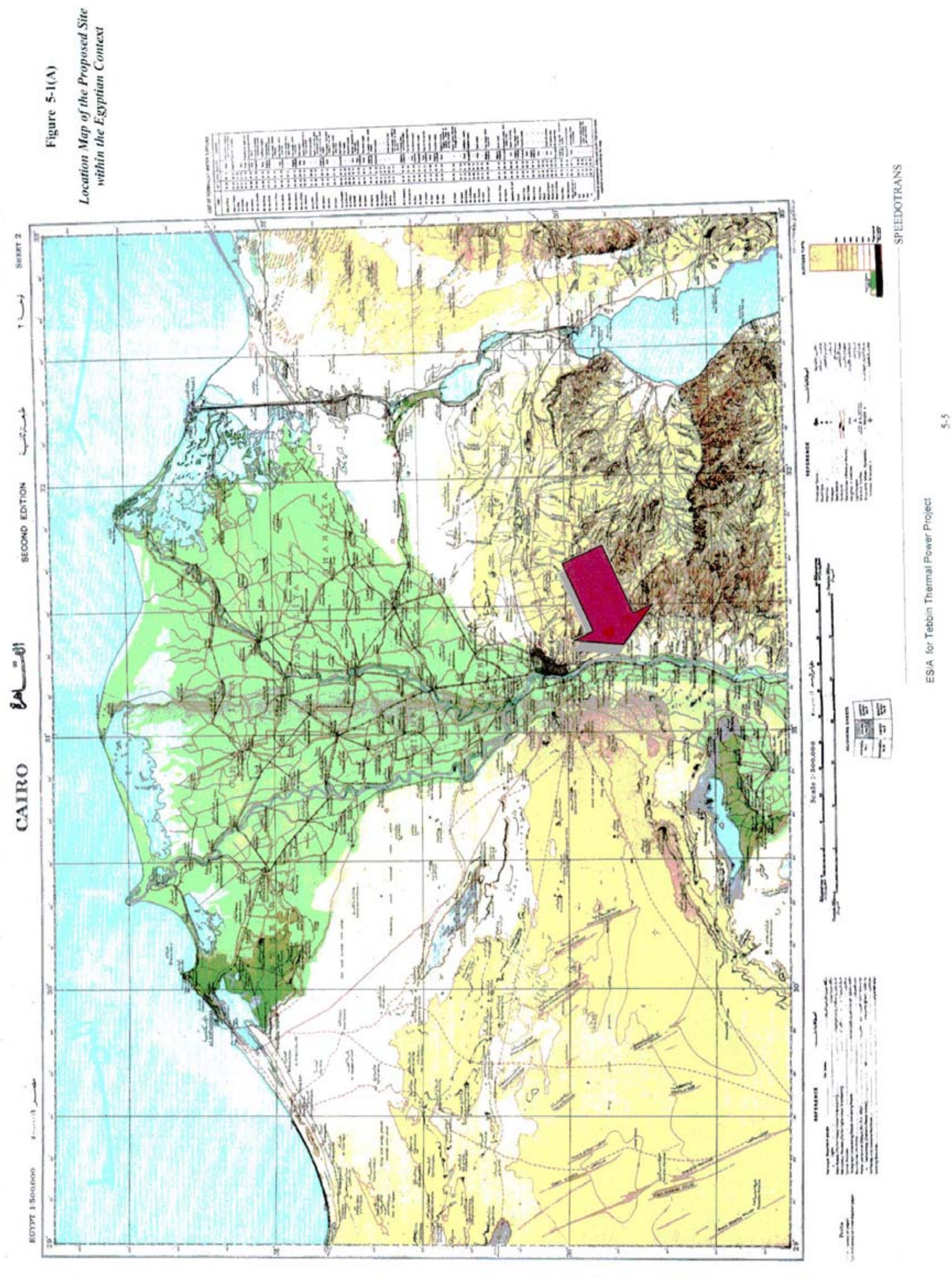
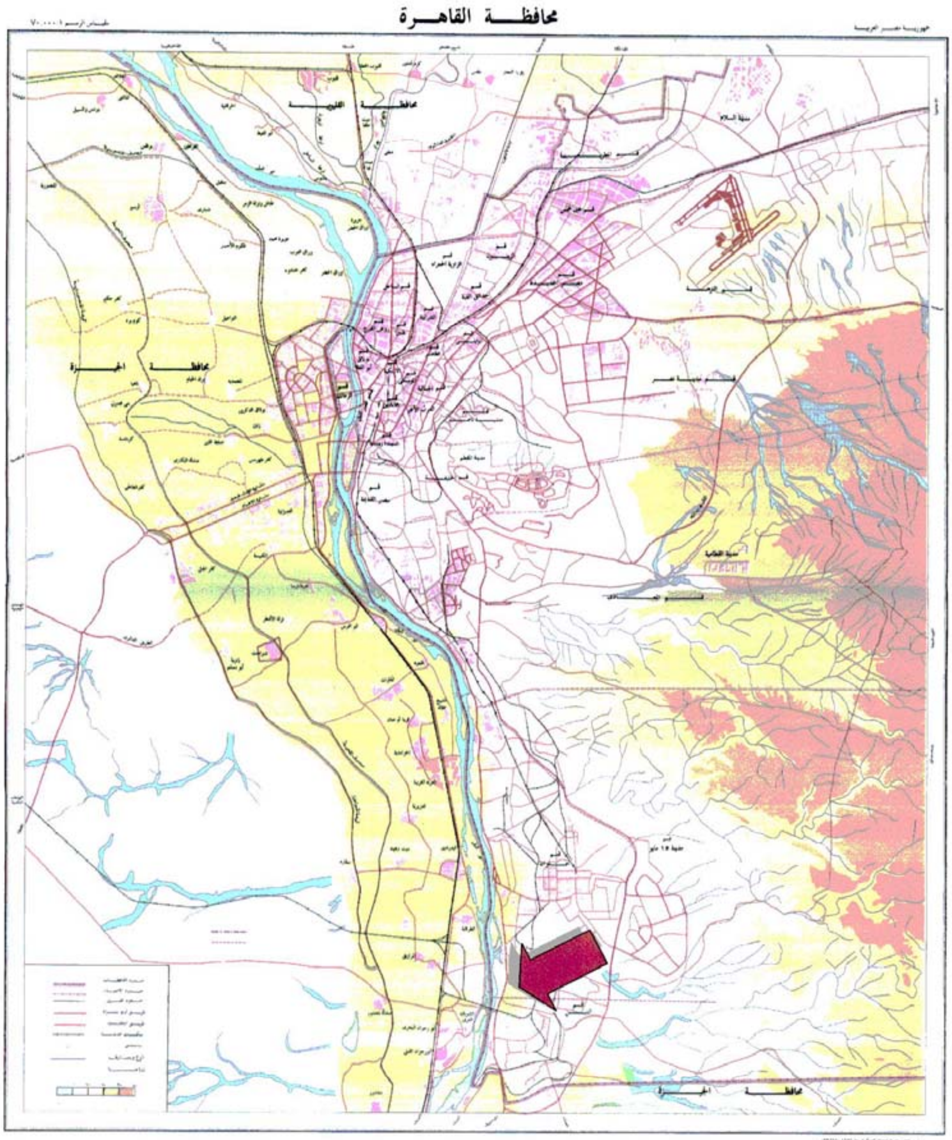


Figure 5-1 (B)

Location Map of the Proposed Site
within the Cairo Governorate Context



ESIA for Tebbin Thermal Power Project
5-6
SPEEDOTRANS
Figure 5-1 (B)
Location Map of the Proposed Site
within the Cairo Governorate Context

Figure 5-1 (C)

Landsat Image (ETM 2001) of Greater Cairo Showing the Proposed Site of the Tebbin Power Plant

Figure 5-2

Localized Map of the Proposed Site

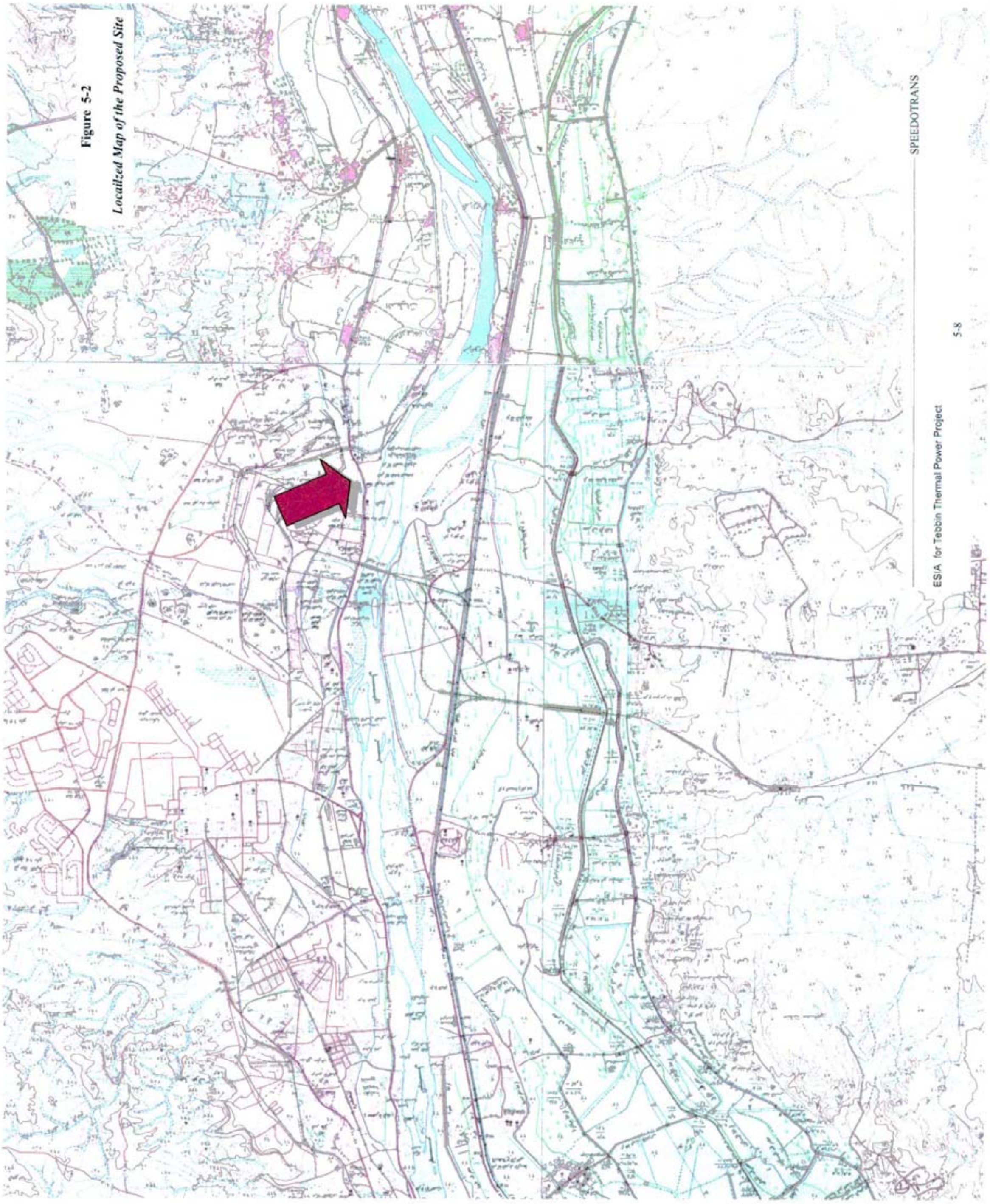


Figure 5-3

General Layout of El-Tebbin Power Plant with Locations of Permanent Control Points

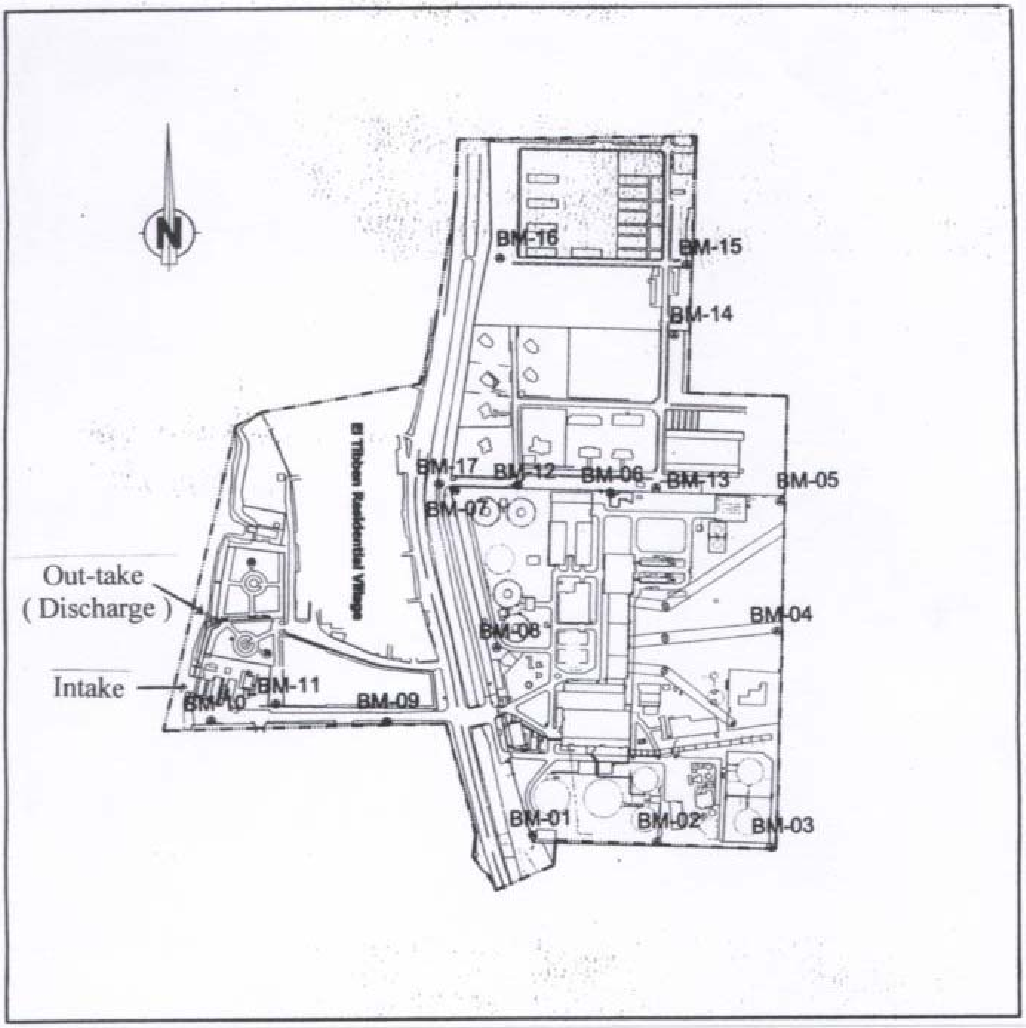
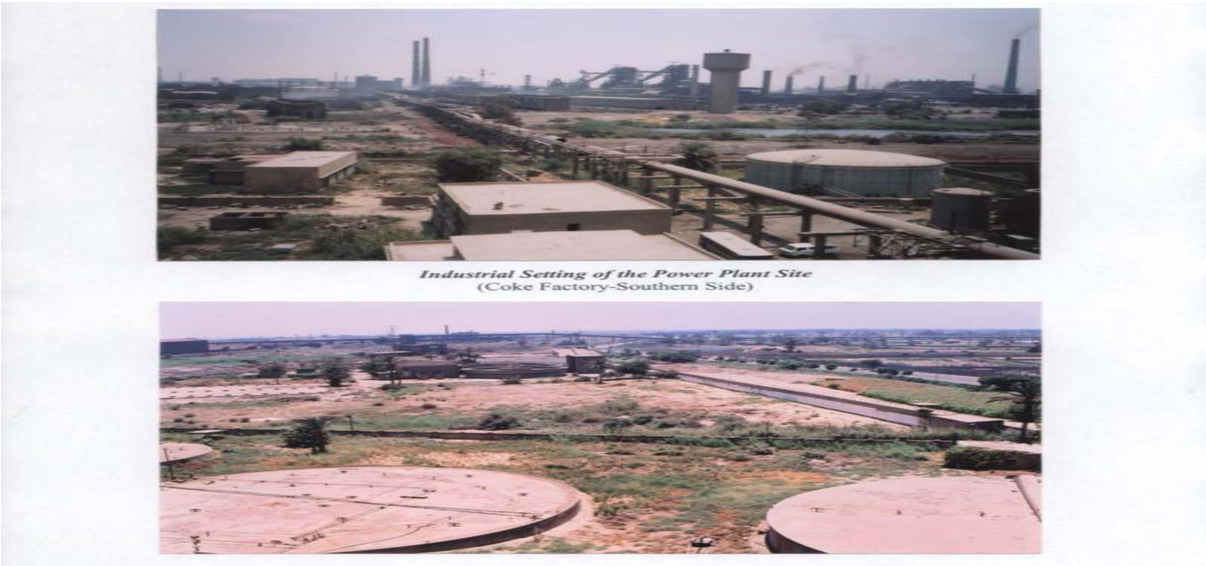


Figure 5-4

Dense Vegetation Coverage in the Northern Part of the Power Plant Site

Figure 5-5

Industrial Setteing of the Power Plant Site
(Iron & Steel Factory-Eastern Side)



Industrial Setting of the Power Plant Site
(Coke Factory-Southern Side)

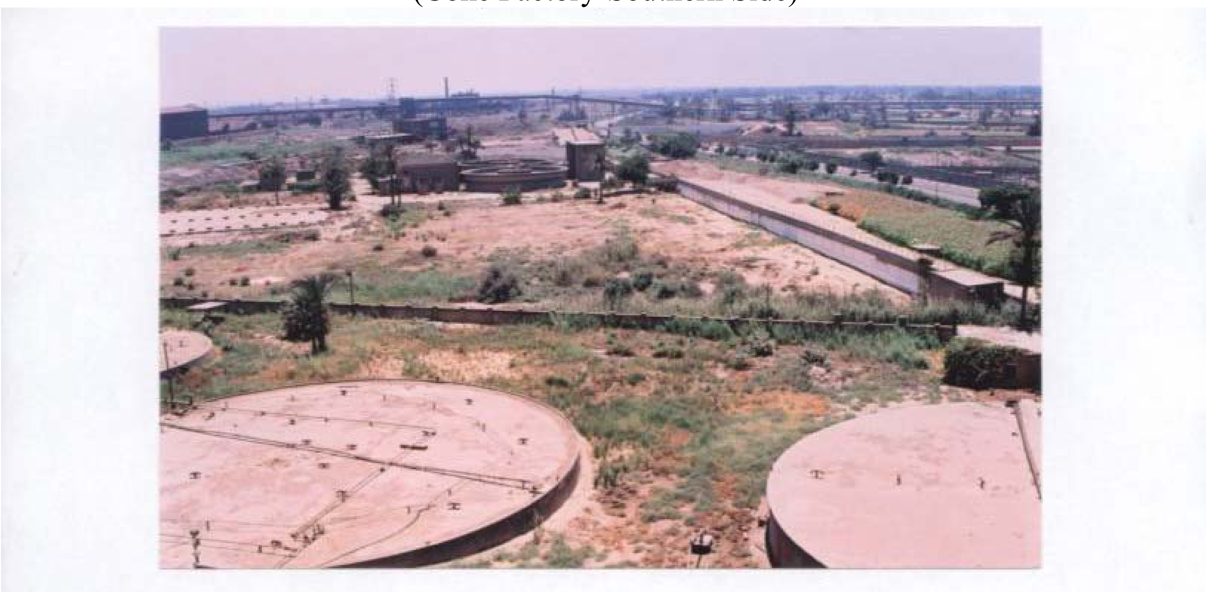
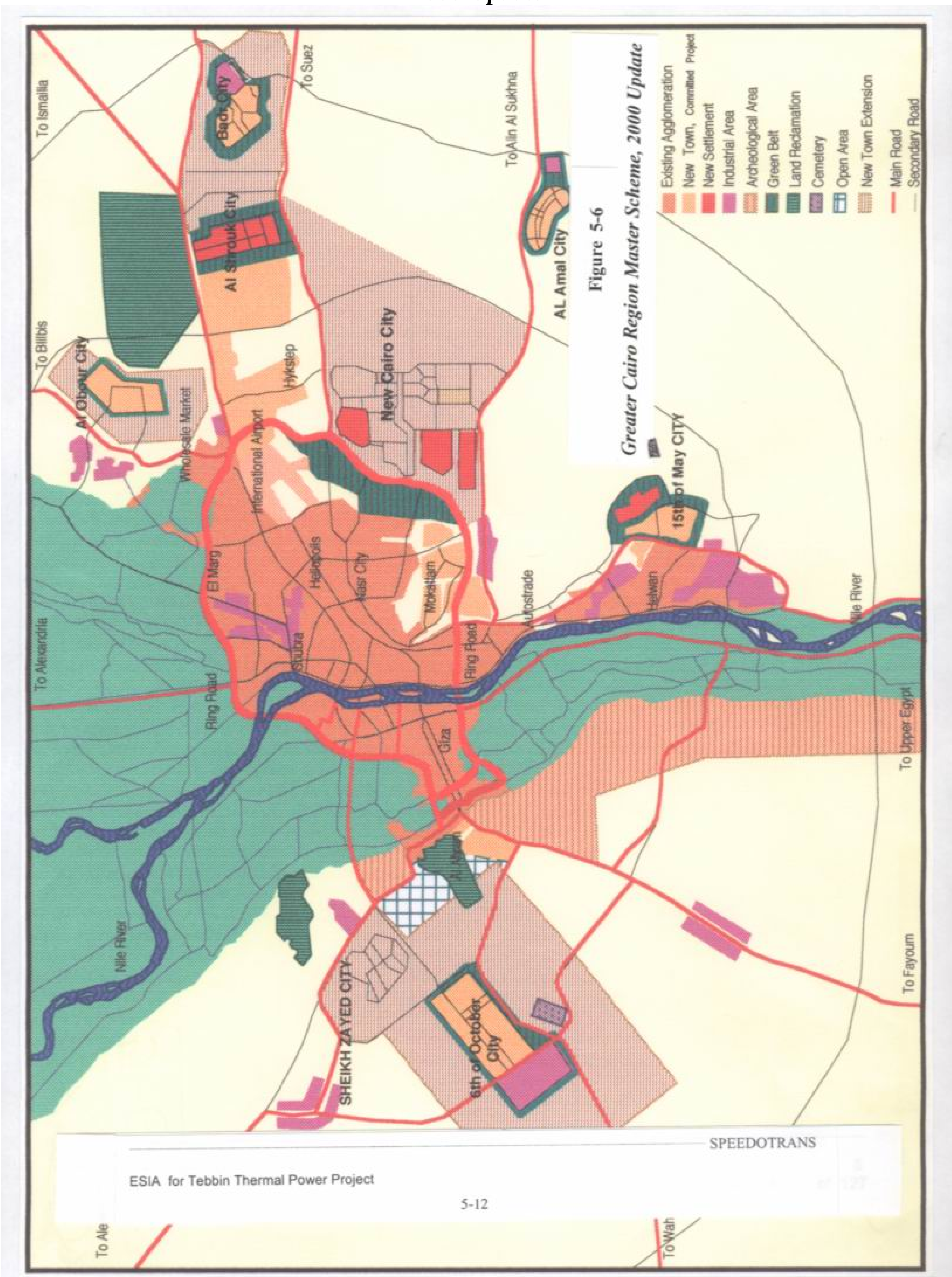


Figure 5-6

Greater Cairo Region Master Scheme, 2000 Update



5.2 SOILS, GEOLOGY, HYDROGEOLOGY, TOPOGRAPHY AND SEISMICITY

5.2.1 Introduction

Information on soils, geology, hydrogeology and topography was obtained from the following sources:

- review of the 1:50,000 scale and 1:500,000 scale as well as both 1:25,000 scale and 1:5000 scale Geological and Geographical Maps; produced by the Egyptian Military Survey Authority and the Egyptian Geological Survey and Mining Authority (EGSMA);

- discussions with the Department of Natural Sciences, College of Sciences and the Institute of Environmental Studies and Research, Ain Shams University;

- discussions with the National Authority for Remote Sensing and Space Sciences, State Ministry of Scientific Research and Technology;

- review of the Hydrogeological Map of Egypt;

- observations made during the site visits, by SPEEDOTRANS and their sub-Consultants in July 2005;

- "Topographic Survey Report of the Existing Power Plant and the Residential Colony", prepared by "Zone Engineering and Survey" Company and PGESCo for the Cairo Elecctricity Production Company (CEPC), 13 July, 2005;

- Baseline Study on the "Geological, Geomorphological and Geohydrological Study for the Site of the Proposed El-Tebbin 2x325 MWe Power Project", conducted by "Enviro-Pro", July 2005.

The general topography of the area is shown in *Figures 5-7 (A) & (B)* and site specific survey is shown in *Figure 5-8.*

Figure 5-7 (A)

General Topography of the Project Area

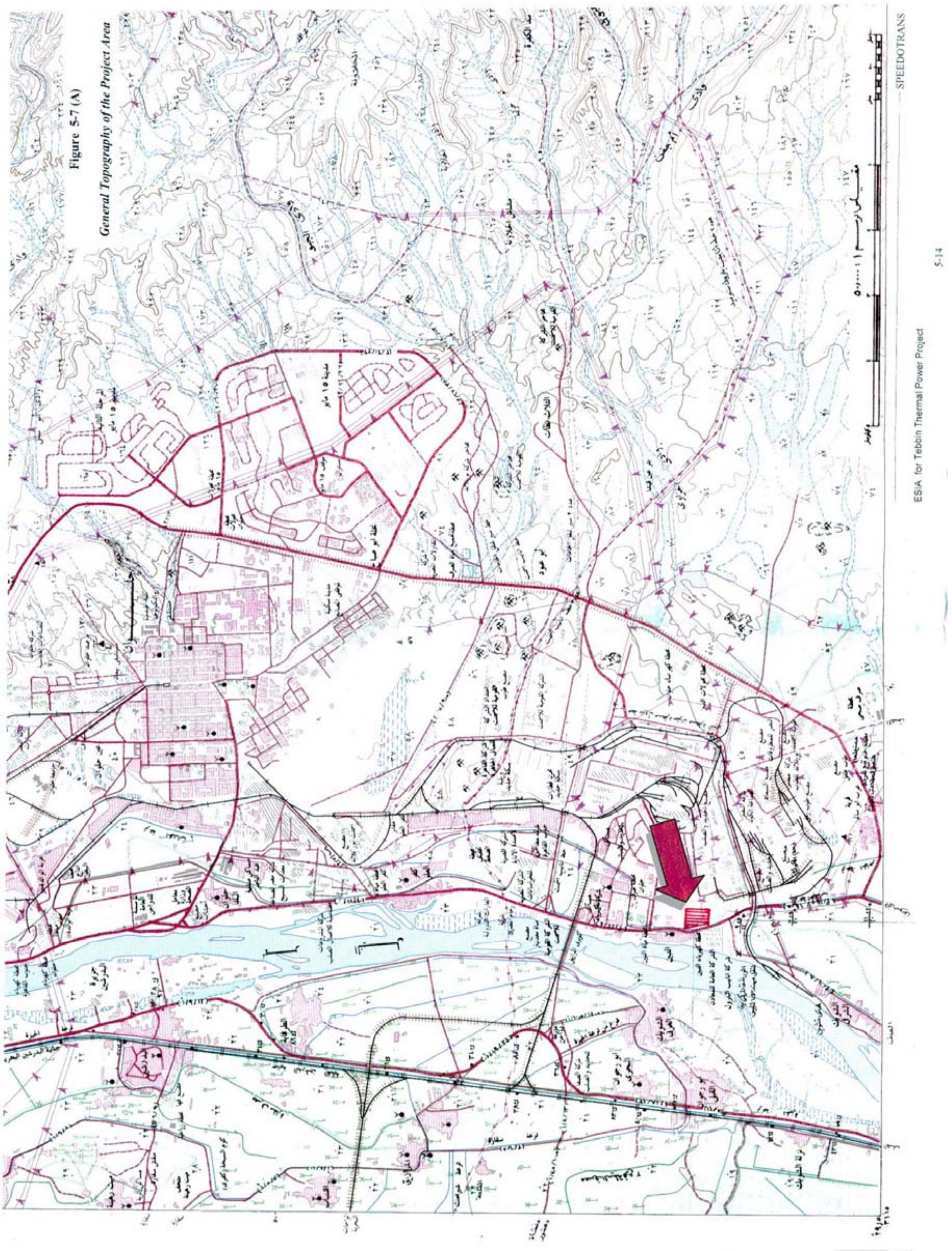


Figure 5-7 (B)

General Topography of the Project Area

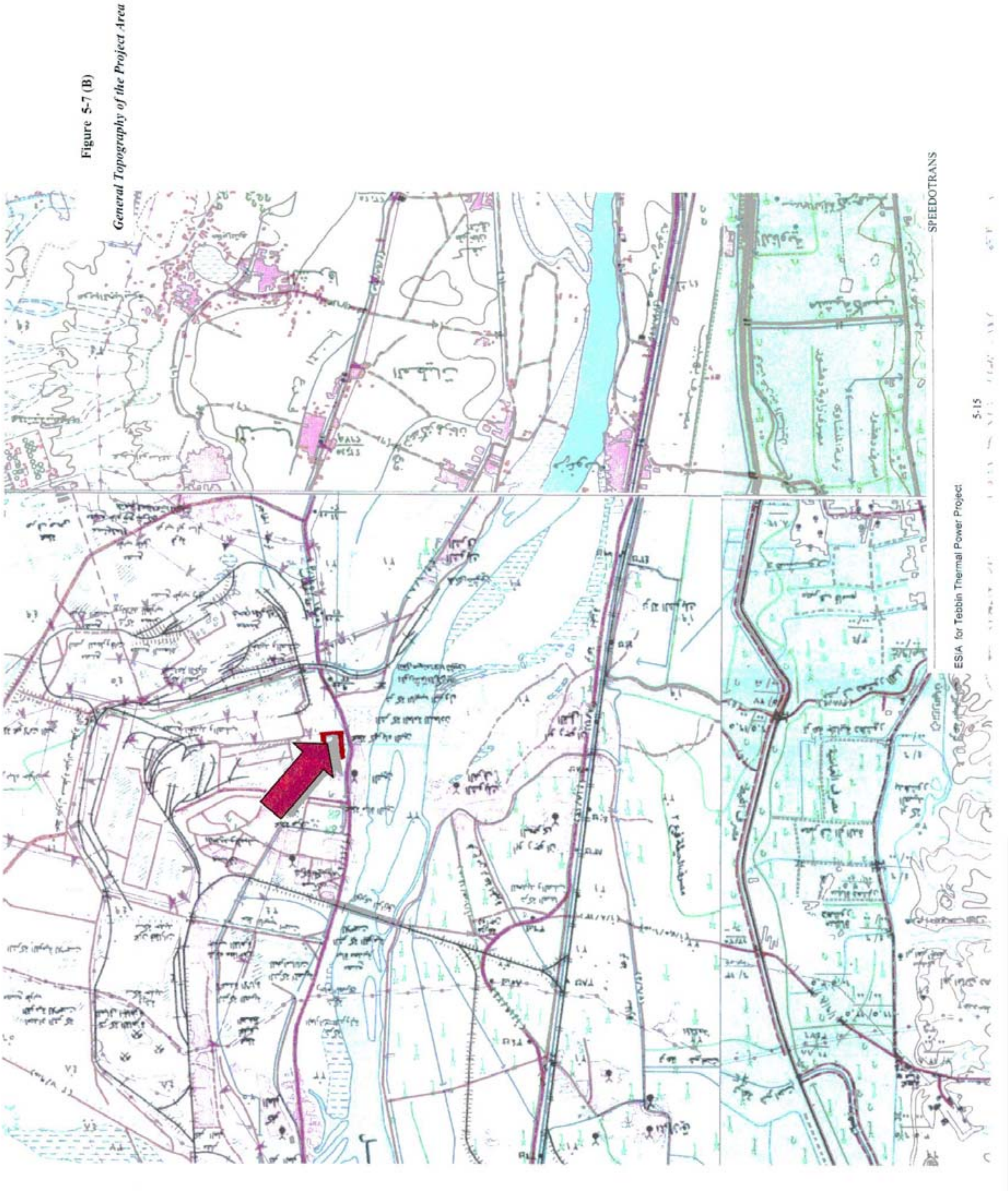
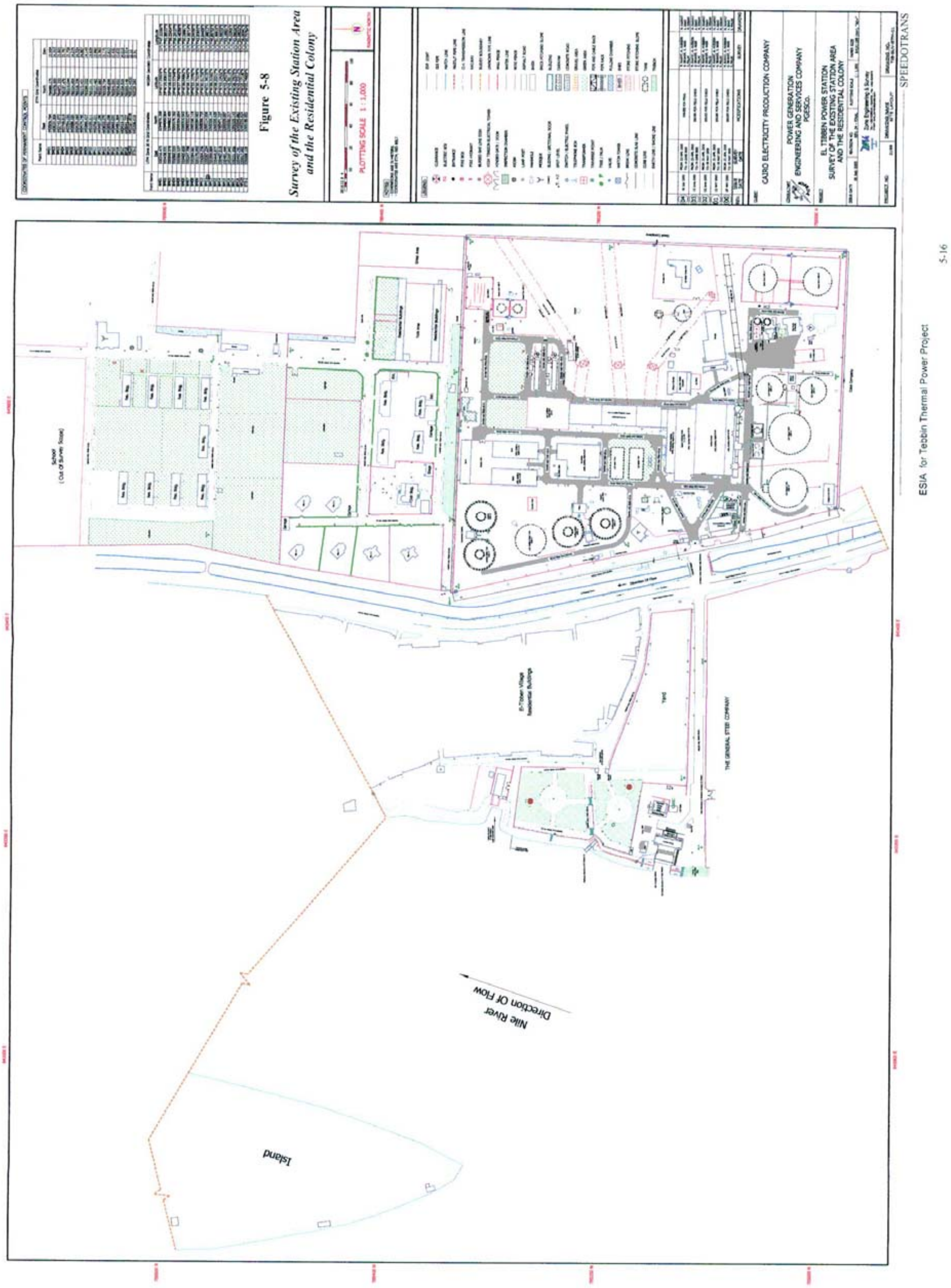


Figure 5-8

Survey of the Existing Station Area and the Residential Colony



5.2.2 General Physiography

The Greater Cairo covers an area of 357.5 square km, delimited by latitudes 29° 40´ - 30° 10´ N and longitudes 31° 00´ - 31° 40´ E. It includes the Governorates of Cairo, Giza and the southern part of Kalyobiah. Greater Cairo is divided into four administrative sectors: North Cairo, South Cairo, East Cairo and West Cairo.

The project area occurs in a part of the highly industrialized land along the eastern margin of the Nile river. It lies at the southern side of the Cairo Governorate which includes the iron and steel industry, the first of its kind created in Egypt since late 1950s. The eastern fringe is demarcated by Estern Desert.

5.2.3 Topography

Topographically, the area generally has a gentle slope ranging in elevation from 22 m to about 25 m above sea level on the Nile flood plain (cultivated and urban areas) while the maximum elevation ranges from 600 m at the highest waterdivide to about 100m.

The surface of the study area is highly affected by fault system oriented mainly NW-SE. It results in a number of elongated parallel and dissected cuestas and some isolated hills.

Five main highs are formed on one line trending NW - SE, which is the same trend of the fault system in the area (*Figure 5-7*). These highs from southeast to northwest are : G. El-Hai (530m) , G. El-Maskhara (474m) , El-Halawana High (259m) , El-Qurna Heigh (229m) and G. Hof (314m).

5.2.4 Geomorphology

The area is characterize by the following main geomorphic units :

**** Nile Alluvial Plain:***

It is a flat narrow strip parallel to the Nile Valley. The width varies from o.5 km to 1.5 km. It consists of Nile silt and having an elevation varies from 22 m to 25 m above sea level.

**** Terraces:***

It forms an undulating surface in the form of isolated patches covered with gravel sheet. It consists of marl and sandy marl. The surface is highly exploited by many gravel quarries.

**** Lower Pediment:***

It is located between contour line 50 m.a.s.l. and contour line 100 m.a.s.l. The surface is gradually sloping and decreases from east to west. It is made of thick limestone sequence of the Middle Eocene Mokattam Formation. Generally, the pediment is occupied by the construction of many factories (Cement, Iron and Steel and others. The limestone pediment is heavily exploited for these industries.

The lower pediment is dissected by tributaries of many wadis such as Wadi Garawi, Wadi Hof, Wadi Degla and others.

**** Upper Pediment:***

The Upper Pediment runs in a northwest–southeast direction parallel to the main scarp which is mainly controlled by faulting system. It covers the area between contour lines 100 m. a.s.l. and 200 m. a.s.l. It consists mainly of limestone, marly limestone and marl.

**** Retreated Scarp:***

It ranges in elevation from a maximum of 6oo m.a.s.l. on the highest waterdivide to about 200m.a.s.l. The surface is highly affected by a fault system oriented mainly NW-SE. It results in a number of elongated, parallel and dissected cuestas and some isolated hills.

**** Drainage System:***

The area is dissected by a number of seven main drainage lines (wadis) and heir basins as the following:

1. Wadi Degla Basin: area 196.4 km^2.
2. Wadi Hof Basin: area 120.04 km^2.
3. Wadi Gabow Basin: area 94.96 km^2.
4. Wadi Garawi Basin: area 322.56 km^2.
5. Wadi El-Agel Basin: area 4.64 km^2.
6. Wadi Abu-Selly Basin: area 9 km^2.
7. Wadi Abu-Selly Basin: area 14.6 km^2.

5.2.5 Geological Setting

The present geological studies resulted in establishing the stratigraphical setting of the sedimentary sequence in the area under consideration and the structural elements that affected the area during the geologic history.

The stratigraphic (lithological) units

The stratigraphic sequences fall in the study area ranges in age from Eocene to the Quaternary. In the following a brief description will given *(Figure 5-9)*.

- Middle Eocene Rock Units:

The Mokattam Group in its south and southeastern part at Helwan area interfingers with Helwan Facies of Middle Eocene. It consists of the following two formations from older to younger.

<u>Gebel Hof Formation:</u>

It is exposed at the base of Gebel Hof and extends northwards to Gebel Toura and exposed at Wadi Hof .The maximum thickness is about 120m as recorded by Farag and Ismail (1959) in Gebel Hof . Who, subdivided the formation into two rock units as follows:

TOP:

Two Nummulitic gizehensis bed. It consists of about 42m of grayish white, slightly chalky, highly fossiliferous with <u>*Nummulites*</u> sp, <u>*Turrietella*</u> sp., <u>*Natica*</u> longa, Cerithium la cheris, The upper 79m is made up of white to yellowish white marly limestone.

One poorly fossiliferous limestone with intercalations of some white chalky and marly limestone with <u>*Lucina*</u> sp. *(Figure 5-10)*.

BASE:

<u>Observatory Formation:</u>

Forming the topmost part of the Middle Eocene section and cover the north and northeastern part and south of Helwan area. It consists of about 77m of white to yellowish white, marly and chalky limestone intercalated with hard, grey dolomitit limestone bands. fossiliferous with <u>*Nummulits*</u> sp, Ostrea elegans, <u>*Pecten*</u> sp, <u>*Lucina*</u> mokattamensis and others *(Figure 5-11)*.

- Upper Eocene:

The Upper Eocene Maadi Group is subdivided into the following three formations from base to top:
Qurn Formation: It consists of about 70m of highly fossiliferous limestone, chalky, white with marl interbeds at the middle part.

Figure 5-9

Geological Map of the Study Area
(Scale 1:100,000 – After Sweden, 1990)

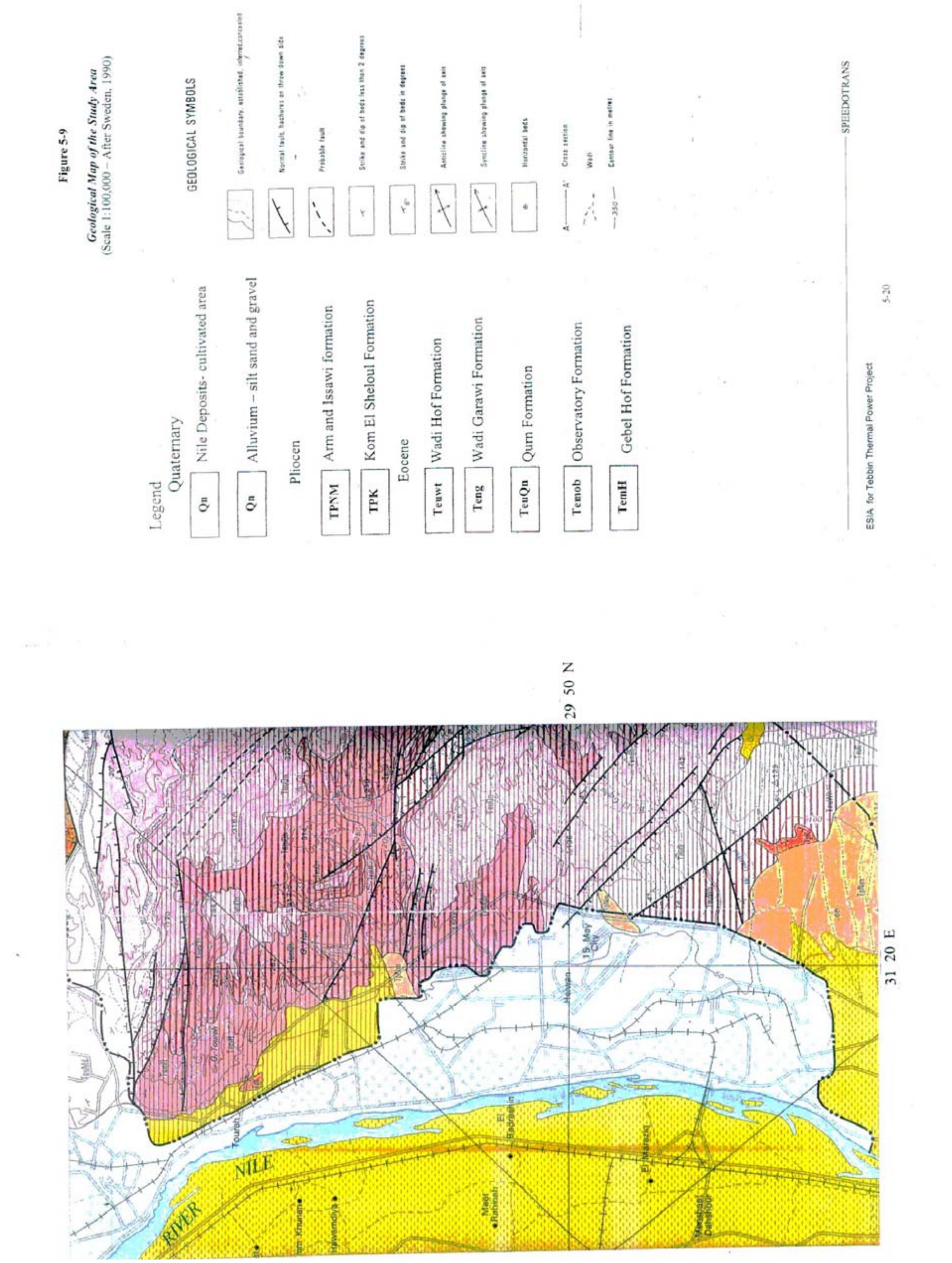


Figure 5-10

Limestone Bedrock of Mokattam Group (Gebel Hof Formation)

Figure 5-11

Gebel Hof Formation Overlain by the Observatory Formation

- Wadi Garawi Formation: It is formed of limestone, marls and shales which represents the topmost part of the carbonate section of the Upper Eocene. The thickness is about 44m.
- Wadi Hof Formation: It represents the clastic section of the Upper Eocene. It consists of about 22m of sands, fossiliferous calcareous sandstone and clays. The southern outcrops of Wadi Hof formation were traced south of Wadi Garawi. The maximum thickness is 50m.

Pliocene Kom El-Shellul Formation:

The marine Pliocene section is represented by about 2-5 m of yellowish brown, gritty calcareous sandstone with Pectin sp. The section was described under the term Kom El-Shellul Formation which is well exposed to the south of Wadi Garawi.

Armant and Issawia Formation:

It is made up of alternating beds of locally derived gravels from Eocene limestone cemented by fine to coarse grain sandstone. The section is friable, yellowish to brownish white colors and extended northward and southward along the Nile Valley in the form of small patchy gravel sheets. The formation was first described by Said (1975) and the age was assigned to the early Pleistocene.

Quaternary Wadi Deposists:

It forms the floor of the wadis which drains to the Nile. It consists of gravels and boulders from limestone, dolomite and rare chert materials derived from the local rock units.

Recent Nile Sediments:

It covers all the area within the Nile Valley as well as the cultivated lands. It is made up of silt and clay with sand interbeds. This is the most fertile cultivated soil.

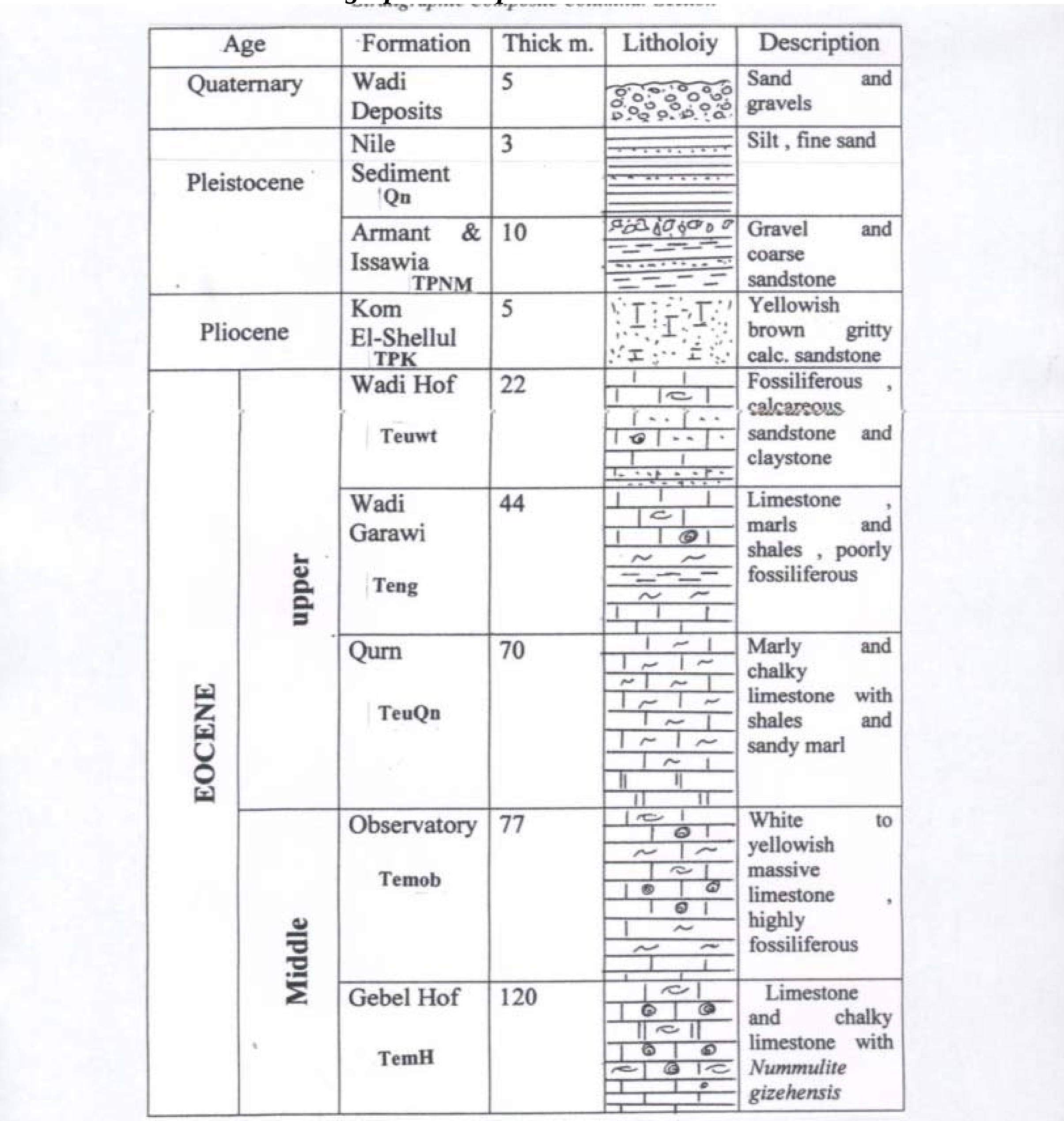
The stratigraphic sequence with a brief lithology of these formations is summarized in *Figure 5-12.*

Structure

Structurally, the area is affected by a number of fractures and normal faults, striking in two main trends in the NW-SE and ENE-WSW directions *Figures 5-13* and *5-14.*

Figure 5-12

Stratigraphic Composite Columnar Section



Age		Formation	Thick m.	Litholoiy	Description
Quaternary		Wadi Deposits	5		Sand and gravels
Pleistocene		Nile Sediment Qn	3		Silt , fine sand
		Armant & Issawia TPNM	10		Gravel and coarse sandstone
Pliocene		Kom El-Shellul TPK	5		Yellowish brown gritty calc. sandstone
EOCENE	upper	Wadi Hof Teuwt	22		Fossiliferous , calcareous sandstone and claystone
		Wadi Garawi Teng	44		Limestone , marls and shales , poorly fossiliferous
		Qurn TeuQn	70		Marly and chalky limestone with shales and sandy marl
	Middle	Observatory Temob	77		White to yellowish massive limestone , highly fossiliferous
		Gebel Hof TemH	120		Limestone and chalky limestone with *Nummulite gizehensis*

Figure 5-13

Fracture Map of the Study Area Based on the Landsat TM image, 1:65,000 and Aerial photographs, 1:40,000 scale

(Italic numerals from 1 through 6 are the locations from which the underground water ensues)

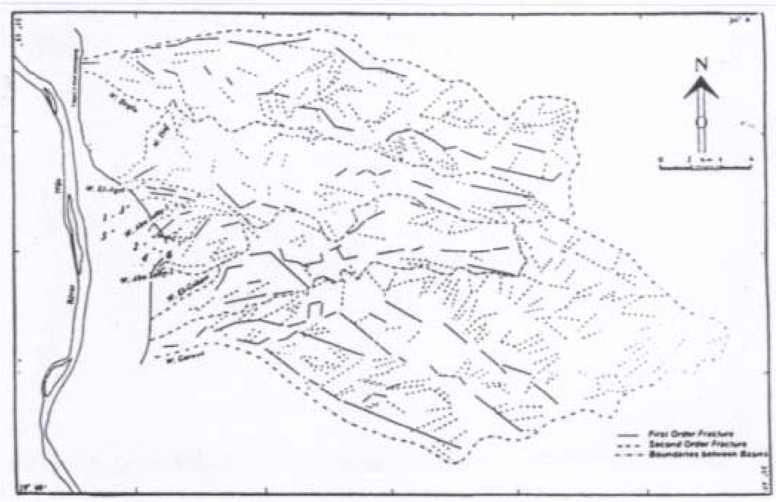
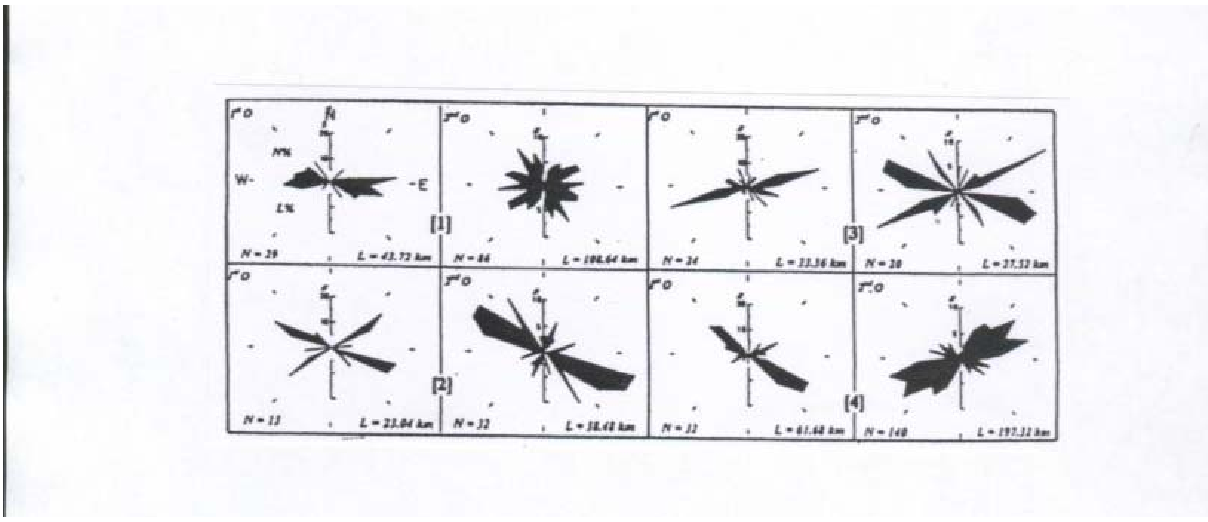


Figure 5-14

Rose Diagrams of the Number Percent and Length Percent of the First and Second Order Fractures for the Four Large Basins of the Study Area (Wadis: Degla (1), Hof (2), El-Gabow (3), and Garawi (4))

(Designations: 1st O: first order 2nd O: Second order, N: Numbers of streams, L: Lengths of Streams)



As far the northern part of Egypt is situated on the unstable shelf as described by Said (1962), the study area was affected mainly by the following faulting and folding patterns:

* Faulting: The area was affected mainly by two system of faulting:
Erytherian trend which extend in a N55°W direction. It is mostly affecting the Eocene limestone plateau. This trend is the younger which affected the older (NE) trend.
Tethyan trend having an E-W direction. It affects the northern part of Gebel Mokattam, Cairo Suez road and Gebel Hof.
Generally, all the faults are of normal gravity type

* Folding System: No folds are visible at the area under consideration. The only folds is seen north and south of Gebel Yahmoum El Asmr and near the Maddi-Kattamiya Road where the fold axis trends in NW-SE direction.

5.2.6 Mineral Resources

The area is mainly rich in the building stone materials as limestone, dolomite, gravels and clay. Clay materials of different geological formations are quarried at El-Tibbin, Helwan and Tourra for cement industry for the construction purposes. The limestone are quarried also for the iron and steel, cock and cement industries.

5.2.7 Water Resources

The water resources in the project area are mainly:

Surface Water

The surface water supply is provided by the Nile river at a distance of about 200m-300m west of the power plant site.

Ground Water

The main source of ground water is Nile Valley aquifer system which is composed of sands and gravels with interbeds of clay lenses. According to the hydrological map of Cairo, Scale 1:100,000 (RGW,1989) the main water bearing formation consists of Quaternary graded sand and gravel. The recharge to the ground water aquifer is usually seepage from the Nile. The aquifer is highly productive and the water level ranges from 16m. to 20m. The Total Dissolved Solid (TDS) values range from 1000 to 2000 ppm. *(Figure 5-15)*.

Figure 5-15

Hydrogeological Map of the Study Area, Including the Proposed Power Plant Site
(after RIGW, 1997-Scale: 1:100,000)

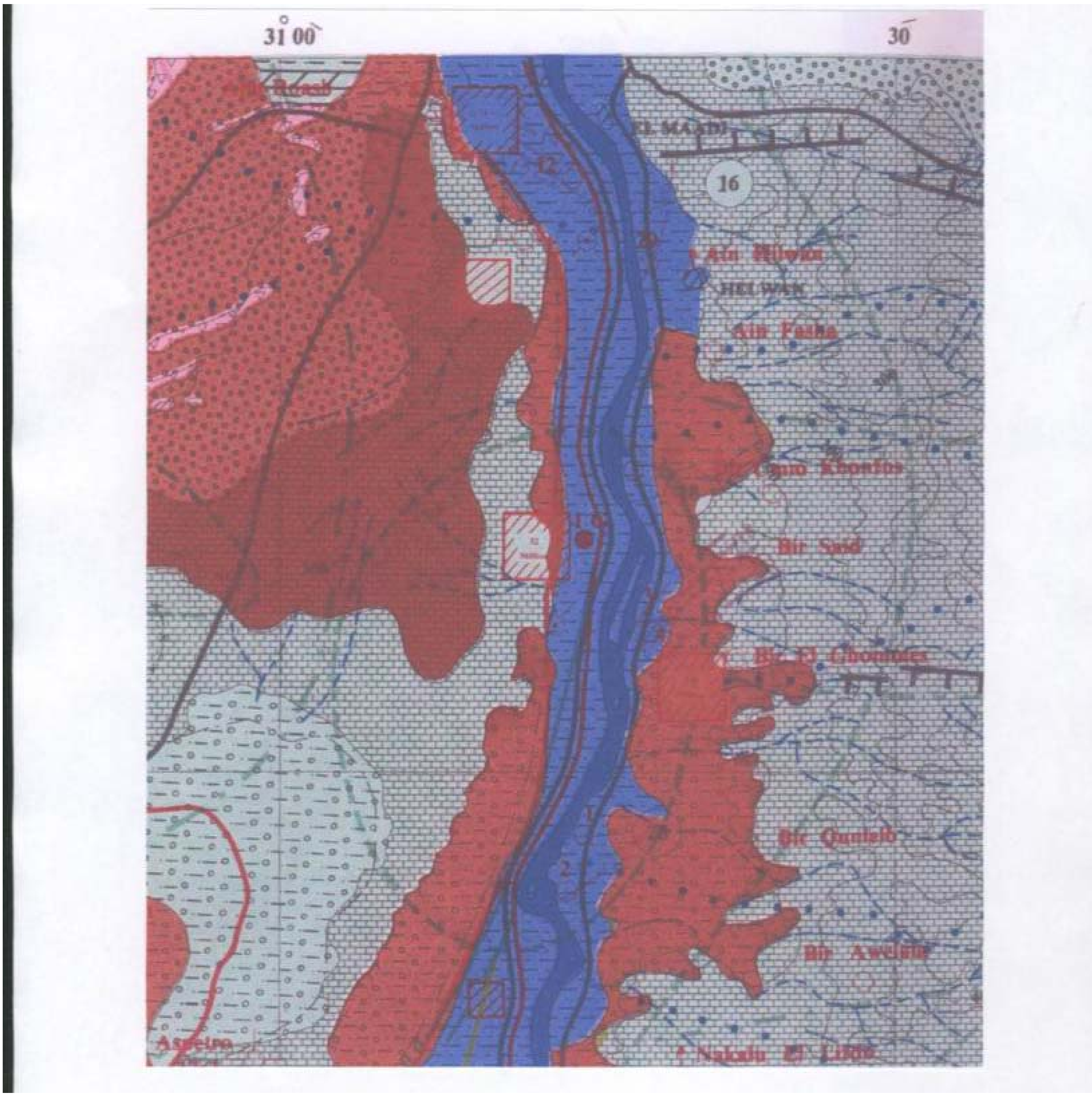
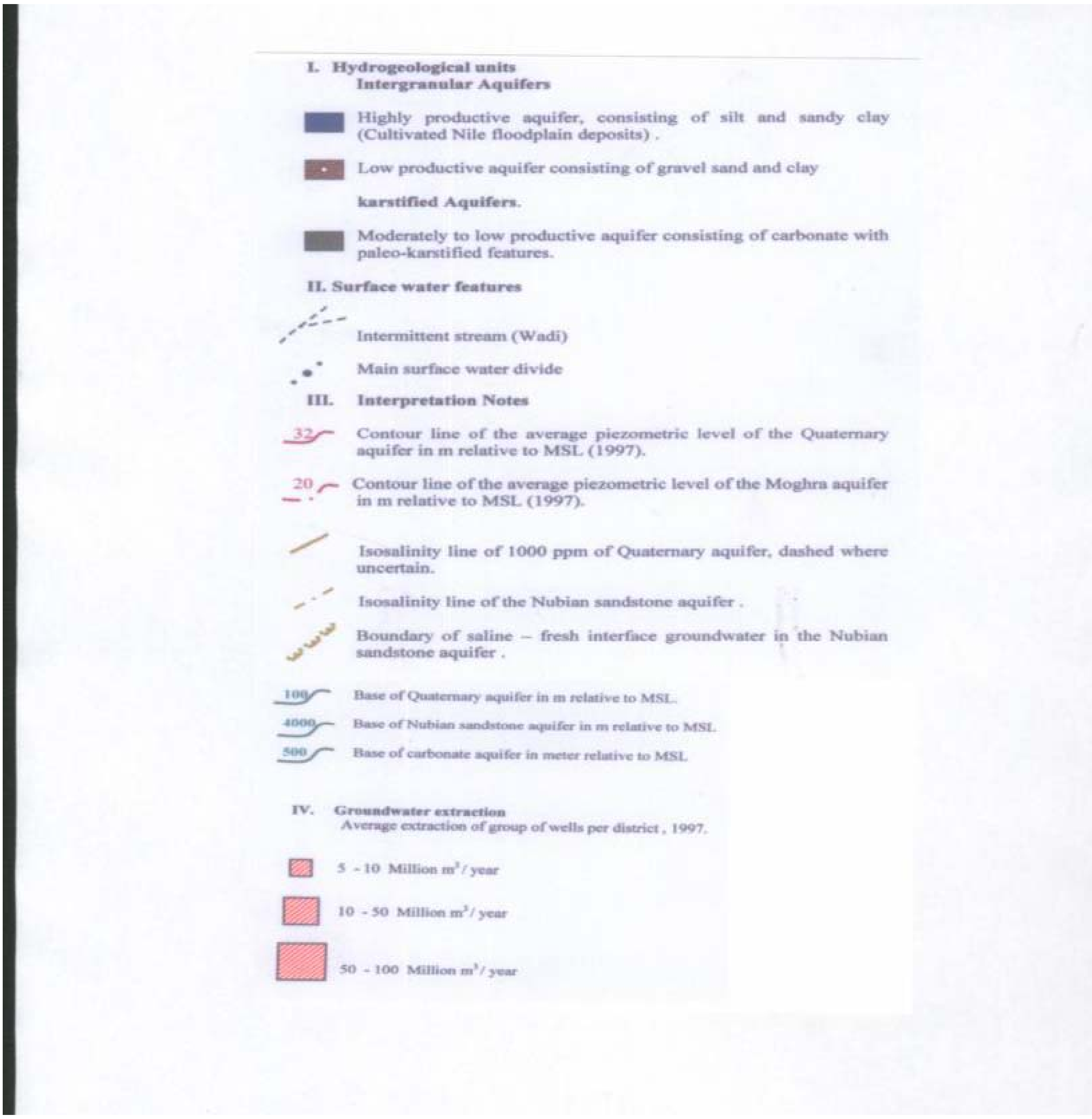


Figure 5-15

Hydrogeological Map of the Study Area, Including the Proposed Power Plant Site
(Legend : after RIGW, 1997-Scale: 1:500,000)



5.2.8 Natural Hazards

Earthquake

The distribution of the earthquake epicenters in Egypt is mainly concentrated along three main trends:

- Gulf of Aqaba (Levant) trend.
- Gulf of Suez – Red Sea Cairo– Alexandria – trend
- Fayum – Cairo- Peluseium trend

In fact, Cairo Helwan district is located in the intersection between the Gulf of Suez and the Cairo Fayum trends *(Figures 5-16* and *5-17).*

The area is characterized by the occurrence of shallow, micro, small moderated and large earthquakes. The activity is mainly attributed to the Red Sea - Gulf of Suez and the Cairo – Fayum trends.

After the Dahshour 1992 earthquake, the following features were observed.

Liquefaction

It was very pronounced at Ezbet El Gammal, Aquaz, Atfieh,Massaged Mousa, Menyet El Saff and Helwan. Water level exceeded one meter over some cultivated area. The trend of cracks (70^o and 110^o) was also observed on the eastern side of the Nile Valley.

Fracturing

Kebeasy (1990) considered the NW trend as the major active trend in Egypt. He also mentioned that the activities along this trend increased in recent years. Seismisity records show that the area is vulnerable to seismic activity that may reach 4-5 on Richter scale *(Figuer 5-17).*

Hamdan (1999) reported the extension of the NW faults which affect the Middle Eocene rocks in the area of 15 May City. One of them is known to dissect the central part of the city .This fault and its associated joints and small displaced fault fragmented Middle Eocene rocks in the foundation level of the city. It is clearly shown that the site of the station is not far from the impact of the earthquakes.

Figure 5-16

Epicentral Distribution of All Earthquakes, Focal Mechanisms of Principal Earthquakes and Active Seismic Trends

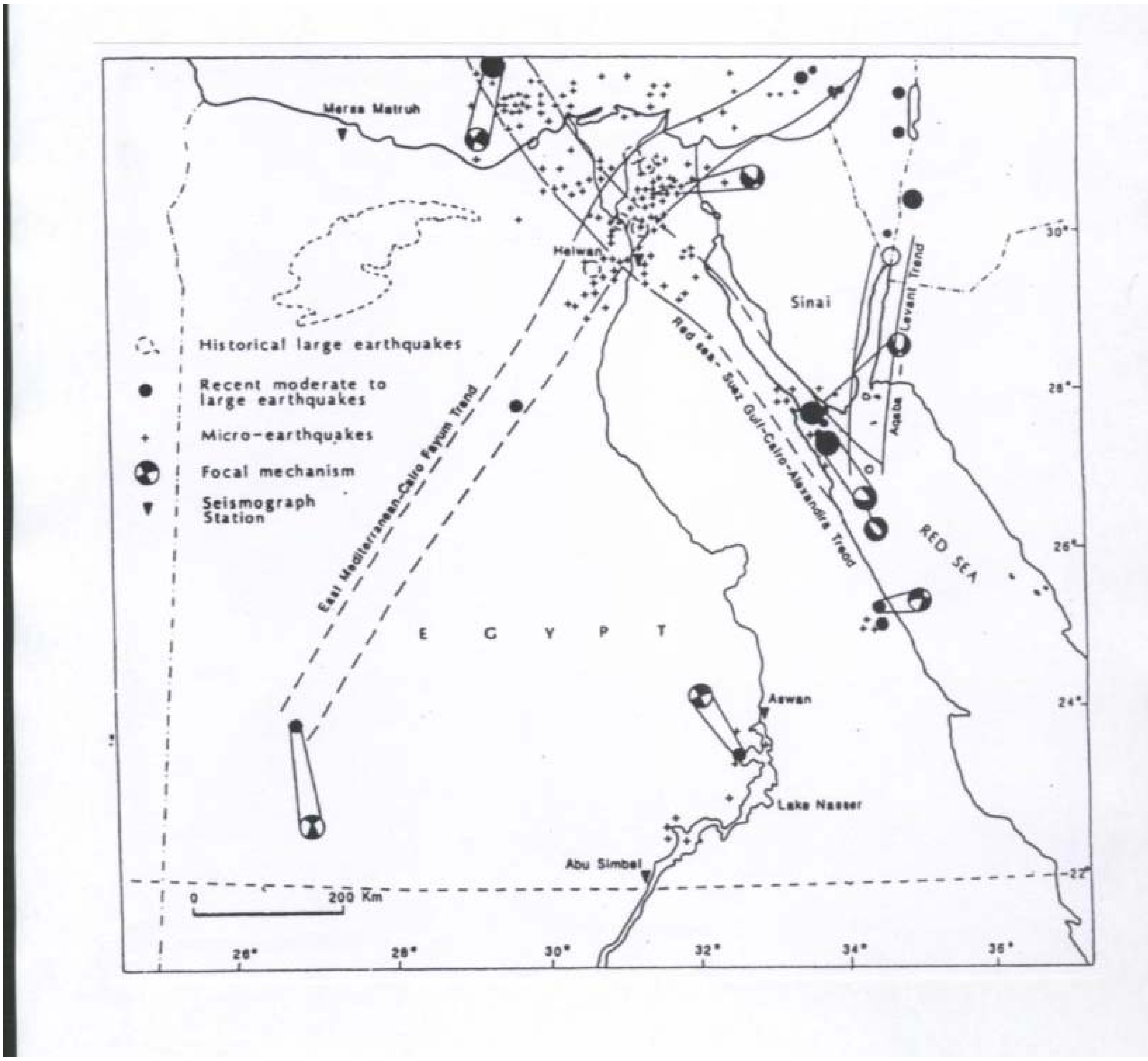
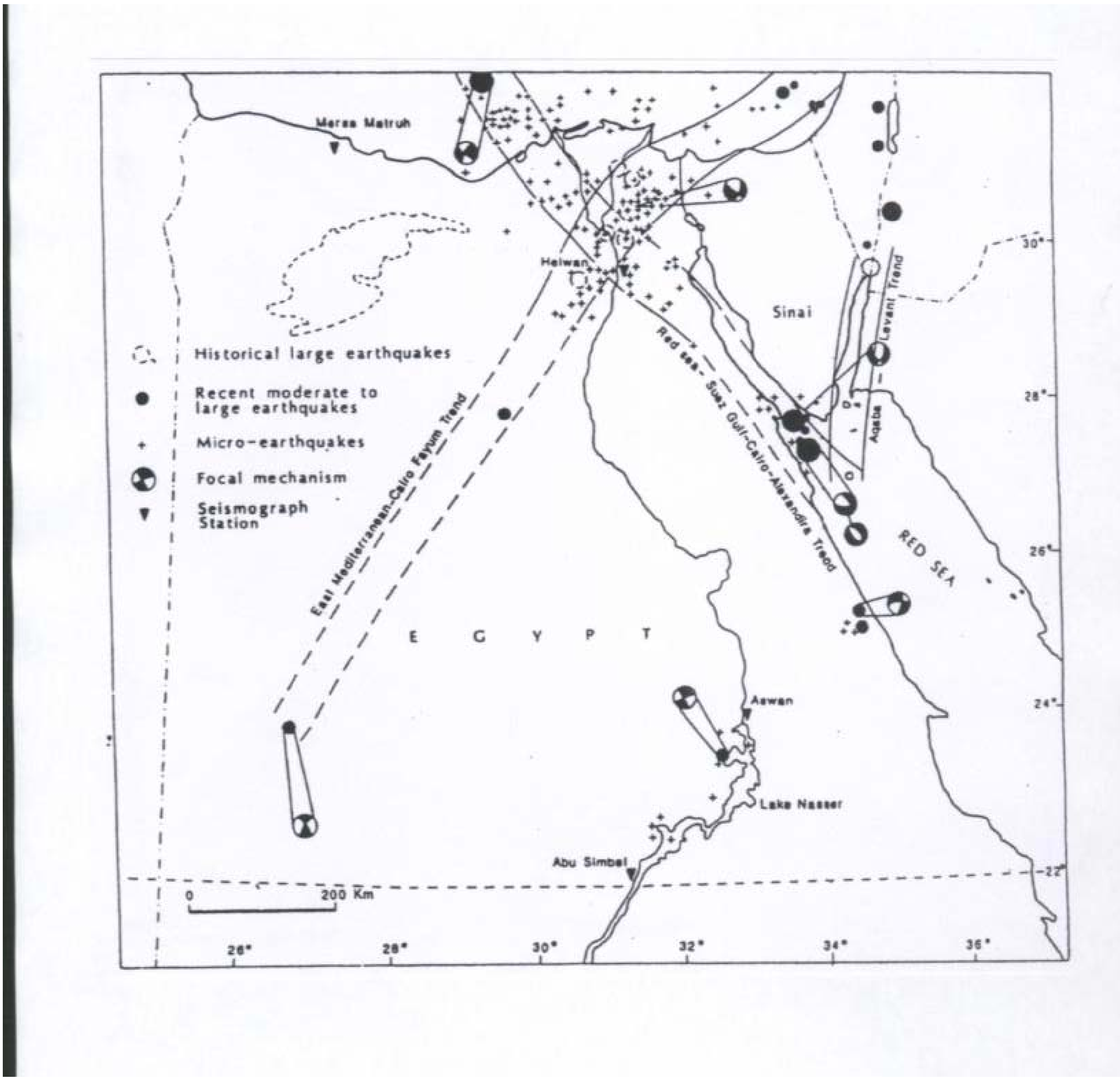


Figure 5-17

Seismicity Map of Egypt
(After Sieberg -1932)



Flash Flood

The study area represents a part of the Nile river megabasin (El-Shazly et.al. 1999). It includes seven drainage basins. They all debouch externally into the flood plain of the Nile river. The water divides between basins and surroundings trend mostly NW- SE or NE-SW. The dry valleys and tributaries of the network were sculptured during the fluvial period during the Pleistocene and recent times.

The identified wadis are W. Degla, W. Hof, W. Garawi, W. El-Gabow, W. El-Agel, W. Abu-Selly-1 and W.Abu Selly-2. They are elongated and covered with Middle Eocene Carbonate rocks. The drainage pattern of the study area is predominantly trellis *Figute 5-18*.

In this case, rainwater will have more time to infiltrate and contribute to groundwater recharge. Basins of long overland flow induce high infiltration rate and have low risk of flash flooding.

Wadi Garawi (*Figures 5-19 and 5-20*) is the main wadi which can threaten the site. The catchments area covering about 322.56 Km. The potentiality of flash flood is high *Figures 5-21, 5-22 and 5-23*).

El- Kafara Dam was built during the 3rd Dynastic period (2780 – 2280, Old Kingdome). The dam is located some 12 Km from the Nile Valley to protect the area from high surface runoff in the wadi. The elevation of the dam is about 140 m.a.s.l. and 120 m above the level of wadi bottom. The slope gradient of the wadi bottom ranges from 85 to 90.

Karst and Pot-Holes

Due to groundwater seepage and surface water infiltration in Wadi Garawi basin, the water stored within the joints and the fracture of the carbonate rocks. The dissolution process resulting in the formation of pot-holes and karst features.

It should be taken in our consideration, the presence of these karst during the foundation of the station especially in the limestone bed rocks.

Some negative geotechnical problems are locally known that adversely affected buildings and other engineering structures in Helwan and 15rd May City including cracking of buildings and roads.

In several parts allover the 15 May City, the fractures are accompanied by karst features that resulted from the chemical action of vadose and deeper ground waters through planes of these fractures.

Figure 5-18

Drainage Basins of the Study Area, Based on Aerial Photographs of Scale 1:40,000 and a Landsat TM Images of Scale 1:65,000
(After Hamdan, 1999)

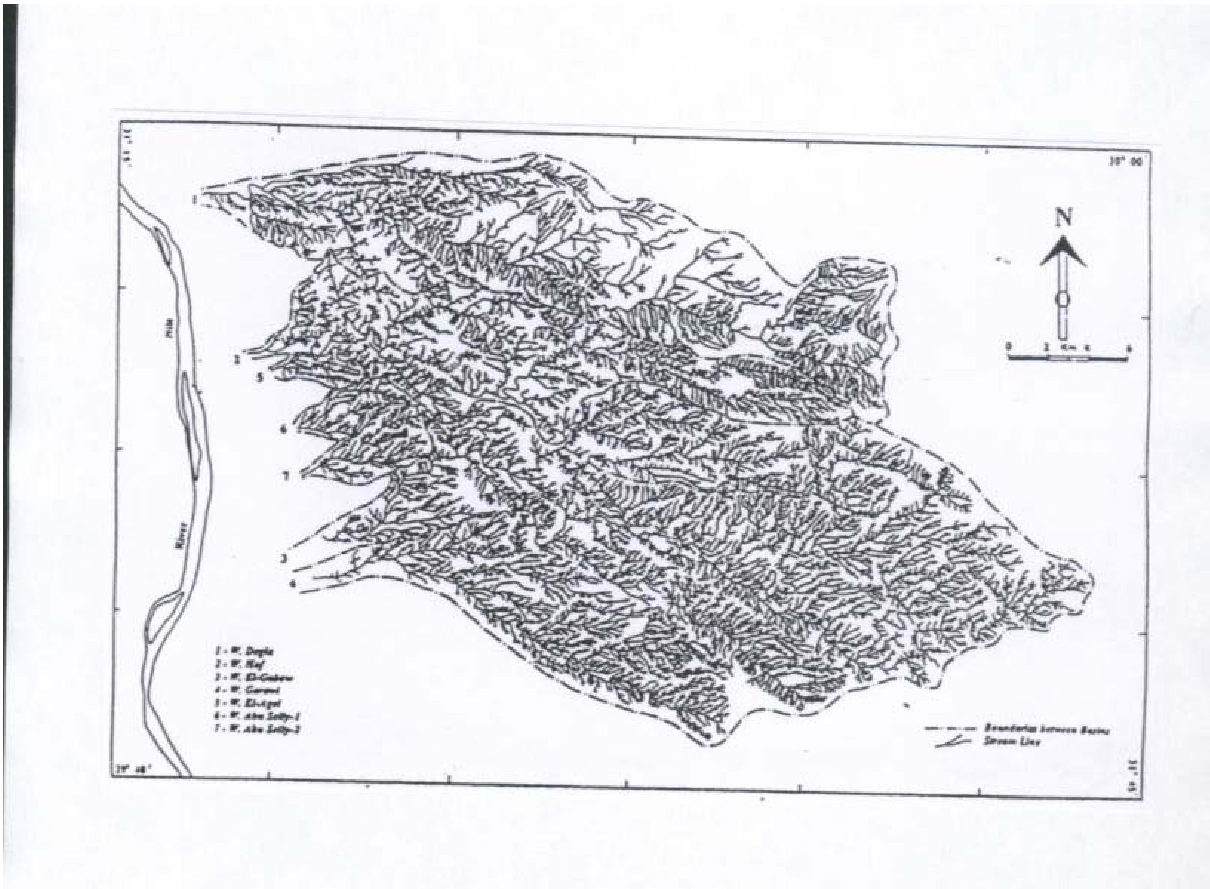


Figure 5-19

Boundaries between Basins and Urban Areas and the Flash Flood Potentiality Based on the Assessment of El-Shamy, 1992
(After Hamdan, 1999)

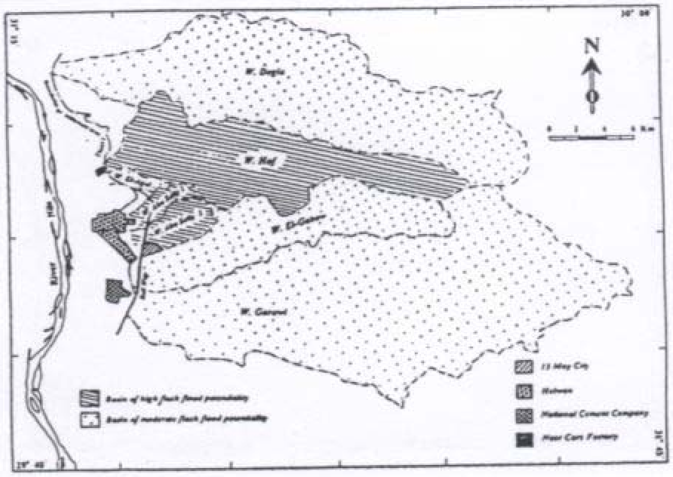


Figure 5-20

Boundaries between Basins and Urban Areas and the Flash Flood Potentiality Based on the Average Length of Overland Flow as Defined by Horton, 1994
(After Hamdan, 1999)

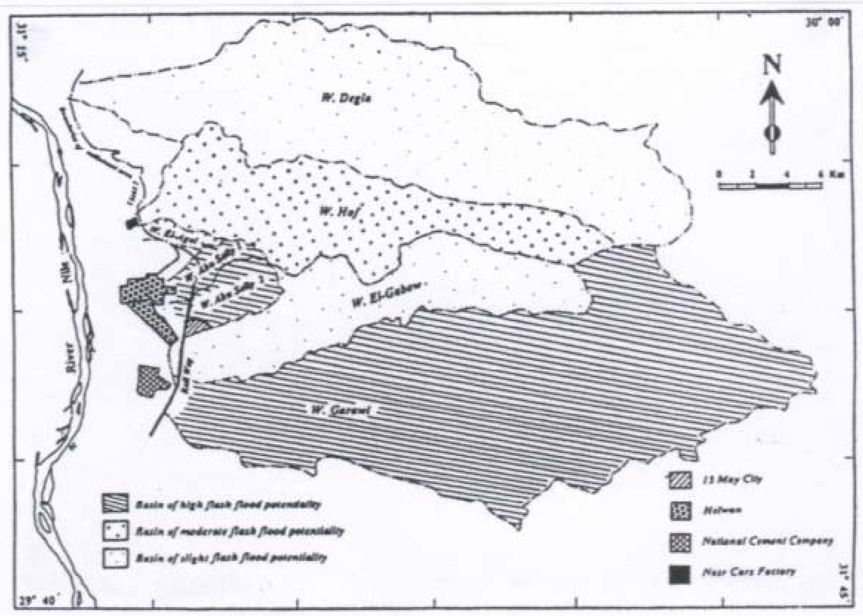


Figure 5-21

Main Geomorphic Features at the Study Area at Delta Wadi El-Garawi

(after El-Hawi, 2000)

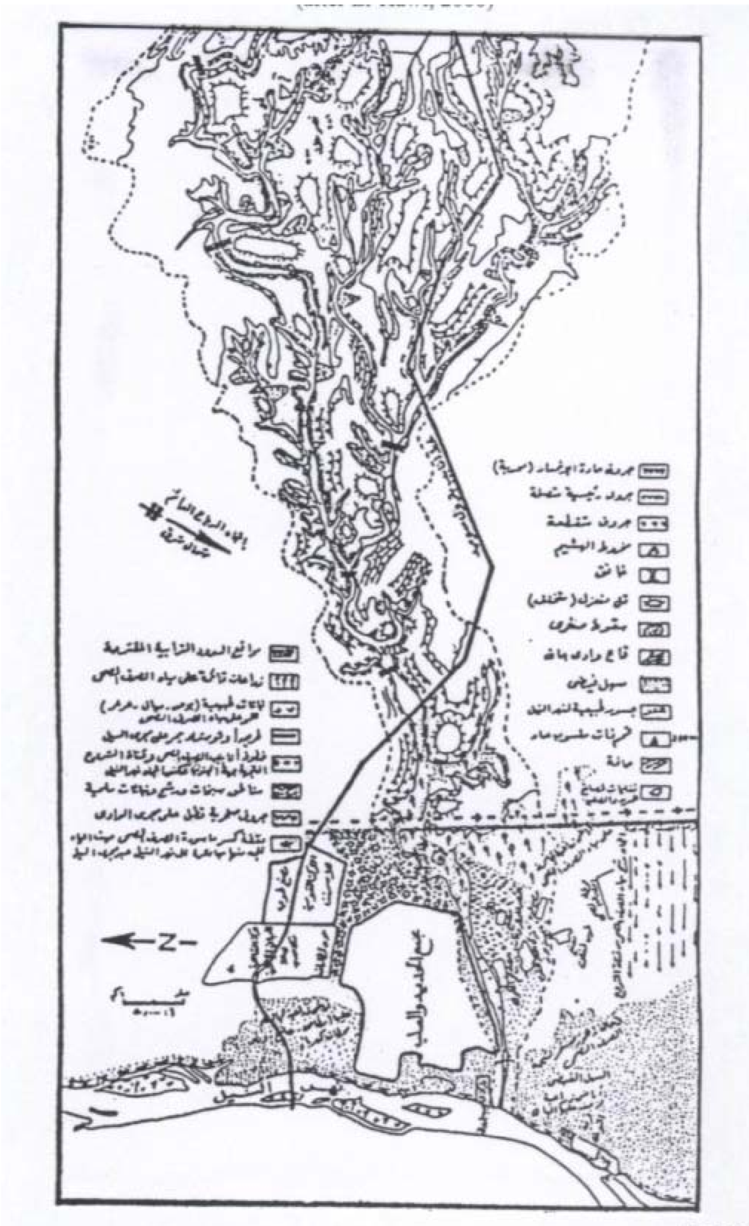


Figure 5-22

Map Showing the Location of Man-induced Hazards in Delta Wadi Garawi
(after El-Hawi, 2000)

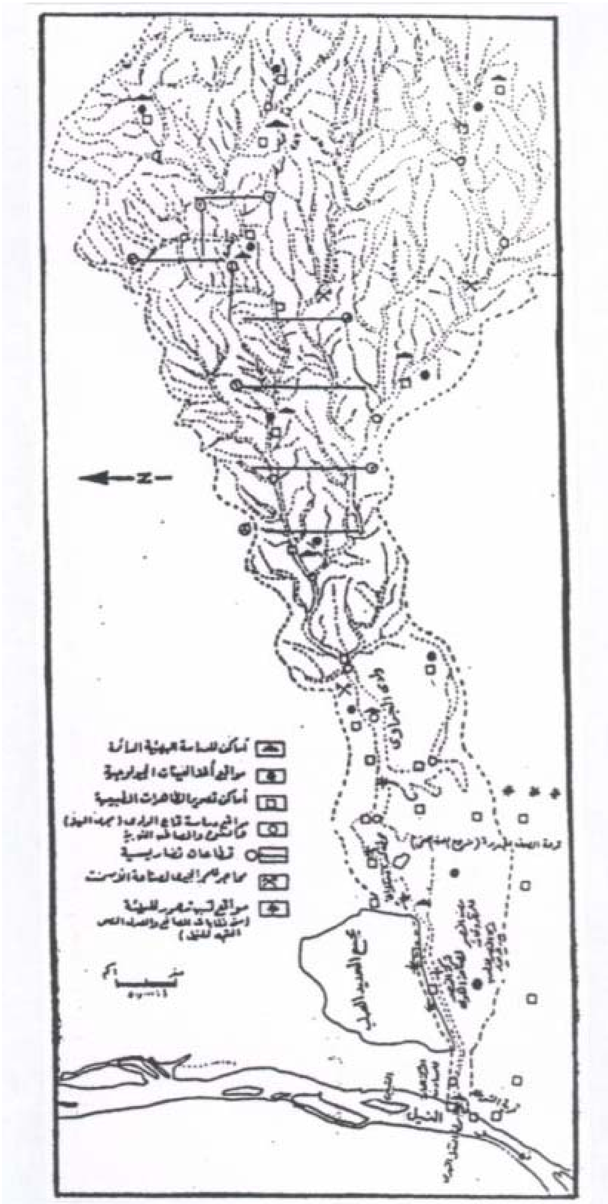


Figure 5-23

Wadi Garawi Course

Figure 5-24

Dust Emission from Cement Industries

5.2.9 Man – Induced Hazards

Siltation

Siltation of the Nile river near the water intake should be monitored routinely to avoid clogging or capacity reduction. The annual current rate of siltation during the operation of the present power station is about 200,000 m3. Periodic mechanical removal of silt by drag-line type shovels may need to be carried out to the site. To avoid possible slope failure of the river banks near the intake tunnel and the outlet discharge tunnel, stone lining of the banks, in the conventional manner, need to be considered.

Water Hyacinth

The excessive growth of Water hyacinth (Ward El-Neel) is a problem of national dimension because of the nutritive–nature of the Nile water due to extensive fertilization of the agricultural land. Mechanical collection of Ward El-Neel and its disposal on land is the common national remedial practice. The water intake tunnel should be protected from the invasion of this floating plant.

5.3 CLIMATE AND METEOROLOGY

5.3.1 Introduction

Both local and regional climatic characteristics play an important role in the dispersal of pollutants in the atmosphere. To understand the potential impacts from a given industrial source, both local and regional climatic conditions and short and long term meteorological factors must be considered. The principal meteorological parameters, which affect the dispersal of airborne pollutants, are the following:

- wind speed, direction and temporal distribution;
- atmospheric stability;
- mixing height (the height below which there is significant mixing within the atmosphere); and
- precipitation (which affects the deposition of the pollutants).

Both micro and macro meteorological factors affecting the general climatic conditions in the region of the proposed site have been examined in this assessment.

5.3.2 Regional Climatic Conditions

This section describes regional climatic conditions in the Cairo South area. *Tables 5-1, 5-2 and 5-3* summarize climatic information available for the area using 35 year monthly average data.

The Cairo South site is characterized by a sub-tropical desert climate with predominantly very hot summers, mild winters, and generally dry and sunny conditions. Rainfall events are rare and occurrences of gales, thunderstorms, and dust storms are occasional.

The climate of the region is caused primarily by the sub-tropical high pressure belt that is prevalent in this area, leading to clear skies for most of the time. The prevailing winds are northerly and can become strong during the winter. The northerly winds are caused by a sub-tropical high pressure cell in the western desert of Egypt during the winter months and by the western edge of a huge Asiatic low over northwestern India during the summer. The sparse rainfall in this area usually falls in the form of showers during the cold season (December, January, February) while under the influence of cold upper level troughs to the north. The highest temperature generally occurs in June through August when tropical continental air masses arrive from western Syria and Iraq on northeast winds while the lowest temperatures are recorded in January and February as polar continental air masses to the north are dragged down in the rear of winter Mediterranean depressions. Relative humidities remain low for most of the year reaching a maximum in November and December or January and a minimum in April and May or June.

Summaries of climatic variables for the site region are available from meteorological data collected at Helwan. The Helwan data furnish wind speed, wind direction, temperature, pressure, precipitation and relative humidity information that are considered to be representative of the Cairo South site. Atmospheric stability information is also available from the Shoubrah E1-Kheima Phase II Report based on data collected at Cairo.

A 35-year Helwan data base (1968-2003) indicates a prevailing northerly wind at the site (30 percent from North-North-West quadrant) with a secondary maximum of winds from the North quadrant (22 percent) followed by North-North-eastrly winds (18 percent) and winds from the North-West-West quadrant (8 percent) and then westerly-southerly winds (12 percent). Calm and variable winds occur approximately 18 percent of the time. Wind speeds and directions measured for 2004 are shown on the Wind Rose in *Figure 5-25*. Wind speeds are generally light to moderate with an annual-average speed of approximately 3.5 meters per second and rarely exceed 30 m/secec. (*Table 5-2*). The temperature data collected at Helwan for a 35 year period indicate a maximum monthly-average temperature of 36^{o}C in July and a minimum monthly-average temperature of 7.6^{o}C in January. Summertime high temperatures average 35^{o}C while winter lows reach 9.3^{o}C. The annual-average temperatures is 22.35^{o}C with record high and low temperatures of 47 and -2^{o}C, respectively. Rainfall at Helwan averages 13 millimeters per year occurring mostly during the winter months (December-March). Relative humidity remains fairly low throughout the year, maximizing at 55 percent for November through January and reaching a low of 40 percent in April and May (*Table 5-1*). The dryness of this climate is further demonstrated by the fact that nearly 80 percent of possible sunshine is received during the year.

The atmosphere stability information derived from the Shoubrah El-Kheima Phase II Report indicates that unstable and neutral conditions occur more frequently (63 percent) than stable conditions (37 percent). However, very stable conditions (Class 7) occur most frequently of the seven stability classes at a frequency of 24 percent. These data alongwith the climatic information points toward generally poor dispersion conditions prevailing during the nighttime hours.

The general absence of rainfall minimizes washout, normally an important mechanism for removing air pollution from the atmosphere. Stable atmospheric conditions also reduce dispersion. As a result, air pollutants in Cairo's atmosphere for long periods, building up and increasing the potential for human exposure and formation of secondary pollutants such as ozone. Air pollutants that fall from the atmosphere through dry deposition (e.g. particulates) are not washed from the ground by rainfall and can be readily re-entrained by winds. There is an air quality monitoring station in the Tebbin area from which a background air quality characterization can be made. Site observations throughout the year 2004 have demonstrated that there are some major sources of air pollutants in the area. Therefore, the availability of background data is critical to this assessment. Based on the existence of some significant industrialization in the site vicinity and the fact that Tebbin and Helwan are both identified, since early fifties of the last century, as an industrial zone, it is assumed that the air quality of this region is characteristic of an industrial setting with significant anthopogenic sources of air pollution. Preconstruction ambient air monitoring, which would be conducted during the next phase of project development, would present guidance on the background air quality characteristics.

Table 5-1

Temperature, Humidity and Rainfall Information for the Proposed Site, (35-year monthly average)

(Based on Weather Monitoring at the Helwan Station)(1)

Month	Av. Temperature (^oC)				Humidity	Rainfall (mm/day)	
	Av. Monthly Max.	Av. Monthly Min.	Highest Daily Max.	Lowest Daily Min.	Relative Humidity (%)	Total Monthly	Max. in Single Day
January	19.1	7.6	31.4	-2.0	55	3.2	13.2
February	20.8	8.7	34.1	1.4	51	2.3	25.0
March	24.8	11.6	37.4	2.5	46	2.0	10.4
April	29.1	15.3	42.6	5.6	40	0.8	6.1
May	33.1	18.9	47.0	10.4	40	0.4	1.3
June	35.5	21.5	45.2	14.6	42	Trace(2)	Trace
July	36.0	23.2	45.3	16.5	49	0.0	0.0
August	35.4	23.2	43.4	16.8	52	0.0	0.0
September	33.8	21.7	44.8	13.8	51	0.0	0.0
October	30.6	18.6	40.0	9.0	51	0.1	1.9
November	25.1	13.6	34.9	4.4	55	1.5	18.1
December	20.4	9.3	34.4	2.0	55	2.8	13.0
Annual-average	28.6	16.1			48.8	13	-

Notes:

(1) This data is extracted from Helwan meteorological station Records, and it covers area of 20 km radius.

(2) Trace = T < 0.1 mm.

Table 5-2

Wind Speed Information for the Proposed Site (Knots)[(1)], (35-year monthly average)

(Based on Weather Monitoring at the Helwan Station)

Month	Av. Monthly Speed (Knots[(1)])	Highest Hourly Av. (Speed/ Direction)[(2)]	Date of Occurrence (Day/Year)	Highest Sudden Plast of Wind [(2)] (Speed/Direction)	Date of Occurrence (Day/Year)
January	5	26/220	17/81	45/240	17/18
February	6	30/190	18/81	50/220	3/92
March	7	28/190	22/85	50/180	22/85
April	8	32/200	16/81	49/340	12/71
May	8	28/280	2/97	54/290	2/97
June	8	20/360	5/77	35/240	13/71
July	7	16/030	3/78	27/010	9/84
August	7	14/010	24/77	23/360	29/69
September	7	20/070	29/77	33/020	11/71
October	7	33/240	9/89	33/240	23/76
November	6	22/240	28/69	38/220	24/76
December	6	25/260	14/77	45/260	14/77
Annual-average	6.83				

Notes:

(1) Knot = 1.85 km/hr.

(2) Highest hourly average and highest sudden plast of wind are provided based on weather monitoring at the Bahtim (northeast Cairo) station.

Table 5-3

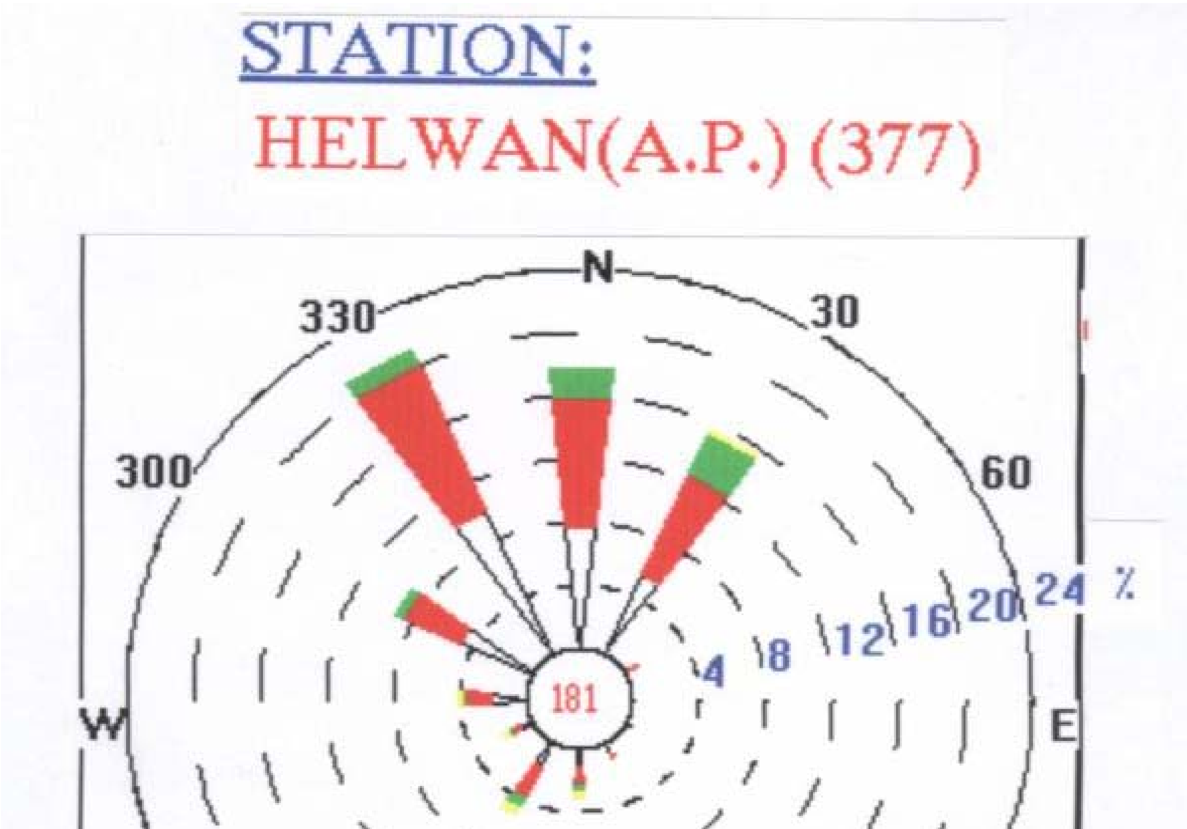
Fog, Mist and Storms Information for the Proposed Site (no. of days), (35-year monthly average)

(Based on Weather Monitoring at the Helwan Station)

Month	**Fog (no. of Days)**	**Mist (no of days)**	**Stirred up Sands/ Duststorms (No. of days)**	**Thunderstorms (No. of days)**	**Gales (No. of days)**
January	2.7	0.7	1.5	0.1	0.0
February	2.1	0.2	2.5	0.2	0.02
March	1.3	0.02	2.8	0.2	0.0
April	0.4	0.0	2.8	0.1	0.1
May	0.2	0.0	1.1	0.1	0.02
June	0.4	0.0	0.5	0.0	0.0
July	1.8	0.0	0.1	0.0	0.0
August	1.8	0.0	0.2	0.0	0.0
September	1.2	0.02	0.1	0.0	0.0
October	1.6	0.0	0.3	0.0	0.0
November	3..4	0.2	0.7	0.1	0.0
December	3.9	0.3	1.2	0.1	0.0

Figure 5-25

Wind Rose of Cairo South
(Helwan/Tebbin Area, 2004)



5.4 AMBIENT AIR QUALITY

5.4.1 Ambient Air Quality Data

Introduction

Concentrations of ambient pollutants vary according to both time and location. They are affected by many factors, the most significant being the size, number and location of emission sources and the prevailing weather.

Nitrogen dioxide is the only significant pollutant emitted to the atmosphere from a gas fired power plant, with respect to human health effects. The other combustion products of natural gas are CO_2 and H_2O. When fuel oil is burnt, SO_2 and particulate matter become significant emissions of concern.

Monitoring at the Site

Air quality monitoring at the proposed site was undertaken by the Air Pollution Preclusion Department, National Research Center during June 2005 on behalf of SPEEDOTRANS. Monitoring took place at five monitoring points located at the center of the proposed site and the boundary four points at the four geographical directions as shown in *Figure 5-25*.

Continuous measurements, over a period of 24 hours, were taken for nitrogen oxides (NOx), carbon monoxide (CO), carbon dioxide (CO_2), sulfur dioxide (SO_2), aldehydes (HCHO), hydrogen sulfide (H_2S), smoke and total suspended particulates. The results of this monitoring are shown in *Table 5-4 and Table 5-5* below. Comparison with Egyptian Threshold Limit Values (TLVs) (as stipulated in *Law 4/1994*) show that the concentrations of gaseous pollutants in ambient air at the proposed site are within the TLVs for 24 hour averages.

Continuous measurements, over a period of 18 months - starting January 2004 and ending June 2005 - were obtained, also, from the air quality monitoring facility of the Egyptian Environmental Affairs Agency (EEAA) at the Tebbin area for nitrogen dioxide (NO_2), thoracic particles (PM_{10}) and sulfur dioxide (SO_2). The results of this EEAA measurements are shown in *Table 5-6* and *Table 5-7* below. This data provided with 24 hr-mean of these pollutants in the background atmosphere of the Tebbin area. Comparison with Egyptian Threshold Limit Values (TLVs) shows that the concentrations of these pollutants in ambient air at the proposed site area are below the TLVs for 24 hr-averages along the year except for the PM_{10}.

Figure 5-26

Tebbin Site Plan and the Selected Monitoring Locations

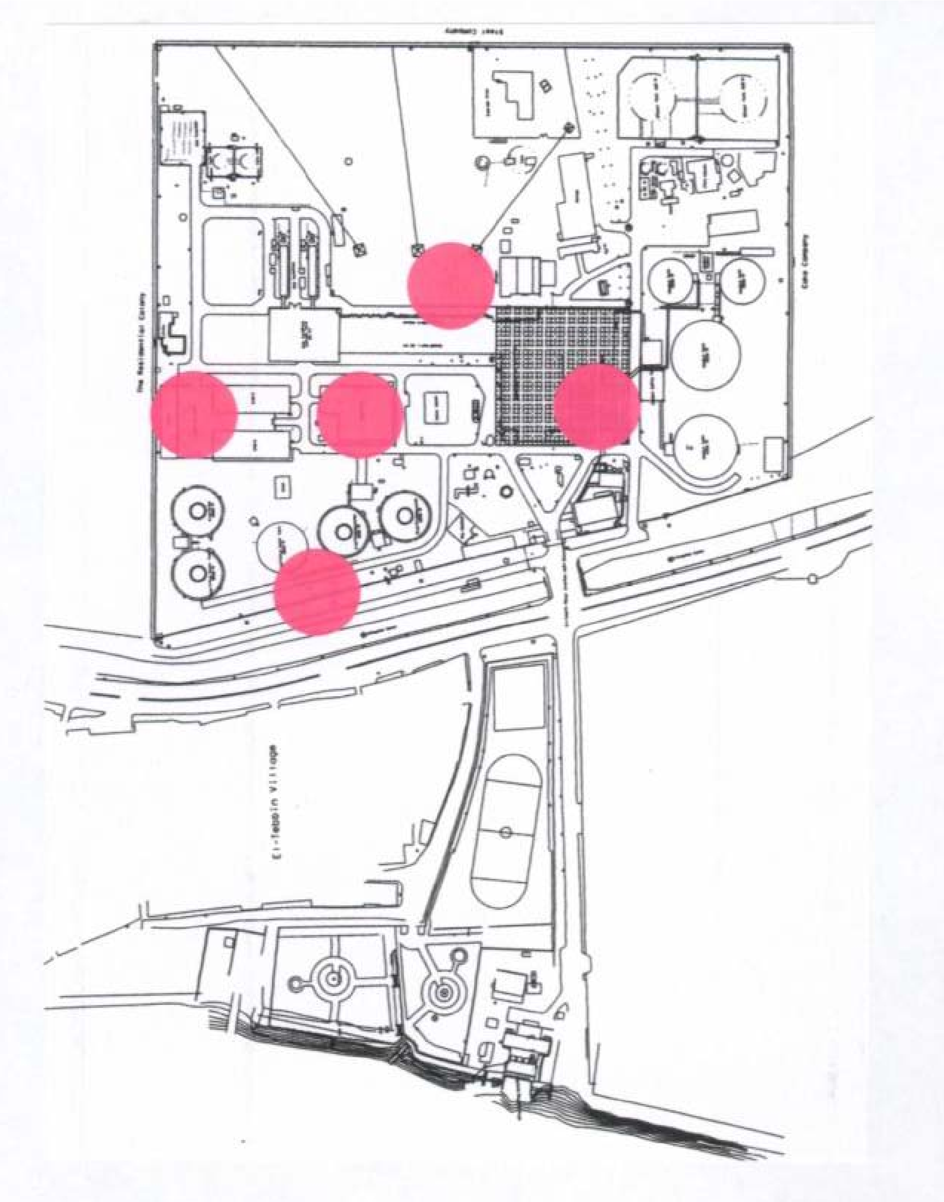


Table 5-4

Mean Concentrations of Gaseous Air Pollutants at the Proposed Project Site
(Measured by the National Reaserch Center (NRC) for 24 hour average)

Site No.	**CO (mg/m^3)**	**CO_2 (mg/m^3)**	**SO_2 ($\mu g/m^3$)**	**NO_2 ($\mu g/m^3$)**	**HCHO ($\mu g/m^3$)**	**H_2S ($\mu g/m^3$)**
1 (Center)	0.9	580	55	93	22	6.8
2 (North)	1.02	560	47	85	19	5.9
3 (South)	1.14	640	73	123	33	5.8
4 (East)	0.90	640	67	110	30	7.5
5 (West)	0.80	530	63	108	28	8.3
Mean	**0.95**	**590**	**61**	**103.8**	**26.4**	**6.86**
EEAA TLV(1)	**10(2)**	**-**	**150**	**150**	**-**	**-**

Notes:
(1) Egyptian Standard for Threshold Limit Value for Ambient Air Quality(24 hour means)as stipulated in Law 4/94.
(2) 8 hour mean.

Table 5-5

Mean Concentration of Non-Gaseous Air Pollutants at the Proposed Project Site
(Measured by the National Reaserch Center (NRC) for 24 hour average)

Site No.	**TSP ($\mu g/m^3$)**	**Smoke ($\mu g/m^3$)**
1 (Center)	269	51
2 (North)	258	51
3 (South)	298	68
4 (East)	300	66
5 (West)	295	61
Mean	**284**	**59.4**
EEAA TLV*	**230**	**150**

Notes:
* Stipulated by the Law 4/94.

Table 5-6 (A)

EEAA Measurements for Main Pollutants at El-Tebbin Area During the Year 2004, $\mu g/m^3$

(Average of 24 hr Average)

Month	Nitrogen Dioxide (NO_2)	Thoracic Particles (PM_{10})	Sulfur Dioxide (SO_2)
January	29.59	150.6	17.37
February	32.04	135.76	16.24
March	30.46	125.93	16.77
April	28.83	106.16	18.3
May	29.05	136.64	18.43
June	26.23	71.08	21.26
July	4.06	94.56	20.75
August	16.76	87.94	18.43
September	20.59	83.49	5.64
October	24.82	64.13	N/A[1]
Novermber	33.67	96.46	N/A
December	43.37	70.41	26.43
24hr Average	**26.62**	**101.93**	**17.97**
EEAA TLV [2]	**150**	**70**	**150**

Notes:
(1) N/A = Not Available.
(2) Stipulated by the Law 4/1994.

Table 5-6 (B)

EEAA Measurements for Main Pollutants at El-Tebbin Area During the Year 2004, $\mu g/m^3$
(Average of Highest Single 24 hr Average)

Month	**Nitrogen Dioxide (NO_2)**	**Thoracic Particles (PM_{10})**	**Sulfur Dioxide (SO_2)**
January	52.5	644.1	32.5
February	63.3	355.0	43.9
March	71.9	262.3	63.1
April	48.8	258.6	41.7
May	50.1	723.1	42.7
June	47.3	131.1	35.6
July	5.3	178.9	33.8
August	55.5	200.4	24.2
September	35.8	239.0	8.3
October	39.6	105.7	N/A(1)
Novermber	41.8	223.6	N/A
December	71.1	221.8	65.0
Average of Highs	**52.5**	**202.3**(2)	**39**
EEAA TLV (3)	**150**	**70**	**150**

Notes:
(1) N/A = Not Available.
(2) Calculated excluding the highest three readings for their episodical nature.
(3) Stipulated by the Law 4/1994.

Table 5-7 (A)

EEAA Measurements for Main Pollutants at El-Tebbin Area During First Half of the Year 2005[(1)],
(Average of 24 hr Average)

Month	Nitrogen Dioxide (NO_2)	Thoracic Particles (PM_{10})	Sulfur Dioxide (SO_2)
January	38.39	72.46	35.62
February	39.71	50.50	26.54
March	34.27	48.78	22.98
April	27.26	54.89	14.64
May	24.92	44.53	14.83
June	22.84	41.79	11.16
24hr Average	**31.23**	**52.16**	**20.96**
EEAA TLV [(2)]	**150**	**70**	**150**

Notes:
(1) Concentration Values of the year 2005 (up till now) couldn't be representative due to its episodical nature. During this period the Petroleum Sector dropped down their gas supplies to all Egypt facilities for maintenance and expansion works at gas fields. Instead, mazout supplies have been increased. Also, this data does not cover one complete year.
(2) Stipulated by the Law 4/1994.

Table 5-7 (B)

EEAA Measurements for Main Pollutants at El-Tebbin Area During First Half of the Year 2005[(1)],
(Average of Highest Single 24 hr Average)

Month	Nitrogen Dioxide (NO_2)	Thoracic Particles (PM_{10})	Sulfur Dioxide (SO_2)
January	89.0	153.6	126.0
February	69.4	102.6	73.7
March	60.7	139.0	86.2
April	58.4	160.2	57.7
May	45.9	116.7	58.7
June	36.8	69.4	30.9
Average of Highs	**60**	**123.5**	**72.2**
EEAA TLV [(2)]	**150**	**70**	**150**

Notes:
(1) Concentration Values of the year 2005 (up till now) couldn't be representative due to its episodical nature. During this period the Petroleum Sector dropped down their gas supplies to all Egypt facilitiesfor maintenance and expansion works at gas fields. Instead, mazout supplies have been increased. Also, this data does not cover one complete year.
(2) Stipulated by the Law 4/1994.

The levels of particulate matter, which ranged between 258 and 300 $\mu g/m^3$, exceeded Egyptian standards for maximum 24 hour mean concentrations at all measurement sites on some occasions. Exceedences are likely to be due to emissions of particles from dry surfaces, vehicle exhausts and industrial processes. These levels are likely to decrease as future Cairo air improvements and plantation programs achieve progress.

The level of smoke at measurement points are likely to be due to industry and traffic, especially heavy trucks, passing west of the proposed site.

5.4.2 Existing Sources of Atmospheric Pollutants

The key existing sources of atmospheric pollution in the project area comprise the following:

- operations at the heavy industrial uses with factory-type facilities to the east of the proposed site (resulting in elevated levels of gaseous pollutants, particulate matter and smoke);
- vehicles using the four-lane major arterial road along the western edge of the proposed site;
- vehicles using the two-lane road located along the northern boundary of the power plant's residential colony;
- locomotives using the single-line railroad track located a short distance to the north of the proposed site; and
- operations at the heavy industrial area of wider Helwan located to the north, northeast, east and southeast of the proposed site.

On the basis of the monitoring data available for the proposed site and from our observations at the site, the air shed around the project site is likely to have the general characteristics of Cairo metropolitan area air shed. Air pollution in Cairo results from automobile exhaust and several types of industrial emissions. Washout by rain, an important mechanism for removing air pollution from the atmosphere is not effective in clearing Cairo's atmosphere because of the city's very limited annual rainfall. Air pollutants that fall from the atmosphere through dry deposition are not washed from the ground by rain and therefore can be readily re-entrained by winds.

As a result, air pollution in Greater Cairo exceeds health standards for major pollutants.

Ambient concentrations of TSP and PM_{10}, irrespective of exceeding regulations, are relatively low compared to other zones in Geater Cairo (almost 800 $\mu g/m^3$ at Cairo North). They are likely to exceed WB guidelines for determining air sheds of moderate quality. Short term monitoring of ambient air quality at the site (and as given in *Table 5-4*), suggests that ambient concentrations of all other pollutants are well below WB moderately degraded air shed guidelines.

5.4.3 Particulate Matter Constituents

For providing an adequate data base on this information, an analytical study was undertaken for some areas in Greater Cairo region during December 2000 by the National Research Center. The main outcomes of this study are summarized as follows.

Smoke

The smoke particle size range, on the average, between 0.07 μm and 0.1 μm at the proposed site. Due to this very small size, smoke behaves in many ways like a gas and has the same penetration power as the gas. Also, smoke doesn't remain in the atmosphere for long. The average time of remaining in suspension was estimated to be 1-2 days.

Suspended Dust

Tables 5-8 through 5-13 give useful information on dust size.

Table 5-8

Average Concentration ($\mu g/m^3$) and Percentage of Suspended Dust at the Proposed Site

Dust Size	Concentration ($\mu g/m^3$)	Percentage (%)
$\leq$ 0.2 μm	308.8	43.66
0.2-10μm	366.2	56.34

Table 5-9

Water-Soluble and Insoluble Constituents of Suspended Dust at the Proposed Site, Percentage

Dust Size	Water-Soluble Matter (%)					Water-Insoluble Matter (%)		
	Chlorides	Sulfates	Ammonium	Nitrate	Nitrite	Org.M.	Com.M	Ash
$\leq$ 0.2 μm	3.44	3.96	0.14	0.8	0.5	4.8	24.4	53
0.2-10μm	1.08	2.90	0.08	0.08	0.04	1.64	20.08	60

Table 5-10

Metals in Suspended Dust, Percentage

Dust Size	Calcium (Ca)	Sodium (Na)	Potassium (K)	Lead (Pb)	Iron (Fe)	Cadmium (Cd)
≤ 0.2 μm	6.27	0.18	0.22	Trace	3.64	0.002
0.2-10μm	5.87	0.11	0.28	0.033	7.71	0.001

Dustfall

Table 5-11

Average Rate of Dustfall (in gm/m²/month) and Percentages of Different Sizes (in μm) at the Proposed Site

Dustfall Rate (gm/m²/month)	Dustfall Size (%)				
	≥ 90	90-80	80-63	63-45	≤ 45
17.08	25.48	18.93	13.58	20.77	21.24

Table 5-12

Water-Soluble and Insoluble Constituents of Dustfall at the Proposed Site, Percentage

Dustfall Size (μm)	Water-Soluble Matter (%)					Water-Insoluble Matter (%)		
	Chlorides	Sulfates	Ammonium	Nitrate	Nitrite	Org.M.	Comb.M.	Ash
≥ 90	1.21	0.93	0.08	0.71	0.55	0.9	37.8	44.9
90-80	1.48	1.07	0.08	0.77	0.66	1.12	34.08	49
80-63	1.74	1.36	0.93	0.89	0.78	1.29	23.31	56.2
63-45	2.04	1.64	1.14	1.26	0.90	1.53	19.27	59.2
≤ 45	2.2	3.28	1.31	1.48	1.08	2.05	20.35	58.60

Table 5-13

Metals in Dustfall, Percentage

Dustfall Size (μm)	Calcium (Ca)	Sodium (Na)	Potassium (K)	Lead (Pb)	Iron (Fe)	Cadmium (Cd)
$\geq$ 90	3.94	0.13	0.23	0.024	5.54	0.002
90-80	3.05	0.16	0.25	0.052	5.05	0.001
80-63	4.48	0.54	0.32	0.09	3.64	0.002
63-45	3.91	0.48	0.28	0.024	3.3	0.004
$\leq$ 45	6.11	0.30	0.32	0.033	4.54	0.002

5.5 AQUATIC ENVIRONMENT

5.5.1 Introduction

The data on the existing aquatic environment has been assimilated from discussions with the Hydraulics Research Institute, the National Research Center and a review of relevant literature, which comprised:

- Dr. Yasser M. Shawky and Eng. Ahmed M. Nada (April 2005); ***El-Tebbin Power Plant-Field Survey and Water Quality Analysis,*** Hydraulics Research Institute;

- Eng. Ibrahim A. El-Desouky, Dr. Yasser Shawky and Eng. Mohamed M. Abdel-Latif (June 2005); ***El-Tebbin Power Plant-Hydrothermal Model Study, Inception Report,*** Hydraulics Research Institute; and

- Prof. Dr. Osama A. Aly (June 2005); ***Assessment of Water Quality Along Selected Site for the Construction of Electric Generation Station at El-Tebbin,*** National Research Center.

The power plant site lies on the right bank of the Nile river, 52.25km upstream the Delta Barrage (measured along the Nile course). The Nile is bordered by flat land which typically composed of paved roads, desert and agricultural lands.

Nile segment across the road along the western side of the site has been investigated and bathymetric survey carried out covering a Nile reach of 5.0 km (2.0 km upstream the intake of the power plant and 3.0 km downstream of it). The bathymetric survey was carried out in 94 cross section profiles normal to the flow direction, the distance between each two cross sections was approximately 50 m. Also, 0.5 m interval contour map was considered including whole details of the surveyed reach.

The bathymetric survey of each cross section was carried out using DSF-600 Digital Survey Fathometer Echo Sounder (Accuracy $\pm$ 0.05m). The survey was carried out using eight DGPS units, (accuracy $\pm$ 0.10m). The system has the capability to determine coordinates in metric system (National Egyptian Coordinate System or universal Coordinate System) from the WGS84 system.

A rubber boat equipped with both Echo Sounder (DSF-600 Digital Survey Fathometer) and DGPS unit used for the river-bed bathymetry. The flow velocity measurements were carried out using recording current-meters (RCM7), which are able to record the mean current speed, flow direction, temperature and salinity. A bed material sampler type (Van Veen grab box) was used to collect the bed material samples from the river bed. All equipments and instrumentions were calibrated upon carrying out the field work.

The contour level map of the whole area is shown in *Figure 5-27.*

5.5.2 Local Hydrography

The Nile river in the project vicinity is fairly straight, except one fine bend located approximately 1.2 km downstream the plant. The Nile width in this area varies between 250 m and 350m, whilst the mean water depth is approximately 14 m most of the year, and 10 m during the low discharge period. No major obstructions are apparent in this reach. The first downstream regulator is located at Delta Barrage which is approximately 52 km downstream the proposed site.

5.5.3 Nile Flow

The Nile flow, at the plant site is mainly controlled by the Delta Barrage. The Nile flow reaches its maximum of about 161 million m^3/day in June and July, while minimum discharge occurs in January with about 41 million m^3/day (*Table 5-14).* According to the Ministry of Water Resources & Irrigation, the Nile flow conditions are given below:

Minimum discharge = 472 m^3/sec. for level of 16.26 +m MSL.
Maximum discharge = 1863 m^3/sec. for level of 19.34 +m MSL.

This maximum discharge is correspondent to the hottest period over the year and the water temperature is taken equal to 28°C.

For most of the year the discharge of the river is 995 m^3/s. The water level at the plant site in the period of dominant flow is 18.00m (MSL). During this period the maximum water temperature might be taken equal to 25°C.

5.5.4 Flow Velocity

Flow velocity measurements have been carried out at several verticals distributed along the width of each cross-section depending on the shape of the cross section. The number of verticals was selected according to the width and bed profile of the cross-section, and to guarantee high accuracy of discharge calculations. The measuring points per vertical were as follow:

- at 0.20, 0.50 and 0.80 of the water depth at each location measured from the water level for four cross sections as follow:
  - Cross-Section (2), at 425 m upstream the intake.
  - Cross-Section (3), at the intake.
  - Cross-Section (4a), at 140m downstream the intake.
  - Cross-Section (4b), at 285m downstream the intake.

- At the mid depth for three cross sections for model calibration purposes as follow:
  - Cross-Section (1), at 770m upstream the intake.
  - Cross-Section (5), at 570m downstream the intake at the right channel.
  - Cross-Section (6), at 260m downstream the intake at the left channel.

Location of the cross sections is shown in *Figure* 5-28.

The results of the velocity measurements at cross section 3 are presented in *Table 5-15.*

5.5.5 Bed Characteristics

A van Veen grab sampler was used to collect bed material samples at the same locations of velocity measurements (three samples per cross-section). *Table5-16* shows main characteristics of collected samples.

5.5.6 Water Quality

Background

The pollution of surface water in Tebbin is limited because Tebbin receives a continuous flow of fairly clean water from the Nile upstream, and the pollutants discharge into the river are considerably diluted by this massive volume of water. No significant discharge of sewage into the Nile occurs in Tebbin. Ambient concentrations of pollutants in the river and main canals do not exceed standard for acute, short-term exposures (DHV Consultants, 1996).

The concentrations of chemicals and bacteria in the Nile's water are well within acceptable standards for safe irrigation of food crops. The levels of chemical and microbial contaminants in canals are likely to be higher because the canals do not receive constant influx of cleaner water.

Nile water quality data within the Tebbin area of influence (intake/discharge points) is obtained for two monitoring locations along the Nile namely: NL 31 and NL 32. These locations are regularly monitored by the Ministry of Water Resources and Irrigation. The first location is upstream the power plant site while the second is 1km downstream.

Some water quality parameters were selected to represent the chemical and biological quality of the Nile water before the power plant site as shown in Table 5-17.

Figure 5-27

Bathymetry of the Tebbin Nile Segment along the Western Side of the Proposed Site

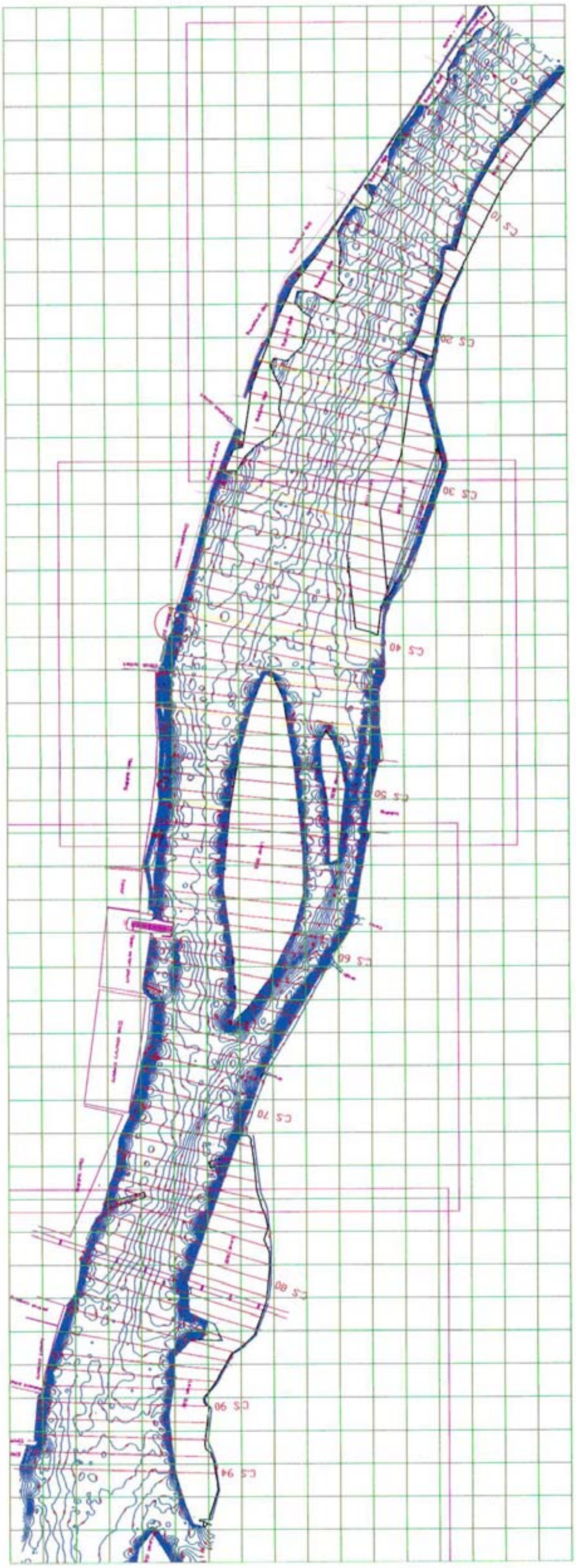


Figure 5-28

Layout Locations of Velocity Measurement Cross-Sections

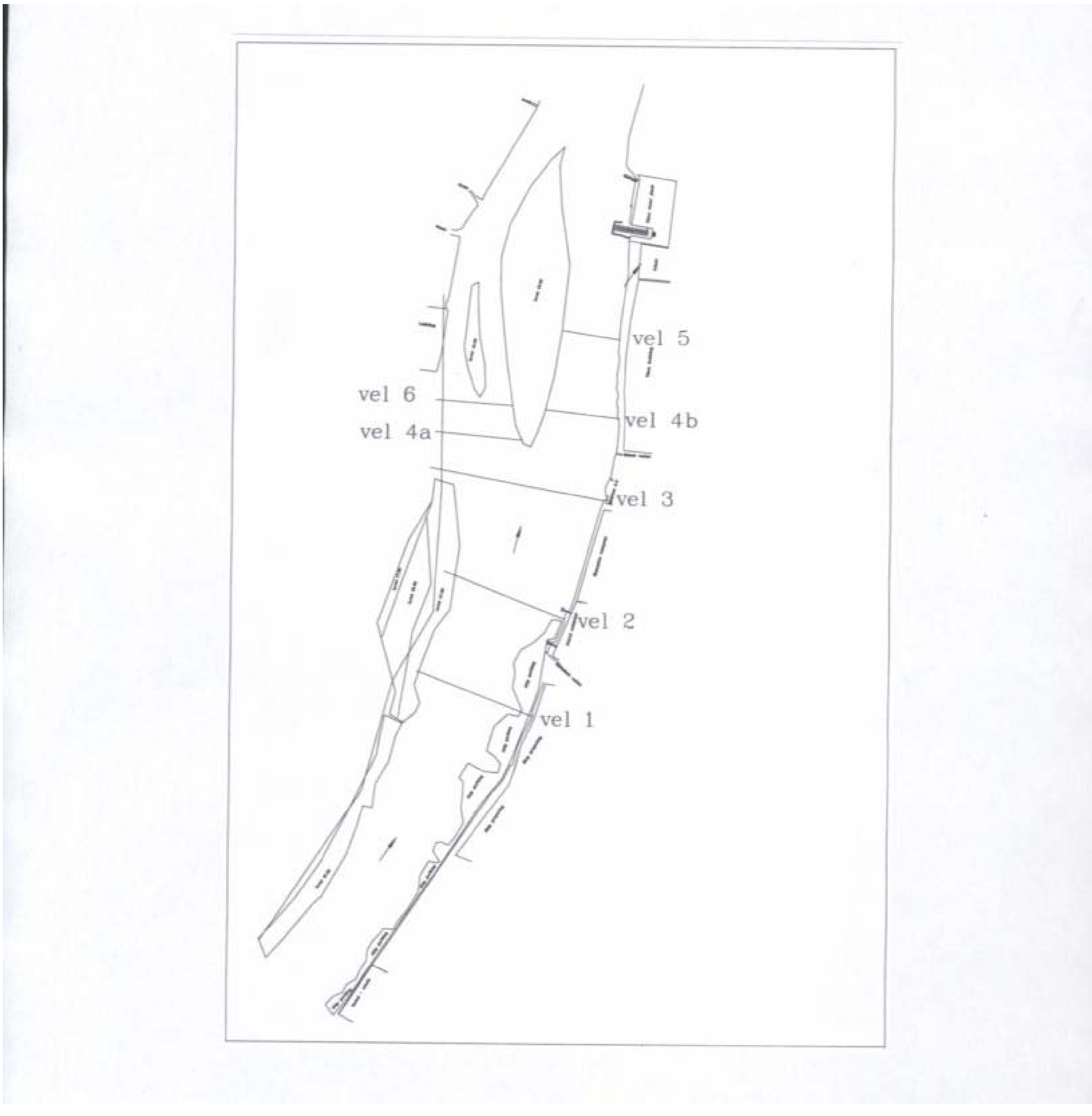


Table 5-14

Nile Water Discharge and Corresponding Water Levels at El-Tebbin Plant Site During 2004

Month	Nile Water Discharge		Water Level (W.L.) (+M.S.L.)
	Q (M.m^3/day)	Q (m^3/sec)	
January	40.78	472	16.24
February	70.15	812	17.00
March	94.85	1098	17.63
April	91.73	1062	17.55
May	97.29	1126	17.69
June	160.96	1863	19.34
July	160.96	1863	19.34
August	141.43	1637	18.82
September	97.37	1127	17.69
October	68.97	798	16.97
November	74.78	866	17.12
December	56.7	656	16.66

Table 5-15

Velocity Distribution at Cross Section 3[(1), (2)]

Distance from Left Bank (m)	Total Depth (m)	Point Depth (m)	Temperature (°C)	Direction (o)	Velocity (m/s)
0	0.0	0.0	0.0	0.0	0.00
16	4.1	0.8	22.8	6.5	0.10
		2.1	22.8	342.3	0.10
		3.3	22.8	344.6	0.09
65	1.1	0.6	22.8	314.1	0.36
118	1.4	0.7	22.8	325.2	0.49
143	1.4	0.7	22.8	330.4	0.54
184	1.9	0.4	22.8	337.5	0.55
		1.0	22.8	335.0	0.50
		1.5	22.8	356.5	0.38
223	2.4	0.5	22.8	343.1	0.57
		1.2	22.8	342.5	0.55
		1.9	22.8	342.1	0.49
283	2.8	0.6	22.8	349.5	0.63
		1.4	22.8	350.3	0.55
		2.2	22.8	347.9	0.41
328	2.8	0.6	22.8	352.0	0.67
		1.4	22.8	352.8	0.61
		2.2	22.8	348.4	0.48
376	3.6	0.7	22.8	1.9	0.67
		1.8	22.9	2.9	0.63
		2.9	22.9	5.3	0.54
414	4.0	0.8	22.9	3.6	0.74
		2.0	22.9	4.7	0.73
		3.2	22.9	4.9	0.65
440	4.3	0.9	22.9	3.5	0.76
		2.2	22.9	4.8	0.71
		3.4	22.9	4.6	0.62
475	5.0	1.0	23.0	6.6	0.78
		2.5	23.0	7.3	0.77
		4.0	23.0	8.8	0.61
517	4.8	1.0	23.0	6.9	0.89
		2.4	23.0	8.4	0.82
		3.8	23.0	8.4	0.64
560	4.8	1.0	23.1	9.3	0.74
		2.4	23.1	10.5	0.69
		3.8	23.1	9.2	0.59
589	5.2	1.0	23.1	9.5	0.60
		2.6	23.1	8.6	0.55
		4.2	23.1	7.1	0.49
613	4.5	0.9	23.2	1.8	0.41
		2.3	23.2	5.5	0.39
		3.6	23.2	4.5	0.26
628	0.0	0.0	0.0	0.0	0.00

Notes:
(1) Location: Left Bank: E = 334360.0, N = 3295238.0 - Right Bank: E = 334977.4, N = 3295126.0
(2) Water Level: 17.64 m – Discharge 1147.81 m^3/sec.

Table 5-16

Characteristics of Bed Sediments

Cross Section Number	Location			Sample Characteristics			
	Sample No.	Distance from Left Bank	Bed Level (m)	d_{16} µm	d_{50} µm	d_{84} µm	σ_g
1	1	110	15.13	246	337	456	1.362
	2	220	12.75	293	430	622	1.457
	3	330	10.73	228	318	658	1.700
2	1	115	15.27	224	317	450	1.416
	2	230	12.87	214	306	446	1.443
	3	345	11.07	241	319	581	1.554
3	1	157	16.24	262	342	475	1.346
	2	314	14.80	271	383	526	1.394
	3	470	12.85	213	300	530	1.580
4(a)	1	79	16.23	200	298	438	1.478
	2	157.5	15.9	291	412	561	1.388
	3	236	15.33	154	291	5242	5.835
4(b)	1	66	13.62	257	387	646	1.586
	2	130.5	13.12	233	354	775	1.822
5	1	50	11.85	205	300	522	1.596
	2	100	11.25	216	307	588	1.639
6	1	68.75	16.25	268	423	667	1.577
	2	137.5	16.15	208	468	691	1.821
	3	207	15.85	224	420	698	1.765

Table 5-17

Nile Water Quality Within El-Tebbin Power Plant

Station	NL 31 (km 888 from AHD)(1)		NL 32 (km 902 from AHD)	
Parameter	**Feb. 2004**	**Aug. 2004**	**Feb. 2004**	**Aug. 2004**
BOD, mg/I (or ppm)	7	1	4	3
DO, mg/I (or ppm)	8.88-9.15	8.15-8.42	9	8.5
TDS, mg/I (or ppm)	218	225	221	226
Faecal Coliform, mpn/100ml (or csu/100ml)	20-3200	50-80	80	70

Notes:
(1) AHD = Aswan High Dam.

It is obvious that the Nile water is well oxygenated and is suitable for all aquatic life forms. Its salinity is also within the recommended standards of the Ministry of Water Resources and Irrigation (Kandil, 2003), thus it is safe to be used for agricultural and industrial purposes. From the biological contamination point of view, the Nile water in the study area is generally within the standard limits. However, concentration of faecal coliforms is high in February 2004 that most probably attributed to sudden discharge of raw domestic waste which is a common illegal practice in some areas (Nasser, 2005).

Water Quality Measurements

Water Quality Measurements as well as sediment samples at five sample locations (500 m upstream the Tebbin site, intake, midpoint of the main stream of the Nile at the intake cross section, 100m and 200m downstream the Tebbin site) were taken on 4th June 2005 (Water Quality Consultation Unit, National Research Center, June 2005). The results of water quality determination include chemical analysis of water samples (physio-chemical parameters, concentration of heavy metals and identification of organic content), microbiological analysis (bacteriological examination and algal counts) and chemical analysis of sediment.

Water Characteristics and Quality

- Physico-chemical Analysis

Table 5-18 presents the results of physico-chemical measurements of water samples collected at selected sites namely No. I, 2, 3, 4 and 5. Values of water temperature, pH and dissolved oxygen content do not reveal the presence of any significant variation in-between the water samples collected at given sites. In addition, water transparency is low at various sampling sites and shows values range between 80 cm and 90 cm which is in agreement with values of suspended solids.

Concentration of TDS ranges between 226 mg/1 and 250 mg/I. Variation in TDS values is rather limited with almost the same values of the Nile river.

Values of total alkalinity are almost the same. These results are in agreement with the general trend of the pH values. Meanwhile, the concentrations of chlorides and sulfate do not show material differences. Concentration of chloride ranges between 18 and 20 mg/I and the concentration of sulfate between 7 and 8 mg/I. Nitrate always presents at a very low concentration in the range of 0.06 to 0.07 mg/I.

Concentration of sodium ions in the Tebbin Nile segment is generally low and sodium contents of water samples approach each other. Variation in concentration of potassium do not show material differences along the 5 sampling sites. Concentration of calcium attains higher values compared to magnesium which is a general characteristic of the Nile river water. Chemical oxygen demand (COD) shows a value of 22 mg O_2/l, and values of biological oxygen demand (BOD) are very low at all sampling sites and do not exceed 4 mg/I.

- Organic Content of Tebbin Nile Segment

Results presented in *Table 5-19* reveal that water samples collected at all sites contain very low concentrations of phenols. Chlorinated hydrocarbons detected in site No. 1 with highest concentration of 1.569 μg/I. Total hydrocarbon and polyaromatic hydrocarbon values range between 1.331 and 2.654 μg/I and between 0.517 and 0.912 μg/I respectively. Also, oil and grease content of water samples is low at all sampling sites and ranges between 0.95 and 1.95mg/I.

- Heavy Metals Content

Table 5-20 shows that all heavy metals under investigation are detected very low in water samples of Tebbin Nile Segment with no exceptions. The concentration of zinc, for instance, ranges between 0.024 and 0.047 mg/I, which is the highest concentration one.

- Bacteriological Examination

Results of bacteriological examination of water samples are given in *Table 5-21*. Bacteriological indicators of faecal pollution are detected in all samples. Total coliform ranges between $1.5x10^3$ and $1.1xl0^5$/100 ml and faecal coliform ranges between $2.8x10^2$ and $4.3x10^4$/100 ml. Total bacterial counts at 22^oC range between $1.2x10^3$ and $6.6x10^3$, whereas counts at 37^oC range between $5.8x10^3$ and $2.5x10^4$ cell/cm^3. Total counts and bacteriological vary between all locations.

- Algal Counts

The general distribution of algae and their counts in water samples are given in *Table* 5-22. In general, diatoms represented the higher counts and range between 5472 and 6202 organisms/ml. Green algal count ranges between 462 and 560 organisms/ml whereas blue-green algae represent the lowest algal population and ranges between 264 and 330 organisms/ml. In general, total algal count ranges between 6288 and 6994 organisms/ml.

Sediment Characteristics

- Organic Content

Results given in *Table* 5-23 reveal the general characteristics of sediments with respect to their COD, total extractable organic matter, oil and grease, total hydrocarbons, chlorinated hydrocarbons and polyaromatic hydrocarbons. Values of COD attain their highest level of 32846 mg O_2/kg at site No. 2 whereas the lowest COD value of 29325 mg O2/kg is recorded at site No.5. This trend in COD values of Tebbin Nile water does not coincide with that of the distribution of total extractable organic matter, where the maximum value is recorded at site No.4 (398 mg/kg) whereas at site No.1 a low value of 215 mg/kg is attained. In support of that trend, the value of oil and grease attained at site No.4 is 319 mg/kg whereas the concentration of oil and grease in water at sample site No.1 is only 173 mg/kg.

Results given in *Table 5-23* reveal that the concentration of total hydrocarbons and polyaromatic hydrocarbons vary from one site to another and partly coincide with the general distribution of COD values and total extractable organic matter of the sediment. The highest concentration levels are recorded in sediment samples derived from sites No.4 and 2 whereas the lowest values are recorded in sample collected at sites No.3 and 1. This is not the same distribution for chlorinated hydrocarbons which attain their highest value at site No.4 (0.91 mg/kg) and the lowest value at site No. 1 (0.23 mg/kg).

- Heavy Metals Content

The concentrations of Zn, Cd, Cr, Pb, and Ni in sediment samples are shown in *Table* 5-24. Cadmium salts are detected very low in all sampling sites with an average value of 0.042 mg/kg. Zinc presents the highest concentration level of heavy metals to be found in the sediments, showing a mean concentration value of 1.212 mg/kg; whereas the mean concentration values of chromium, lead and nickel are 0.316, 0.184 and 1.79 mg/kg, respectively.

Table 5-18

Physico-chemical Analysis of Water Samples

Parameters	Unit	Concentration				
		Site (1)	**Site (2)**	**Site (3)**	**Site (4)**	**Site (5)**
pH	-	7.5	7.6	7.6	7.5	7.4
Water Temperature	^{o}C	29	29	28	29	29
Electrical Conductivity	µmho/cm	420	410	403	385	397
Dissolve Oxygen	MgO_2/I	8	8	7	7	8
Transparency	Cm	90	90	80	80	90
Total Dissolved Solids	mg/I	250	240	230	226	232
Suspended Solids	mg/I	8	6	8	9	10
Total Solids	mg/I	258	246	238	235	242
Total Alkalinity (as $CaCO_3$)	mg/I	122	120	124	122	124
Chloride(CI^-)	mg/I	20	20	20	20	18
Sulfate (SO_4^{--})	mg/I	7	8	7	7	7
Nitrate (NO_3-N)	mg/I	0.06	0.07	0.06	0.06	0.06
Sodium (Na^+)	mg/I	20	22	20	22	20
Potassium (K^+)	mg/I	3	4	3	3	3
Calcium (Ca^+)	mg/I	26	28	25	27	26
Magnesium (Mg^{++})	mg/I	9	10	10	10	10
COD	mg O_2/l	10	22	12	18	16
BOD	mg O_2/l	2	4	2	4	2

Notes:
(1) Upstream.
(2), (3) Just before (fronting) the power plant site.
(4) 100m downstream.
(5) 200m downstream.

Table 5-19

Physico-chemical Analysis of Water Samples

Parameters	Unit	Concentration				
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
Phenol	mg/I	0.005	0.007	0.005	0.002	0.005
Oil& Grease	mg/I	0.95	1.95	1.19	1.26	1.31
Polyaromatic Hydrocarbons	μg/I	0.517	0.666	0.912	0.618	0.741
Total Hydrocarbons	μg/I	1.331	2.654	2.168	1.775	2.215
Chlorinated Hydrocarbons	μg/I	1.569	0.494	0.882	0.606	1.123

Table 5-20

Heavy Metals Analysis of Water Samples

Parameters	Unit	Concentration					Detection Limits*
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)	
Zinc	mg/I	0.025	0.024	0.047	0.041	0.041	0.005
Cadmium	mg/I	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
Chromium	mg/I	<0. 02	<0. 02	<0.02	<0. 02	<0.02	0.02
Lead	mg/I	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Nickel	mg/I	<0.02	<0.02	<0.02	<0.02	<0.02	0.02

Notes:
* Detection Limits: The sensitivity of the equipment.

Table 5-21

Microbiological Analysis of Water Samples[(1)]

Site No.	Total Bacterial Count, Cell/cm^3		Most Probable Number Index/100ml	
	At 22°C	**At 37°C**	**Total Coliform**	**Faecal Coliform**
Site (1)	2.2×10^3	1.2×10^4	2.4×10^3	2.8×10^2
Site (2)	6.6×10^3	7.6×10^3	4.6×10^4	3.7×10^3
Site (3)	3.6×10^3	2.5×10^4	1.5×10^3	3.1×10^2
Site (4)	1.2×10^3	1.4×10^4	4.6×10^4	1.8×10^3
Site (5)	2.3×10^3	5.8×10^3	1.1×10^5	4.3×10^4

Notes:

(1) Samples Delivery Date : 4/6/2005.
Date of Analysis : 4/6/2005.

Table 5-22

Algal Counts of Water Samples

Parameters	Count (Organisms/ml)				
	Site (1)	**Site (2)**	**Site (3)**	**Site (4)**	**Site (5)**
Diatoms	5472	6202	5500	5980	5610
Green Algae	552	462	560	506	516
Blue-Green Algae	264	330	270	322	292
Total Algal Counts	6288	6994	6330	6808	6418

Table 5-23

Organic Analysis of Sediment

Parameters	Unit	Concentration				
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
COD	mg O_2/kg	32620	32846	29780	30592	29325
Extractable Organic Matter	mg/kg	215	231	255	398	376
Oil & Grease	mg/kg	173	185	204	319	305
Polyaromatic Hydrocarbons	mg/kg	1.23	3.06	1.32	2.63	2.25
Total Hydrocarbons	mg/kg	16.4	22.3	15.2	33.8	31.5
Chlorinated Hydrocarbons	mg/kg	0.23	0.31	0.39	0.91	0.56

Table 5-24

Heavy Metals Analysis of Sediment

Parameters	Unit	Concentration					Detection Limits(1)
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)	
Zinc	mg/kg	1.22	2.05	1.05	0.88	0.86	-
Cadmium	mg/kg	0.05	0.07	0.05	0.03	0.01	0.002
Chromium	mg/kg	0.32	0.40	0.29	0.31	0.26	-
Lead	mg/kg	0.16	0.21	0.12	0.21	0.22	-
Nickel	mg/kg	0.33	0.40	0.36	0.38	0.32	-

Notes:
(1) Detection Limits: The sensitivity of the equipment.

5.6 AQUATIC ECOLOGY

5.6.1 Aquatic Flora

Background

The Nile river and its branches (Damietta and Rosetta), the extensive network of irrigation canals with their ramifications till the level of field ditches, and the equally extensive networks of drainage provide: (1) aquatic habitats of various dimension and water; and (2) bank and embankment habitats.

The river control structures built during this century and earlier caused certain changes in the water habitat: rates of water flow, silt load and hence turbidity and erosive power, and chemistry of water. The development of industry and human settlements, mostly within the inhabited Nile Valley and the Delta, caused excessive discharge of industrial and domestic effluents into the water bodies. Again, the full control of the river flood and of the river water level stopped the seasonal rise and fall of the water, a phenomenon that used to flood and drain the river terraces. These ecological changes caused changes in the flora of these water bodies. For instance the submerged plant *Myriophyllum spicatum* was not included in earlier records of the Nile plants. The evidently vigorous growth of other submerged species all over the Nile and its branches may be due to reduction of silt load (especially during the flood) and hence reduction of turbidity. It is also noted that the composite *Ceruana pratensis*, once a common plant along terraces and banks of the Nile and major irrigation canals, is now a very rare species, probably disappearing (EEAA/UNEP, 1993).

Within the complex of habitat types that may be grouped under this Irrigation Drainage Network category and its associated habitats, the following sets have been recognized (EEAA/UNEP, 1993).

Aquatic Habitat Types

- Aquatic-Submerged:
  This includes the following community types: *Ceratophyllurn demersum, Potamogeton pectinatus, Potamogeton crispus, Elodea Canadensis* and *Najas armata.*

- Aquatic-Floating (rooted):
  This includes the following community types: *Nymphaea coerulea, Potamogeton nodosus, Echinochloa stagninum* and *Polygonum salicifolium.*

- Aquatic-Floating (free):
  This includes the following community types: *Eichhornia crassipes* and

Lemma gibba - Spirodela polyrrhiza.

- Emergent Reed Swamp Vegetation:
  This group is associated with bank and island habitats, and include the following community types: *Echinochloa stagninum* (also group b), *Typha domingensis, Phragmites australis* and *Leersia hexanra.*

Nile Bank Habitat Types (El-Sheikh, 1989)

- Vegetation of the Terrassements:
  This group includes the following community types: *Panicum repens, Imperata cylindrical* and *Desmostachya bipinnata.*

- Vegetation Types on both Terrassements and Bank Slopes:
  This group includes the following community types: *Cynodon dactylon-Rumex dentatus, phragmites australis-Imperata cylindrica* and *Saccharum spontaneum.*

- Vegetation types on the Lower Levels of the Bank:
  This includes community types that are transitional with the aquatic vegetation and Comprises: *Polygonum salicifolium, Phragmites australis* and *Echinochloa stagninum.*

5.6.2 Aquatic Fauna

As the project area is located in the vicinity of the Nile river, an overview of the aquatic fauna is given hereunder.

Rotifera

Rotifers are found in immense number and variety in freshwater lakes, ponds and streams. Wayside pools, drains, and even the dirty water are prolific sources of rotifers. The free-swimming members of the *rotifers* constitute a high percentage of the *plankton* which is the main food for many young and adult fishes.

In Egypt, this group is well represented in freshwater ecosystems. Nearly 118 species of rotifers have been recorded in the Nile river.

Protozoa

Flagellates which are capable of photosynthesis represent a basic link in the food chain of organisms. Our knowledge of the Egyptian protozoan fauna is not sufficient and the group is much less known than other faunal groups. The

Subphyla Mastigophora, Sarcodina and *Ciliphora* are represented in Egypt. They are well distributed in the Nile river and its tributaries.

Annelida (Earthworms & Leeches)

Freshwater *annelids* in Egypt include two families *Obligochaeta* and *Hirudinea*. The aquatic forms are nearly all confined to freshwater. Aquatic oligochaetes play an important role in reducing the great masses of aquatic vegetation to a finely comminuted condition. Some leeches, like *glossiphoniid* members are known to act as intermediate hosts for certain parasites. Others play an important role as a mean of biological control for the snail vector parasites infecting man and other mammals. Others provide food sources for insects, crustaceans, fish and birds. The leech species are limited and until now 19 leech species have been recorded.

Crustacea

Cladocera constitute the largest group of freshwater crustaceans. They live chiefly among the weeds, clinging to plants and higher algae. *Cladocera* have great economic value. Together with the *Copepoda,* they constitute the chiefagency for converting the smaller algae into a form edible by the carnivorous aquatic animals. They are themselves of great value as food for young fishes and there is a period in the life of almost every fish when it feeds exclusively on them. In Egypt, 43 species of *Cladocera* have been recorded in the Nile river and inland lakes.

Acarina (Mites)

Freshwater *mites* compose an important part of aquatic fauna. The majority of water mites are parasitic. About 84 *mite species* belonging to 53 genera have been recorded in Egypt belonging to 37 families.

Mollusca (Bivalves & Snails)

Mollusca species are well distributed along the Rive Nile and in inland and coastal lakes as well as irrigation channels. They prefer living among aquatic plants and in mud. On the other hand, 13 *bivalve* species have been recorded in the Nile river and its tributaries. The following species are recorded (Ibrahim et al., 1999).

Bellamya unicolor (common), *Lanistes carinatus* (common), *Valvata nilotica* (rare), *Gabbiella senaariensis* (common), *Melanoides tuberulata* (common), *Cleopatra bulimoides* (common), *Lymnaea natalensis* (common), *L. columellu* (rare), *Biomphalaria alexandrina* (common), *Bulinus truncatus* (common), *Caelatura teretiuscula* (common), *Sphaerium hartmanni* (common), and *Pisidium amnicum* (rare and has been collected near the project site).

Much attention in this organisms was and still given to the principal snail groups which transmit Schistosomiasis as *Bulinius* spp. and *Biompholaria* spp., as well as *Lymnaea* spp, which transmit fascioliasis (liver flukes) to animals and man.

Osteichthyes (Bony Fishes)

During recent decades, the Nile river ecosystem has been subjected, as previously mentioned, to many ecological stresses that led to significant changes in the physico-chemical properties of the water, and consequently affected the biological ecosystem. In response to these changes, several fish species disappeared completely, while others began to show marked decline, espccially in the down stream areas, where the water is almost lentic.

Boulenger (1907) mentioned that Loat was the first who made a fish survey of the Nile and he recorded about 85 species, inhabiting the Egyptian Nile waters. The present number of recorded species is 70 included under 16 families and 49 genera. Three families (i.e. Characinidae, Cyprinidae and Siluridae) include about 70% of the species. Of the 85 species that were previously recorded at the beginning of the present century, 15 species are extinct and were not recorded during the last 50 years.Furthermore, due to the change in the River regime most riverine fish are becoming rare and these represent 51 species. Only 15 species are the most common and contribute to the freshwater production of Egypt. Cichlids (e.g. *Tilapia* spp.) especially *Oreochromis niloticus, Sarotherodon galilaeus, Tilapia zillii* contributes the highest percentage of freshwater production. The list of common and threatened fish species is given in *Table 5-25*.

Table 5-25

List of Common and Rare/Threatened Fish Species in the Lower Nile Segment till Delta Barrage

Common Fish Species	Rare/Threatened Fish Species
Mormyrus kannume	*Gnathonemus cyprinoides*
Labeo niloticus	*Alosa fallax*
Barbus bynni	*Labeo horie*
B. perince	*Labeo victorianus*
Hydrocynus forskalii	*Chrysichthys rueppelli*
Bagrus bajad	*Clarotes laticeps*
B. docmak	*Auchenoglanis occidentalis*
Chrysichthys auratus	*Schilbe niloticus*
Schilbe mystus	*Siluranodon auritus*
Synodontis schall	*Synodontis serratus*
Lates niloticus	*Synodontis clarias*
Tilapia zillii	*Aphanius fasciatus*
Oreochromis niloticus	*Dicentrarchus labrax*
Oreochromis aureus	*D. punctatus*
Sarotherodon galilaeus	*Hemichromis bimacalatus*
Mugil cephalus	*Haplochromis bloyeti*
Liza aurata	-
Liza ramada	-
Clarias gariepinus	-

The following fish species are recorded in the Nile Segment around the project site: *Oreochromis spp, Tilapia zillii, Anguilla anguilla, Clarias gariepinus, Heterobranchus spp, Lates niloticus* and *Synodontis clarias*. Around the project site, only low fishing and some recreational fishing are practiced. Interviews with the local community and the Egyptian General Authority for Fish Resources Development, Ministry of Agriculture indicated that the catch is generally low and that no commercial fishing takes place near the site.

No snail species were collected during the field survey. Annelids (earthworm) were observed.

Reptilia & Amphibia

Aquatic reptiles and amphibians are not well represented in Egypt. Only 4 aquatic reptile species have been recorded in Egypt, belonging to 4 families. Three of them are considered rare species, while the fourth one (Nile-Turtle) has disappeared during the last 30 years.

Seven amphibian species have been recorded in Egypt, belonging to 3 families and 4 genera i.e. Bufo, Rana, Hyla and Ptychadena. Three species are common while the other 4 are rare.

Vertebrate Fauna

The vertebrate fauna of Nile Banks is generally that of the Nile Valley with a few exception of species specifically adapted to this aquatic habitat such as amphibians, herons and bitterns, the moorhen, some snakes and particularly the Red-eared Turtle, an introduced species native of the United States and South America whose introduction seems to have been both accidental and deliberate (Saleh, 1997).

5.7 FLORA AND FAUNA

5.7.1 Introduction

A landscape ecological approach was adopted for addressing flora and fauna within the proposed site area.

Information and data on the project hinterland, area, and site were gathered from published material, reports and Internet search. Field reconnaissance was carried out to identify site-specific ecological settings and their floral and faunal communities. As for threatened and endangered species, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, Washington D.C., 1973) has produced very comprehensive lists of endangered species inventoried in three different appendices according to their degree of exposure to risk of extinction. Besides, the International Union for the Conservation of Nature (IUCN) detains an exhaustive list of threatened and endangered species of plants and animals allover the world (IUCN Red List of Threatened Species). They are divided into different categories according to their conservation status. These categories, according to the 2001 revised version, are: Extinct (EX) – Extinct in the Wild (EW) – Critically Endangered (CR) – Endangered (EN) – Vulnerable (VU) – Least Concern (LC) – Data Deficient (DD) – Not Evaluated (NE). In the previous 1994 version, the category Lower Risk (LR) was replacing LC. This category was divided into three subcategories: Conservation Dependent (cd), Near Threatened (nt), and Least Concern (lc). The current IUCN Red List includes assessments using both the 1994 and the 2001 Red List Categories and Criteria. The CITES appendices and IUCN Red list were used to describe the international status of species. To determine the local status, it was referred to the available literature and information tools, such as EEAA/UNEP (1993) and particularly to the database of the Biodiversity Unit of the Natural Protectorates Department (EEAA) regarding all the Egyptian protected species including invertebrate fauna.

Interviews with the former power plant officials and members of the surrounding community also were carried out to collect additional information.

Satellite images of different spatial, temporal and spectral resolution were also used. The sources of the images are: Landsat TM and Ikonos satellites. Landsat TM image having 30 x 30 m resolution was used to describe the landscape ecology of the project hinterland. This satellite image was digitally processed to delineate water bodies/ courses, urban/urbanized features and agricultural/vegetation units as shown in *Figure 5-29.*

5.7.2 Ecology of the Project Hinterland

The Tebbin Power Plant project area falls within two main physiographic regions (*Figure 5-29* and *Figure 5-30*). These are the northern part of the Nile Valley and the Northern Eastern Desert Eocene Plateau (Kassas, 1993;

Kassas

Figure 5-29

A Landsat Satellite Image Showing the General Landscape of El-Tebbin Power Plant Area

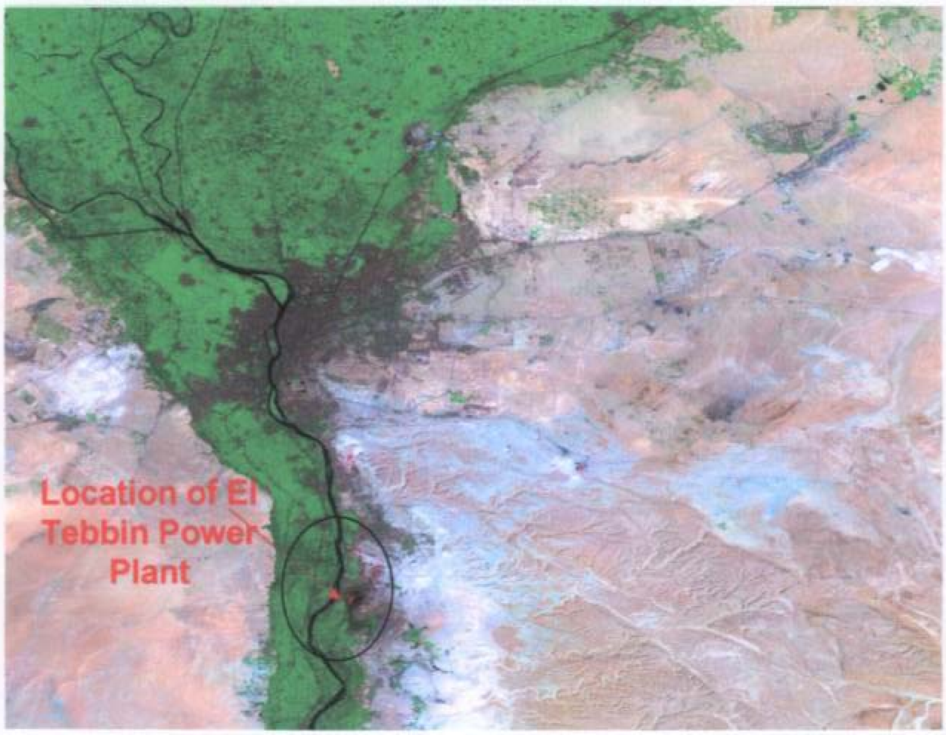
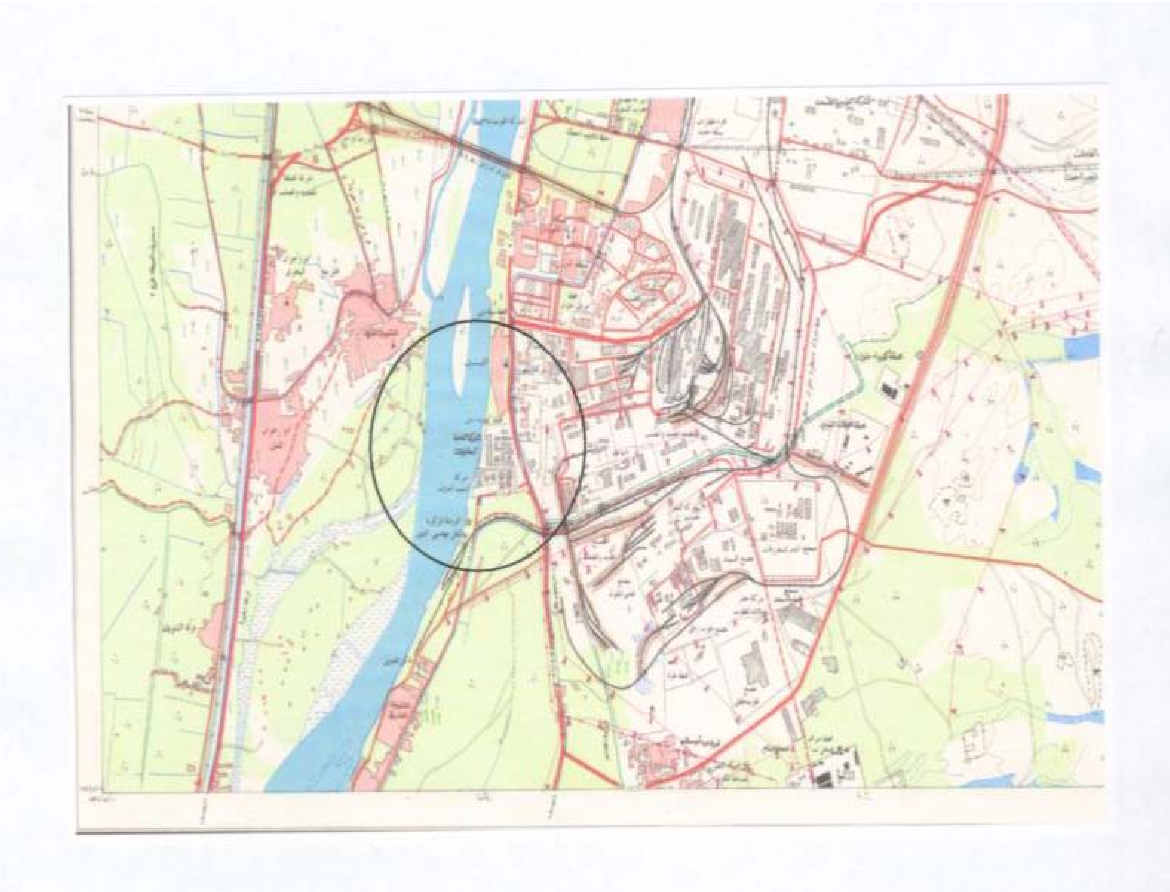


Figure 5-30

General Map Showing the Plant Location and its Surrounding Land Uses



et al., 1995). Although the Nile Banks are included within the Nile Valley, they have been considered as a separate habitat. In fact, they support a particularly adapted biodiversity related to both the riverine and terrestrial ecosystems.

Thus, the project hinterland may express characters of these three ecosystems and ones of edge habitats (e.g. Nile Valley/Eastern Desert) that would reflect a heterogenuous biodiversity. As a result, the flora and particularly the fauna of this habitat is a mixture of valley and desert biodiversity. On the other hand, numerous species prevail in one of the two ecosystems. Besides, species with particular morphological and physiological adaptations to a particular ecosystem may result absent in the other.

The invertebrate fauna, particularly annelids and molluscs, of the area show general specific adaptation to definite habitats such as the Nile banks and agricultural fields. Vertebrate fauna, principally mammals and birds, seem more adapted to life in both ecosystems with their different habitats that compose the study area; while reptilian species appear to be more restricted to a particular ecosystem.

Habitats and Biodiversity

Nile Valley and Delta

The Nile Valley and Delta are typical river oasis. South of the intensively cultivated Nile Delta, which is about 166 km long and 250 km wide, the average width of the Nile Valley is only about 10 km. This ecosystem forms a densely inhabited riverine oasis of farmlands and human settlements of all sizes.

With thousands of years of intensive human activities, the modern Nile Valley and Delta are essentially a man-made ecosystem. Animals now inhabiting the region are those that are able to tolerate human activities or those that can avoid contact with man. The intensive cultivation and the widespread use of agrochemicals have eliminated many of the native animals of the region (EEAA/UNEP, 1993).

The investigated soil is formed from the interaction between alluvial deposits and calcareous formation that was originated from the weathered materials rich with $CaCO_3$ from the Eastern Desert.

Survey of study area has resulted in the recognition of some sub-systems. Their principal characteristic features have been recorded as well as prevalent floral and faunal species. Some of these sub-systems showed analogous biodiversity, while others had more specific attributes.

Nile Valley’s Sub-systems

Agricultural fields

There are limited agricultural fields inside the study area of different sizes and with various crops *Figure 5-31*. It has been noticed that these fields appeared in different “healthy” conditions according to their distance and exposure to pollutants.

Soil texture of agricultural areas is sandy loam. The main weeds, shrubs and trees found in this habitat are: *Ammi majus* L. (Greater Ammi); *Malva parviflora* L. (Cheeseweed); *Cichorium pamilum* Jacq. (Chicory); *Ricinus* and *Ficus* trees; and Palm trees.

Very few faunal species were observed within the agricultural areas. Birds were also scarcely noticed most probably due to high pollution in the area as a result of the near by industrial establishments.

Human Settlements

Human settlements are mainly located in El Tebbin city and its immediate vicinity with scattered small slums southwards. Only a small settlement was found some 130 m to the northwest of the power plant close to the site of water intake/discharge *Figure 5-32*.

Flora

The farmlands of the Nile Delta provide habitat for a variety of weeds and ruderal plants in the fields, canal and drain banks, road and railway embankments, fallow fields, etc. Some of these are exotic species that were inadvertently introduced but have now become naturalized, such as *Argemone mexicana*, *Aster squamatus* and *Ageratum conyzoides* (Boulos and El-Hadidi, 1984). In addition, a large variety of field and economic crops are cultivated under agricultural controls.

Fauna

Invertebrates

Annelida (Earthworms & Leeches)

Annelids are found mainly in agricultural fields, Nile and irrigation channels’ banks. Some leeches, like glossiphoniid members are known to act as intermediate hosts for certain parasites. Others play an important role as a mean of biological control for the snail vector parasites infecting man and other mammals. Others provide food sources for insects, crustaceans, fish and birds. The leech species are limited and until now 19 leech species have been recorded (EEAA/UNEP, 1995).

The expected annelids of the NileValley and Nile banks habitats inclue: *Pheretima californica* Kinberg, 1867 (common); *Pheretima elongata* Perrier, 1872 (common); *Nannodrilus staudei* Mich., 1897, terrestrial (common); *Eisenia rosea f. bimastodes* Cognetti, 1901 (rare); *Allolobophora jassyensis* Var. *orientalis* Mich. 1897, terrestrial (common); and *Alboglossiphonia weberi* Blanchard, 1897 which lives undersides the stones and between leaves of water lily *Eichhornia crassipes* (rare).

Arachnida (Scorpions and Spiders)

Only seven orders of Arachnida are represented in Egypt (EEAA/UNEP, 1995). The available information about arachnids in Egypt is limited. There are limited information about their localities and habitats and the status of each species is often not determinable.

Hexapoda (Insects)

A study on invertebrate fauna carried out in an onion field in Giza, revealed the presence of representatives of the following orders of insects: Coleoptera, Hymenoptera, Lepidoptera, Psocoptera, Diptera, Tysanura, Thysanoptera, Neuroptera, Hemiptera (EEAA/UNEP, 1993).

Mollusca

Molluscs are present on Nile and irrigation canal banks. As they are strongly associated with the aquatic environment, they are broadly discussed in the Nile banks section.

Vertebrate Fauna

Four species of amphibians and 34 species of reptiles are known from the Nile Valley and Delta. Characteristic amphibians include *Bufo regularis, Ptychadena mascareniensis and Rana ridibunda* (EEAA/ UNEP, 1993; 1995; Saleh, 1997).

Common breeding birds of the Nile Valley and Delta include 66 species (Goodman *et al.*, 1989). At least 14 of these are not known to breed outside that habitat. The Nile Valley and Delta with their abundance of water and food available for birds provide an important, relatively, easy and safe route for trans-Saharan, palearctic migration. Huge numbers of individuals of many species utilize this route during both spring and autumn migrations. The region also provides wintering habitats for large populations of many palearctic migratory species (EEAA/UNEP, 1995; 1993; Tharwat, 1997).

Figure 5-31

Limited Agriculture within the Hinterland of the Power Plant

Figure 5-32

Human Settlements Near the Power Plant Site

Forty mammalian species are known to occur in the Nile Valley and Delta (Osborn and Helmy, 1980; Wassif *et al*., 1984; Qumsiyeh, 1985; Wassif, 1995) at the present time. Wild carnivores have suffered a great deal of decline in the recent years as a result of intense urban development and secondary poisoning with pesticides widely used to control *Arvicanthis niloticus* and other rodent pests (EEAA/UNEP, 1993; 1995).

Vertebrate fauna (Reptiles/Reptilia) that were generally recorded in the study area within the Nile Valley ecosystem include: *Hemidactylus turcicus* (NB), (D)[(1)]; *Chalcides ocellatus* (NB), (D); *Mabuya quinquetaeniata* (NB); *Chamaeleo africanus; Leptotyphlops cairi; Coluber florulentus* (NB); *Natrix tessellata* (NB); *Psammophis sibilans* (NB); and *Telescopus dhara* (D).

Common Birds of the Nile Valley include: *Passer domesticus; Bubulcus ibis; Elanus caeruleus; Milvus migrans* (NB); *Falco tinnunculus* (NB); *Rostratula benghalensis* (NB); *Burhinus senegalensis inornatus* (NB); *Vanellus vanellus* (NB); *Hoplopterus spinosus; Streptopelia senegalensis* (NB); *Streptopelia turtur; Psittacula krameri manillensis; Centropus senegalensis aegyptius; Tyto alba; Athene noctua glaux; Apus pallidus (D); Merops orientalis; Upupa epops; Riparia riparia* (NB); *Hyrundo rustica* (NB); *Galerida cristata nigricans* (NB); *Anthus pratensis* (NB); *Motacilla flava pygmaea; Motacilla alba* (NB); *Lanius excubitor* (D); *Corvus corone; Pycnonotus barbatus; Sylvia melanocephala; Cercotrichas galactotes; Phylloscopus collybita; Prinia gracilis deltae; Cisticola juncidis; Saxicola torquata; Luscinia svecica; Turdus merula; and Anthreptes platurus metallicus*[(2)].

Common Mammals of the Nile Valley include: *Hemiechinus auritus aegyptius* (D); *Crocidura flavescens* (NB); *Crocidura religiosa (nana)* (NB); *Crocidura floweri; Rousettus aegyptiacus; Rhinopoma hardwickei arabium; Rhinopoma microphyllum; Taphozus perforatus; Taphozus nudiventris* (D); *Pipistrellus kuhlii; Pipistrellus rueppellii; Tadarida teniotis; Tadarida aegyptiaca; Rattus rattus* (NB); *Rattus norvegicus* (NB); *Mus musculus* (NB); *Acomys cahirinus cahirinus; Acomys russatus; Arvicanthis niloticus* (NB); *Gerbillus gerbillus gerbillus; Gerbillus pyramidum pyramidum; Gerbillus andersoni; Canis aureus* (D); *Vulpes vulpes* (NB), (D); *Mustela nivalis* (NB); *Herpestes ichneumon; Felis chaus* (NB); and *Felis silvestris libyca* (NB)[(3)].

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(1) (NB) Also on Nile Banks, (D) Also in Desert Ecosystem; Source: Saleh, 1997.
(2) Source: Tharwat (1997); Miles (1998); Baha El Din and Atta (2002); Bruun and Baha El Din (2002).
(3) Source: EEAA/UNEP (1993); Wassif (1995); Animal Diversity Web

5.7.3 Landscape Ecology of the Site

The Tebbin Power Plant is located south to the Tebbin City along the Nile some 200-300 m to the east of the main Nile brach (*Figure 5-29* and *Figure 5-30*). The area is characterized by limited agricultural activities (*Figure 5-29*) and limited human settlements which is located closer to the cooling water discharge site (*Figure 5-30*). Other human settlements exist to the north of the power plant.

The main landscape feature is the presence of heavy industries, most of them are polluting the environment of the area as evident from the pictures taken around the plant site (*Figure 5-33*). These industries include the Iron & Steel, Company for Metals, El Nasr for Cock and Chemicals, etc. In addition, high resolution (ETM+) satellite images acquired for the power plant site and its surrounding landscape clearly depit the impacts of environmental pollution around the plant site, mostly to the south east of the plant, shown in red and black colors in the image *(Figure 5-34)*.

Also shown in the satellite image the immediate vicinity of the power plant where a lot of industries are located *(Figures 5-34)*. Agricultural lands appear in the farthest east of the power plant just behing Iron & Steel factory as well as to the south of the neighboring industries of El Tebbin popwer plant.

Just parallel to the Tebbin power plant runs a drainage ditch where some people through solid and liquid waste in *(Figure 5-35)*. In front of the existing cooling water intake/discharge location of the power plant, there exists a vegetated sand bar in the middle of the main Nile course *(Figure 5-34* and *Figure 5-36)*. The size of this elevated land varies with the variation in water level of the Nile. Aquatic marginal vegetation dominates this plot where some fishermen huts exist. Just on the other side of the Nile acroos the power plant, lies El Shbak El Gharbi Village *(Figure 5-36)*.

Plant life in the area around the site appears to be heavily impacted mainly from the air emissions of the adjacent industries. This is evidenced by the presence of *Lemna* sp. which is a good plant indicator of pollution *(Figure 5-35)*. Effect of pollution was also evident from the absence of the fruits from the palm trees in the study area in this time of the year. It has been observed that the trees which grow on road sides are characterized by a weak growth and parts or all of their shoot systems are dry. This is especially clear in case of the following trees which are used as wind shields (*Eucaluptus camaldulensis, Eucaluptus rosterata, Bombax, Delonix regia and Casuarina equisetiformis*) both along the road to the plant site and along its fences. Animal life is apparently strongly affected as both the diversity and species richness were very low.

- ***Fauna of the power plant site***

Very few animal species were observed on site. They include house sparrows, doves, Cattle Egret, wasps *(Figure 5-37)*, butterflies, ants and may be some rodents as evidenced by the presence of some land burrows. The number of these faunal species were very low, sometimes not even exceeding one specimen. This observation may indicate the heavy impact of pollution due to the surrounding industries. Comparing the faunal diversity of the Tebbin Power Plant to other power plants in the Delta or the Valley, it appears that this plant posses the least diversity and the least species abundance. As discussed just earlier, this may be due to the heavy pollution loads produced by the nearby industies.

In front of the location of the cooling water intake/discharge only one specimen of Pied Kingfisher (Ceryle rudis) was observed while it was fishing in the near bank area of the Nile. This indicates the presence of small Nile fishes in this area across the project site.

Aquatic fauna of the area in front of the water intake appeared similar in diversity to those of similar areas of the Nile banks. Fresh water mollusks included the following species: *Lanistes carnatus* and *Bellamya unicolor (Figure 5-38 A)* which are considered as a vector of the nematode species *Cercaria puslla* and *Angiosrongylus cantonensis* (the rat lung Nematode), as well as *Cleopatra bulimoides (Figure 5-38 B)* which is considered as a vector of the nematode species *Gastrodiscus aegypticus* and *Prohemstomum vivax.*

Fishing activities take place in the area by individual fishermen who use either small boats or just a line and hook. The main catched fishes are *Bargus bajad* (bayad), *Heterobranchus longifilis* (karmout) and *Tilapia* sp. (Bolty). However, within the site hinterland, fisheries are considered a minor resource to harvest by the locals.

- ***Flora of the power plant site***

On the contrary to the faunal diversity, the plant site is characterized by high floral diversity. Some of the plants aged from 1958 when the plant was first erected. Some of the plants are so biologically, genetically and economically important.

The study area was characterized by dense vegetation coverage despite of the fact that it is located in a heavily industrialized location. The recorded plant species in the study area can be divided into 2 groups:

The first group includes some of the very common wild Egyptian flora that colonizes neglected areas inside and outside the power plant, near the agricultural drainage banks. The most common representatives of this group include the following plants:

Figure 5-33

Polluting Industries around the Site of El-Tebbin Power Plant

Figure 5-34

ETM+ Satellite Image of the Study Area Showing the Environmental Pollution around El-Tebbin Power Plant Site

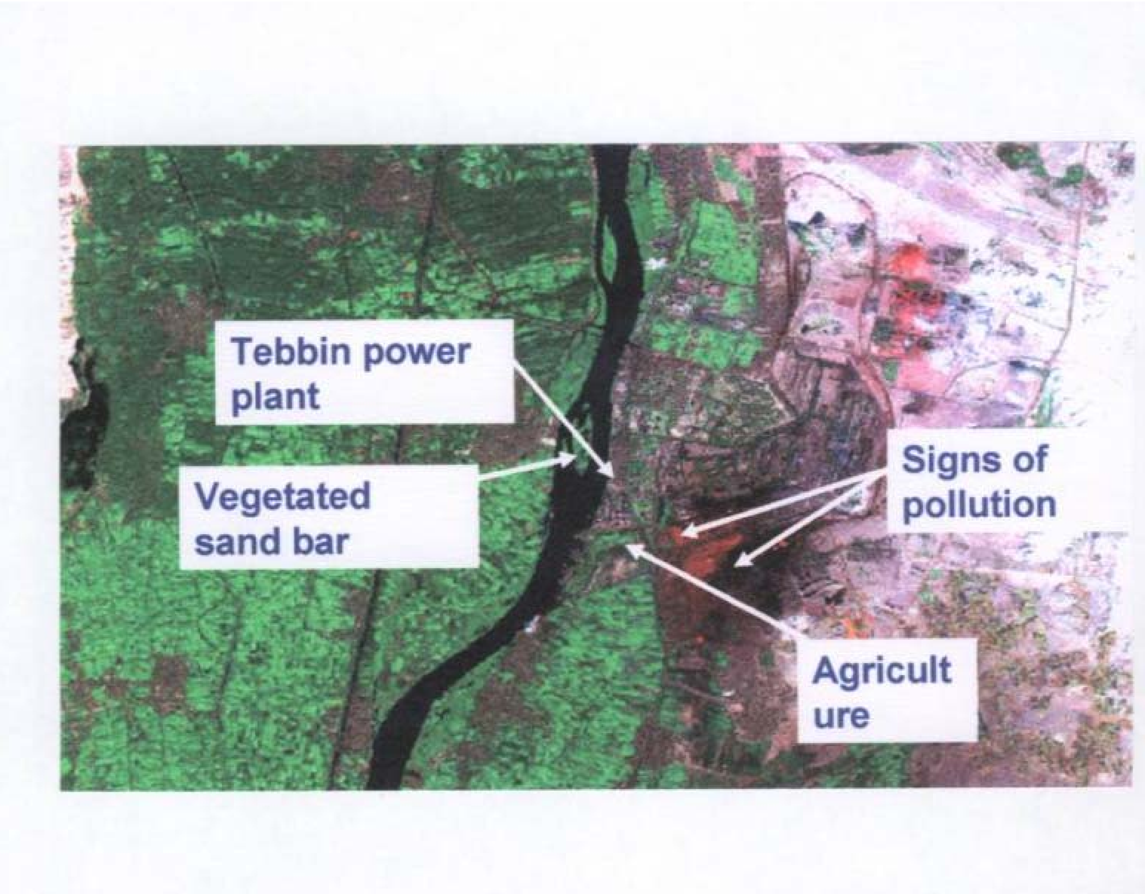


Figure 5-35

Drainage Ditch along the Power Plant Fence with Lemna sp.

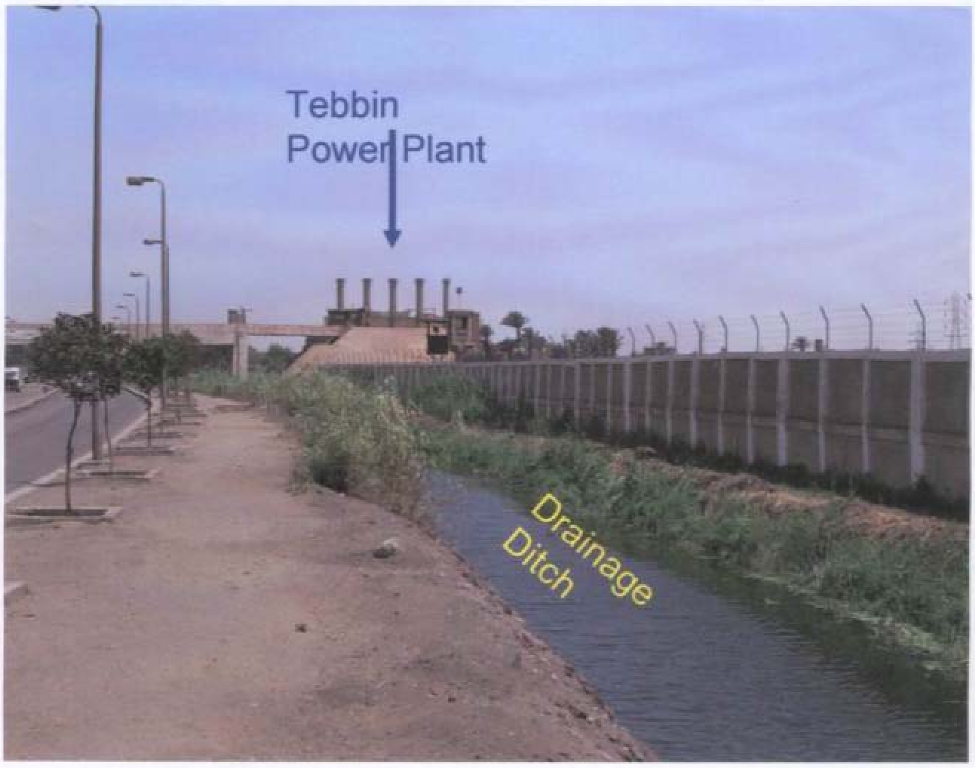


Figure 5-36

Panorama of the Western Side where Intake and Discharge Structures of the Tebbin Power Plant are Located, Showing the Vegetated Sand Bare and El-Shobak El-Gharbi Village

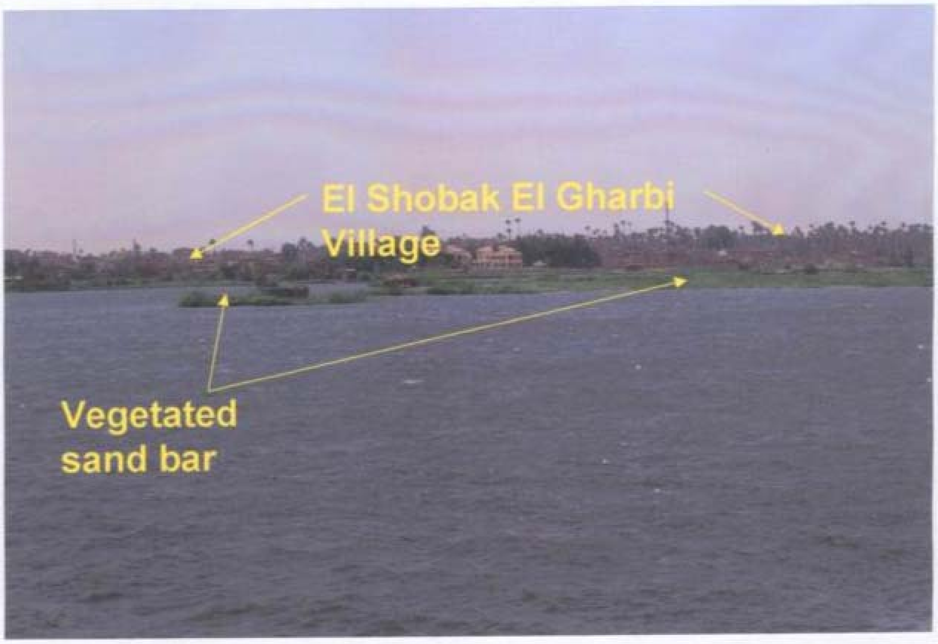


Figure 5-37

Wasp Sucking Nectar from Calotropis Shrup on Site

Figure 5-38

Fresh Water Snails Found along the Nile Bank of Water Intake/Discharge Location

1. *Phragmitis australis*, Family: Gramineae
2. *Imprata cylidrica,* Family: Gramineae
3. *Calotropis procera,* Family: Asclepidaceae
4. *Cyprus rotandus*, Family: Cyperaceae
5. *Cyprus* sp., Family: Cyperaceae
6. *Typha australis*, Family: Typhaceae
7. *Ecchornia crassipus,* Family: Pontederiaceae
8. *Asparagus stipularis*, Family: Liliaceae
9. *Asclepus* sp., Family: Asclepidiaceae
10. *Tamarix aphella*, Family: Tamaricaceae
11. *Oxallis* sp., Family: Oxallidaceae
12. *Nicotiana gluca,* Family: Solanaceae
13. *Datura stramonium,* Family: Solanaceae
14. *Lippia* sp., Family: Verbenaceae

The second group includes cultivatable trees and shrubs whose life spans extend to at least 20-40 years. The trees on the top of this list includes:

1. *Bombax* sp., Family: Bombacaceae *(Figure 5-39 A)*
2. *Pinus* sp., Family: Pinaceae *(Figure 5-39 B)*
3. *Delonix regia*, Family: Liguminosae
4. *Ficus nitida,* Family: Moraceae
5. *Ficus elastica* var. *decora*
6. *Morus* sp.
7. *Eucalyptus sp.* 1, Family: Myrtaceae
8. *Eucalyptus sp.* 2, Family: Myrtaceae
9. *Casuarina equisetiformis*, Family: Casuarinaceae
10. *Bauhinia varigata,* Family: Leguminosaea
11. *Antigonon leptopus*, Family: Polygonaceae
12. *Zizyphus spina christii,* Family: Rhamnaceae
13. *Washingtonia* sp. *(Figure 5-40)*
14. *Cassia nodosa*
15. *Theoja orientalis*

The most important trees inside the station area are:
1. *Bombax* sp.;
2. *Pinus* sp.; and
3. *Washingtonia* sp.

The importance of the above mentioned trees is due to their old age and the scarcity of *Pinus* trees in Egypt. These trees are considered a historical treasure that should be preserved as part of the renovation plan of the Tebbin power plant.

The main location at which new constructions and installations will be carried out inside the power plant *(Figure 5-41)* includes the following collection of plants:

(1) Antigonon sp.; (2) Callitropus sp.; (3) Zizyphus sp. *(Figure 5-42)* (to be protected as an important genetic resource); (4) *Morus sp.; (5) Vitis sp.; (6) Nicotiana sp.; (7) Cyperus sp.; (8) Imprata sp.; (9) Casuarina sp.; (10) Eucalyptus sp.; (11) Dodonia sp.; (12) Ricinus sp.; (13) Conyza sp.; (14) Phragmitis sp.; (15) Phoenix sp.; and (16) Ficus sp.*

5.7.4 Nature Conservation

No Natural Protectorates occur within the spatial influence area of the proposed project. However, major natural water resources; i.e. the Nile river and Ismailia Canal; occur in the vicinity of the project.

Figure 5-39

Biologically Important Bombax (A) and Pinus (B) Trees within the Power Plant Site

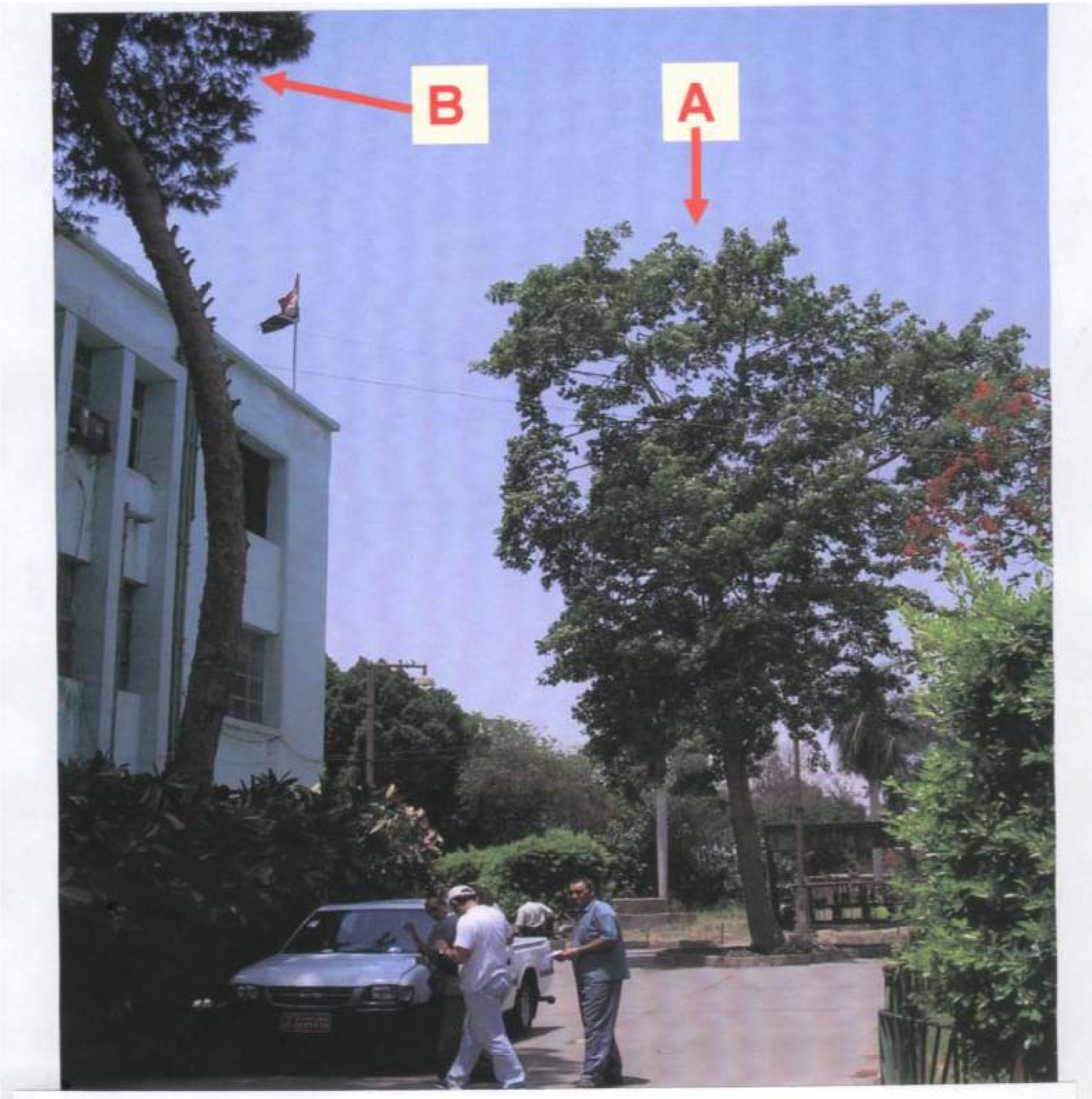


Figure 5-40

Biologically Important Washingtonia Palm Trees in the Site

Figure 5-41

Panorama of the Site where the New Power Generating Units will be Built

Figure 5-42

Biologically Important Zyzophus Tree Located East of the Site of the New Tebbin Power Power Plant

5.8 AMBIENT NOISE

5.8.1 Noise Sensitive Receivers

The major land use surrounding the site is industrial with some residential, supplemented by the noise that may be generated from traffic on the Cairo/Es-Saff Road to the west.

Residential colony has been identified in the neighbourhood of the proposed site boundaries, where the power plant operators are reside, and there are some population centers about 150m northwest the proposed site. The nearest land uses around the site are human settlements, public domain and industrial facilities with the Tebbin power plant's employee housing area, approximately 150 m to the north and the Iron and Steel Factory, approximately 250m to the east, Cock Factory, approximately 400m to the south, industrial compound including facilities of the General Company of Metals, the Petroleum Pipelines Company and the Central Workshops of Tebbin Transport, approximately 300m to the southwest, and the intake and discharge structures of the Tebbin Power Plant, approximately 200m and 300m to the west across the Cairo / Es-Saff Road. Agricultural lands appear to the south of the neighboring industries of the Tebbin power plant site as well as in scattered small areas to the farthest east within the desert land.

Due to the industrial nature of the proposed site and referring to the land use map of Greater Cairo, which identified both Tebbin and Helwan area as industrial one, the area is categorized as "Industrial Areas" with respect to Egyptian ambient noise standards (see *Table 2-5* in Section 2.6.4).

5.8.2 Ambient Noise Levels

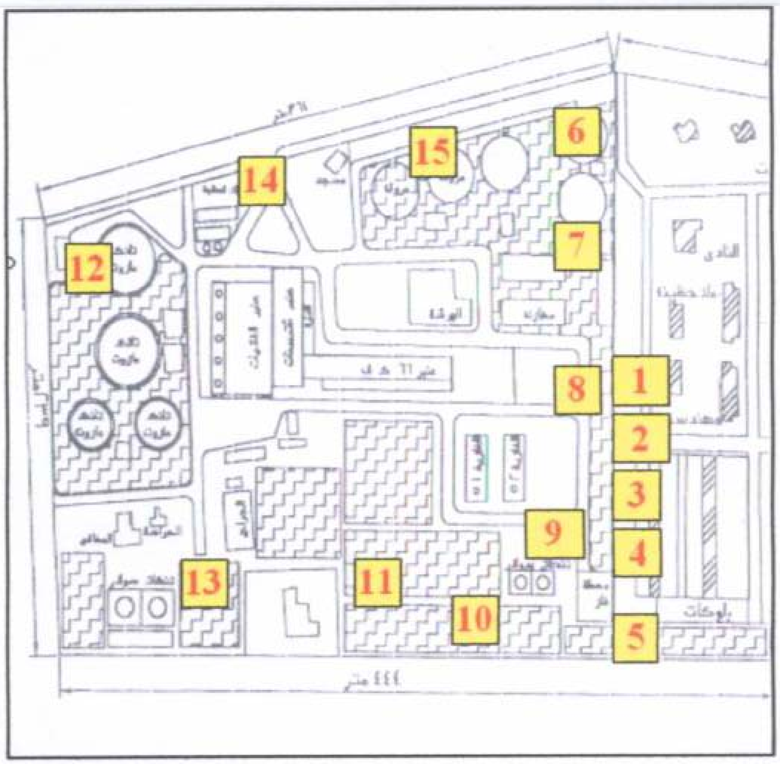
In view of the presence of adjacent noise sensitive receivers a noise survey was carried out on the site of the proposed plant by representatives of SPEEDOTRANS and MB Consultant in June 2005. The main existing noise sources on, and surrounding the site, were found to comprise the following:

- vehicular traffic on the Cairo/Es-Saff Road; and
- prevailing wind.

Measurements were taken using a calibrated Brüel and Kjaer (B & K) Type 2260 Precision Sound Analyser, in a "free-field" location away from any reflective surfaces and 1.2m above the ground. All of the instruments used conform to IEC 651 Type 1 accuracy (Precision sound level meter, intended for laboratory or field use where accurate measurements are required). The average ambient level recorded was L_{Aeq} 59 dB(A). *Figure 5-43* provides with measurement locations. Also, *Table 5-26* and *Figure 5-44* through *Figure 5-47* present the results giving the sound levels for each third-octave band.

Figure 5-43

Measurement Locations Near the Fence of the Power Plant



Location No.	Description
1	Inside the residential area beside the station (nearby the fence)
2	Inside the residential area beside the station (nearby the fence)
3	Inside the residential area beside the station (nearby the fence)
4	Inside the residential area beside the station (nearby the fence)
5	Inside the residential area beside the station (nearby the fence)
6	Inside the power station (nearby the northern fence)
7	Inside the power station (nearby the northern fence)
8	Inside the power station (nearby the northern fence)
9	Inside the power station (nearby the northern fence)
10	Inside the power station (nearby the eastern fence)
11	Inside the power station (nearby the eastern fence)
12	At the southern fence
13	At the end of eastern fence (at fuel tank)
14	At the main gate
15	At the western fence

Table 5-26

Values of Sound Levels at the Site

Location	LAeq	LAF Max	LAF Min	LAF1	LAF10	LAF90	LAF99	LAF50	LAF5	LAF95
1	55.80	67.31	-	78.45	76.65	75.91	73.84	72.01	71.50	70.49
2	53.69	68.15	-	79.48	76.68	75.59	73.30	71.49	70.98	70.23
3	62.011	77.51	-	81.29	77.78	76.91	74.44	72.62	72.14	71.02
4	57.52	73.37	-	83.86	79.18	77.14	72.78	70.52	70.03	69.22
5	58.18	71.99	-	80.00	75.92	74.73	71.94	69.68	69.16	68.19
6	58.81	72.41	-	89.77	84.78	81.92	77.10	71.12	70.05	68.16
7	52.82	62.67	-	73.96	72.58	71.86	69.70	76.80	67.30	66.21
8	58.31	68.74	-	74.63	73.43	72.84	71.00	69.33	68.85	67.81
9	55.59	68.02	-	81.68	76.18	74.80	71.85	69.74	69.30	68.40
10	55.82	68.60	-	87.27	84.48	83.07	76.72	72.85	72.05	70.37
11	56.05	69.55	-	89.64	86.96	85.16	78.37	74.61	73.81	72.49
12	63.95(1)	74.48	59.70	85.05	83.01	81.81	79.10	76.89	76.30	75.35
13	63.76(1)	82.23	51.35	91.17	87.14	83.66	77.03	74.54	73.99	73.18
14	68.01(1)	81.26	62.94	85.83	81.85	80.69	77.63	75.27	74.69	73.44
15	65.20(1)	79.63	54.88	88.07	85.64	84.11	79.16	74.94	73.95	72.50

Notes:

(1) Background Noise Measurements were performed on 8 June 2005. The existing old Tebbin Power Plant was operational and CEPC stopped its operation by the end of this day (plant retirement). Noise levels generated by the old equipment were somehow higher than today's technology. This justifies the high LAeq level of point 3. Points 12, 13, 14 & 15 were also affected by traffic noise at Cairo/Es-Saff road. Even though, the average LAeq = 59 dB(A).

Figure 5-44

Spectrum Graph of Values of Sound Levels for Eash Third Octave Band
(Locations 1, 2, 3 & 4)

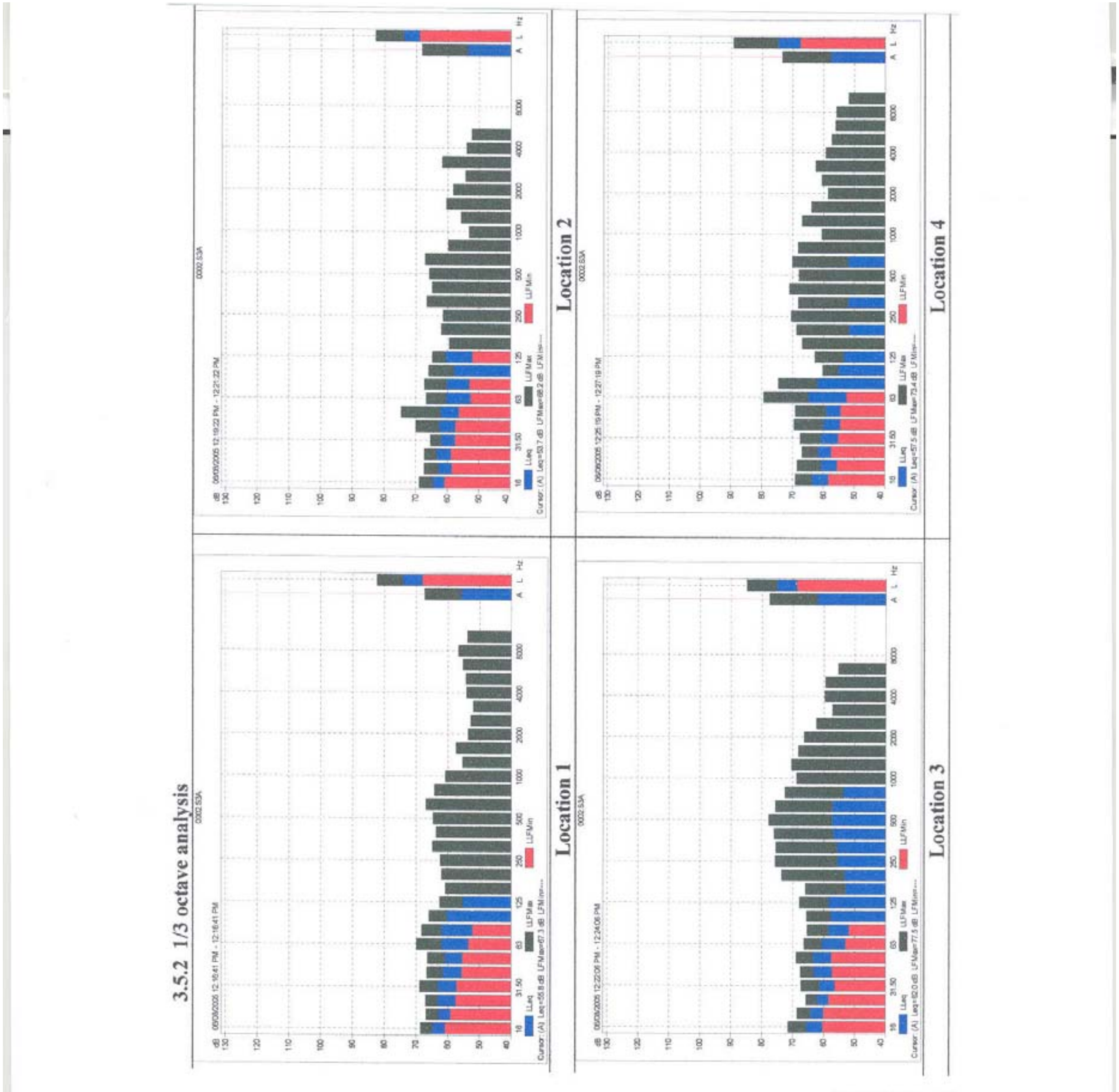


Figure 5-45

Spectrum Graph of Values of Sound Levels for Eash Third Octave Band
(Locations 5, 6, 7 & 8)

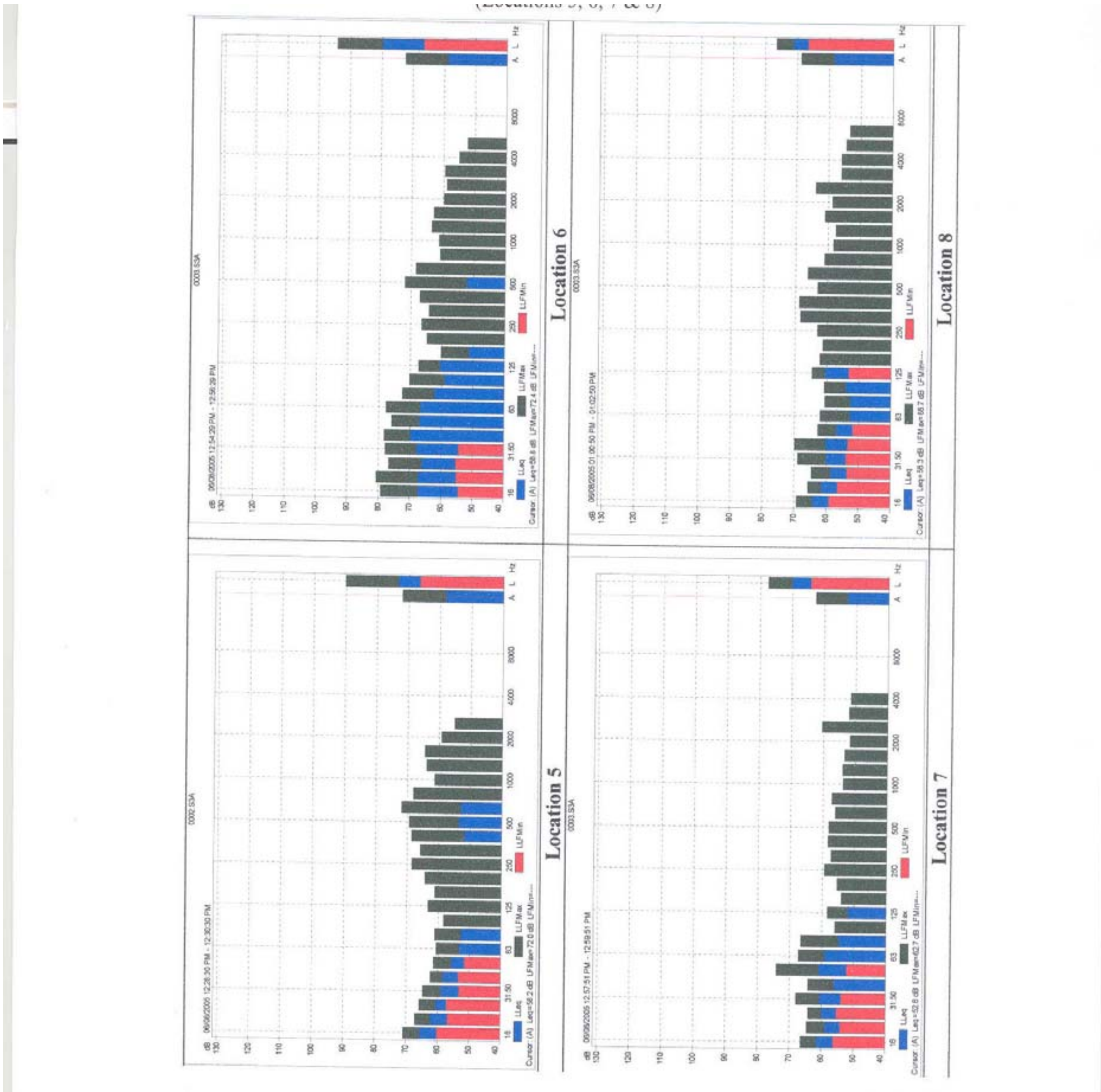


Figure 5-46

Spectrum Graph of Values of Sound Levels for Eash Third Octave Band
(Locations 9, 10, 11 & 12)

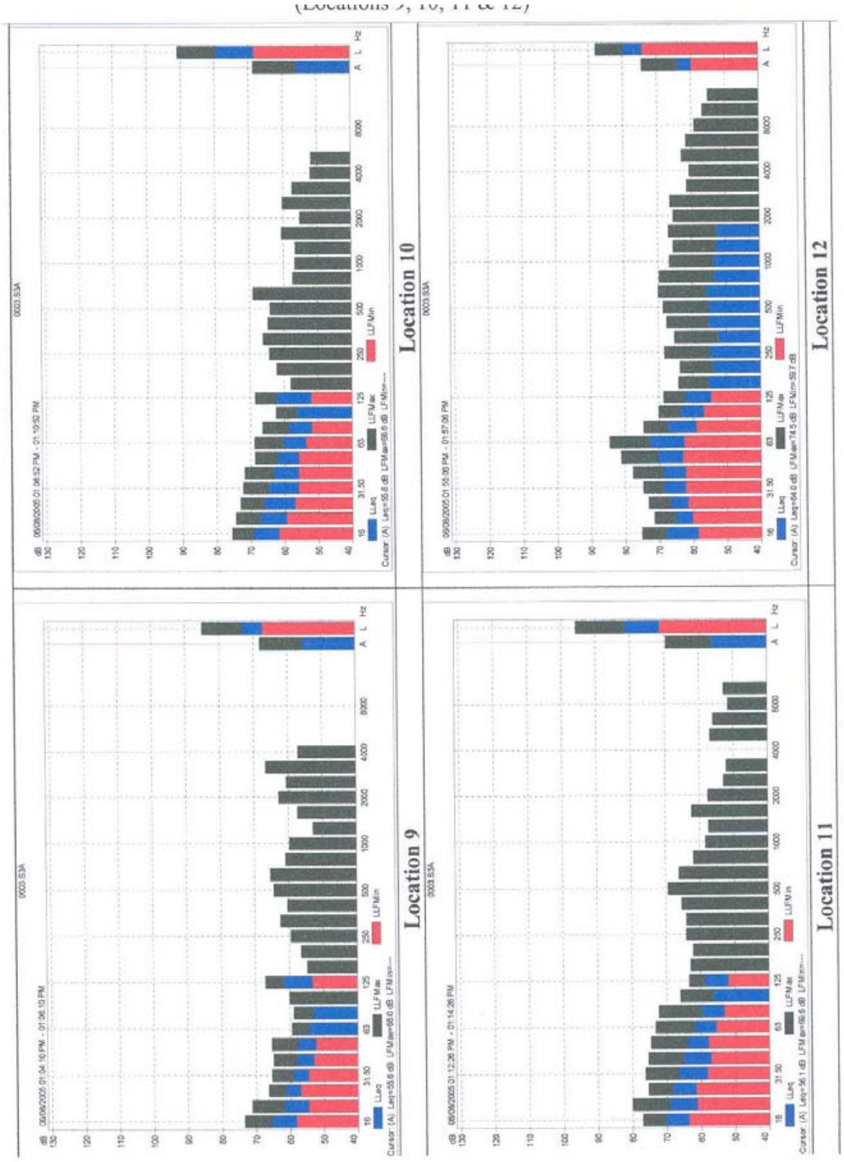
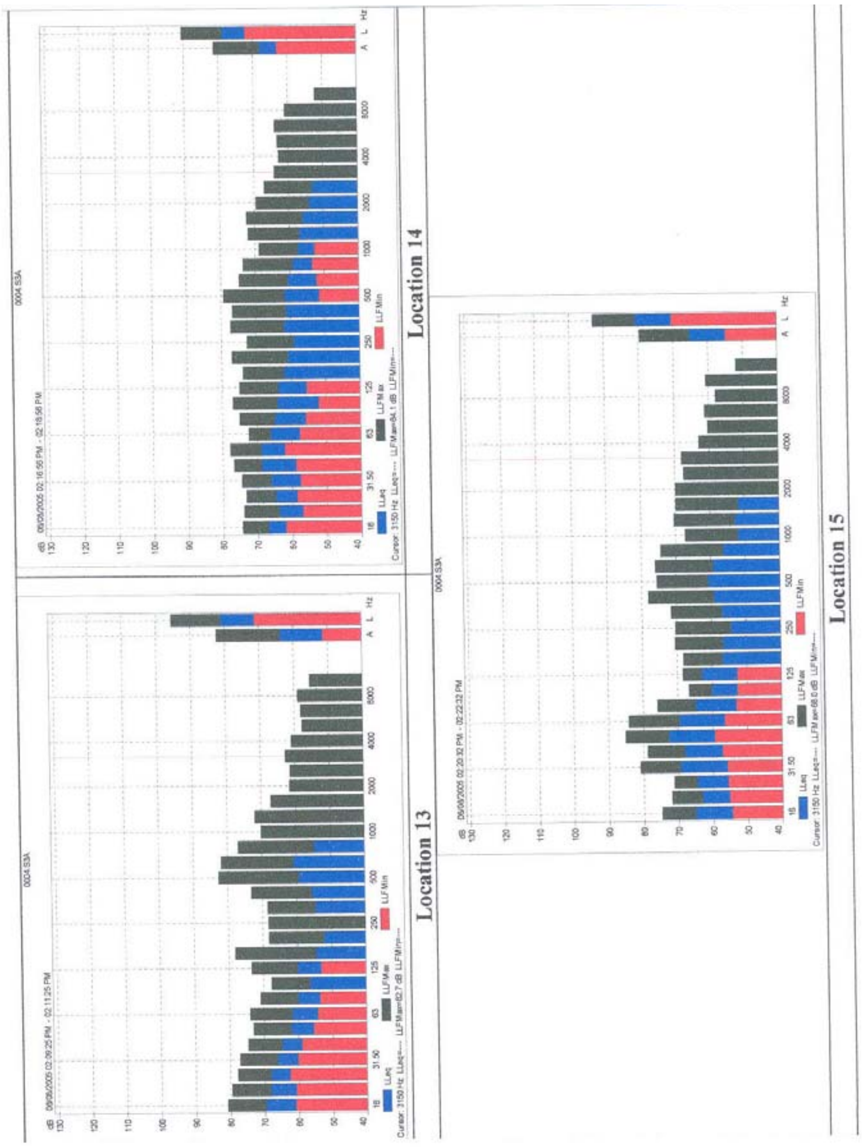


Figure 5-47

Spectrum Graph of Values of Sound Levels for Eash Third Octave Band
(Locations 13, 14 & 15)



5.9 LAND USE AND LANDSCAPE CHARACTER

5.9.1 The Proposed Site

Field surveys, conducted by SPEEDOTRANS in cooperation with EEHC and CEPC in May 2005 and verified by Zone Engineering & Survey and PGESCo in July 2005, were undertaken to examine the site location and its surrounding area.

The survey showed that there are no significant terrestrial ecosystems on or near the proposed site. Only the northern part of the power plant site itself is characterized by floral diversity. Other ecosystems present are typical of those throughout the urbanized land. Moreover, the site currently houses an old power plant house, plant warehouses, maintenance buildings, and accompanying work and storage sheds. This 10-hectare site is also associated with a plant employee housing area to the north of it. Small single-family villas occupy part of the colony area and additional mid-rise apartments are currently there.

Figure 5-48 shows a 1:5,000 scale map, composed of 3 available Cairo maps (K-26, J-26 and J-27), with a very detailed land use data of the project surroundings within a circle of around one kilometer, illustrating the surrounding urban landscape with industrial and infrastructure facilities. It delineates the boundaries of the project site, its relation to adjacent landscape and the details of the field survey. *Figure 5-49* illustrates some zoomed portion of *Figure 5-48.* The industrial and infrasture land usage has been dedicated to such an industrial characterization since mide 1950's and will continue as such for long-term future settings. *Figure 5-50* depicts the schematic planning for long-term development of the Greater Cairo Region set by the General Organization for Urban Planning and approved by the Minister of Housing, Utilities and Urban Communities, the Governor of Cairo Governorate, the Governor of Giza Governorate, and the Governor of Kalyoubia Governorate. *Figure 5-51* shows enlarged part of the Cairo South where Tebbin and Helwan are clearly designated as industrial area for long years to come.

5.9.2 Overview of the Surrounding Land Use

The site is situated in a generally built-up, high-industrialized setting within the Cairo metropolitan area (see*Figures 5-52, (A, B & C)).* Land uses in the immediate vicinity of the site include heavy industries and mid-rise apartment buildings. There are, however, scattered far field vacant plots of land of varying sizes in the most eastern area that are available for agriculture. Immediately south of the site is a Cock factory that is followed in the far south by agricultural land. To the north of the site is the plant's residential colony bounded by Maadi/Helwan Highway. Across this Highway located is the Tebbin Institute for Metallurgical Studies (TIMS). Next to the TIMS in further north is the Tebbin water treatment plant followed, in the same direction, by

El-Maraziq residential community. Also, the Tebbin residential community is located to the east of El-Maraziq community. The Tebbin community is bounded from the northeast, the east and the south by the Iron and Steel facilities, which occupies a wide land extended to the south east of the power plant site.

As previously mentioned, being within the Cairo metropolitan area, the site appears to be well served by the roadway network. Along the northern edge of the plant's rasidential colony is a two-lane major arterial highway carrying significant traffic volumes. A two-lane road is located immediately west of the site.

A single-line railroad track is located a short distance to the north of the site called El-Maraziq railroad. Some barge traffic is traveling on the Nile river. Bus service within the vicinity of the site is available and well used.

In the immediate northwest vicinity of the site, about 150m distance, there is a number of privately owned housing units, primarily low to mid-rise apartment buildings.

Right before the western edge of the power plant site and across Cairo/Es- Saff Road, there is a free field land (owned by the power plant) ended to the west by the Nile River bankline, where cooling water intake and discharge structures are located. An industrial featured structures lie directly to the south of this area and include facilities that belong to the General Company for Metals, the Petroleum Pipelines Company and the Central Workshops for Tebbin Transport. To the south of this industrial compound is a green cultivated land extends beyond El-Shobak El-Sharqi with very few, very small residential plots.

5.9.3 Landscape Character

The landscape character of the site and its surrounding area is determined and characterized by:

- the bankal location and the influence of the Nile river;
- the flat terrain and urban character of the Cairo Southern Zone;
- the sparsely vegetated surroundings; and
- existance of heavy industry and infrastructure facilities, housing complexes, public buildings and road linkages.

The industrial and utility character of the region are the main influences on the area. However, despite the scale of the industrial development, this would ensure that the landscape is visually able to accommodate those intrusive features.

Figure 5-48

1:5,000 Scale Map, Composed of
3 Available Cairo Maps
Showing the Surrounding Urban Landscape
with Industrial and Infrastructure Facilities

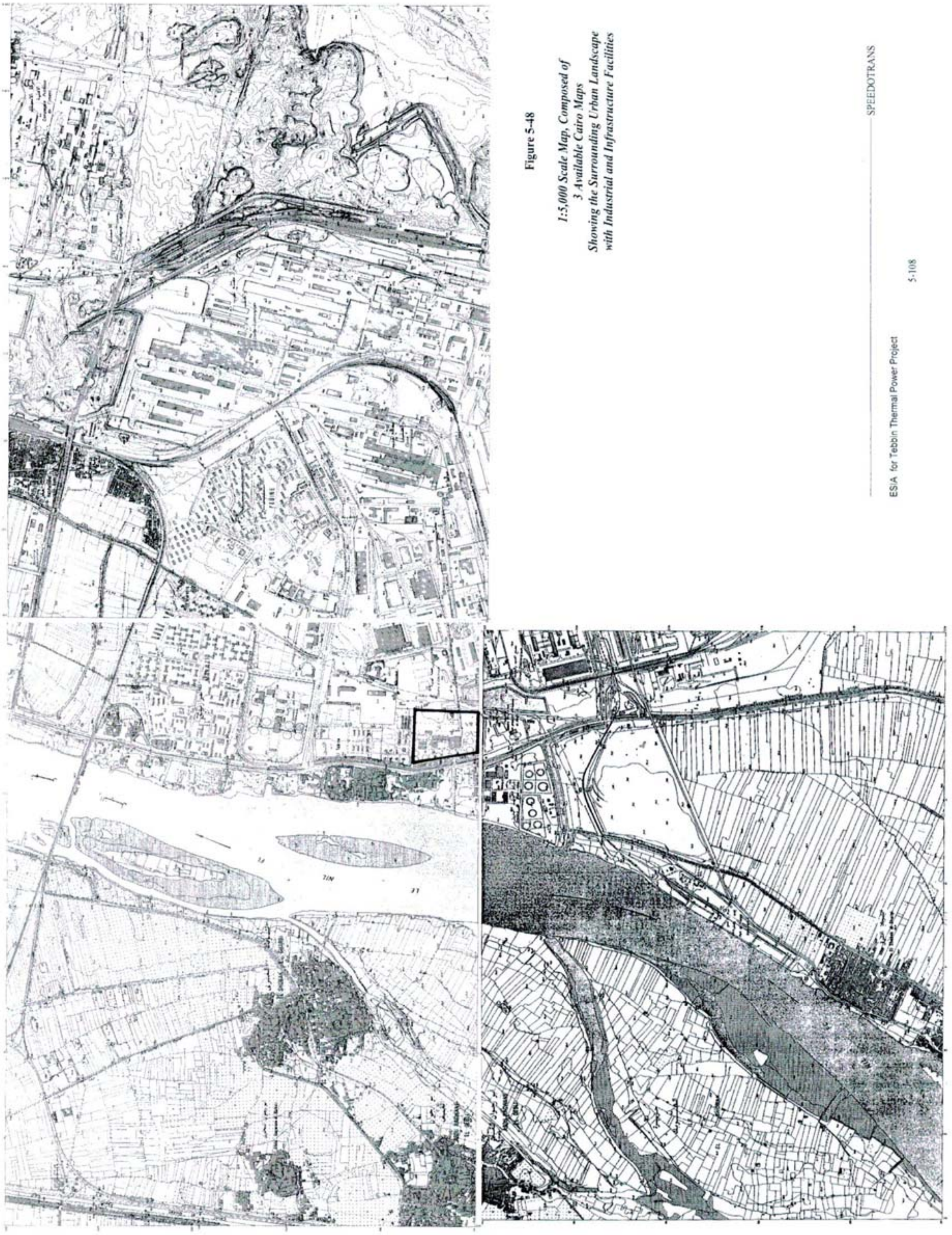


Figure 5-49

1:5,000 Scale Map Showing Detiled Features of the Nearest Landscape to the Proposed Power Plant Site

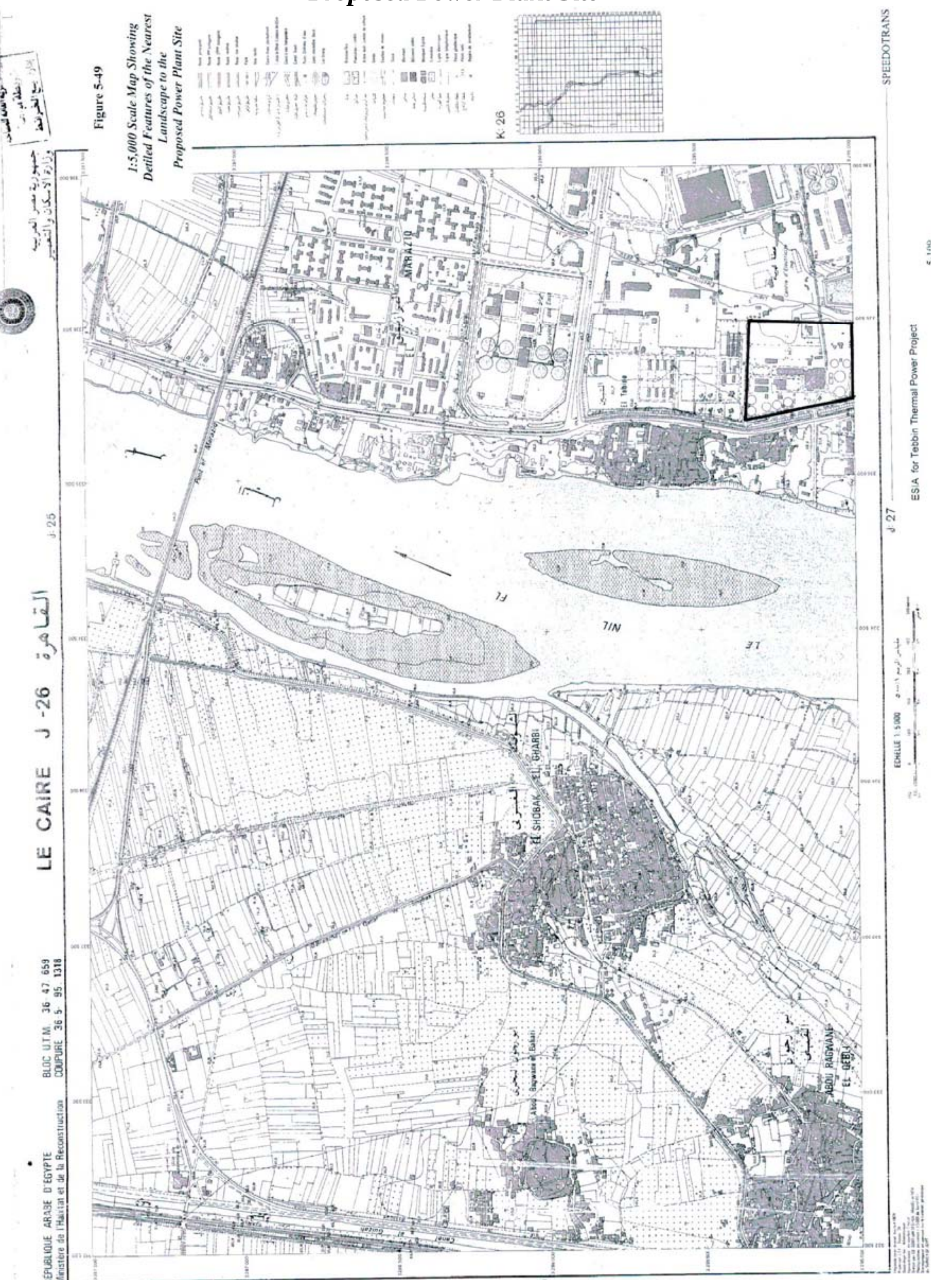


Figure 5-50

***Schematic Planning for
Long-Term Development of the
Greater Cairo Region, 2000***

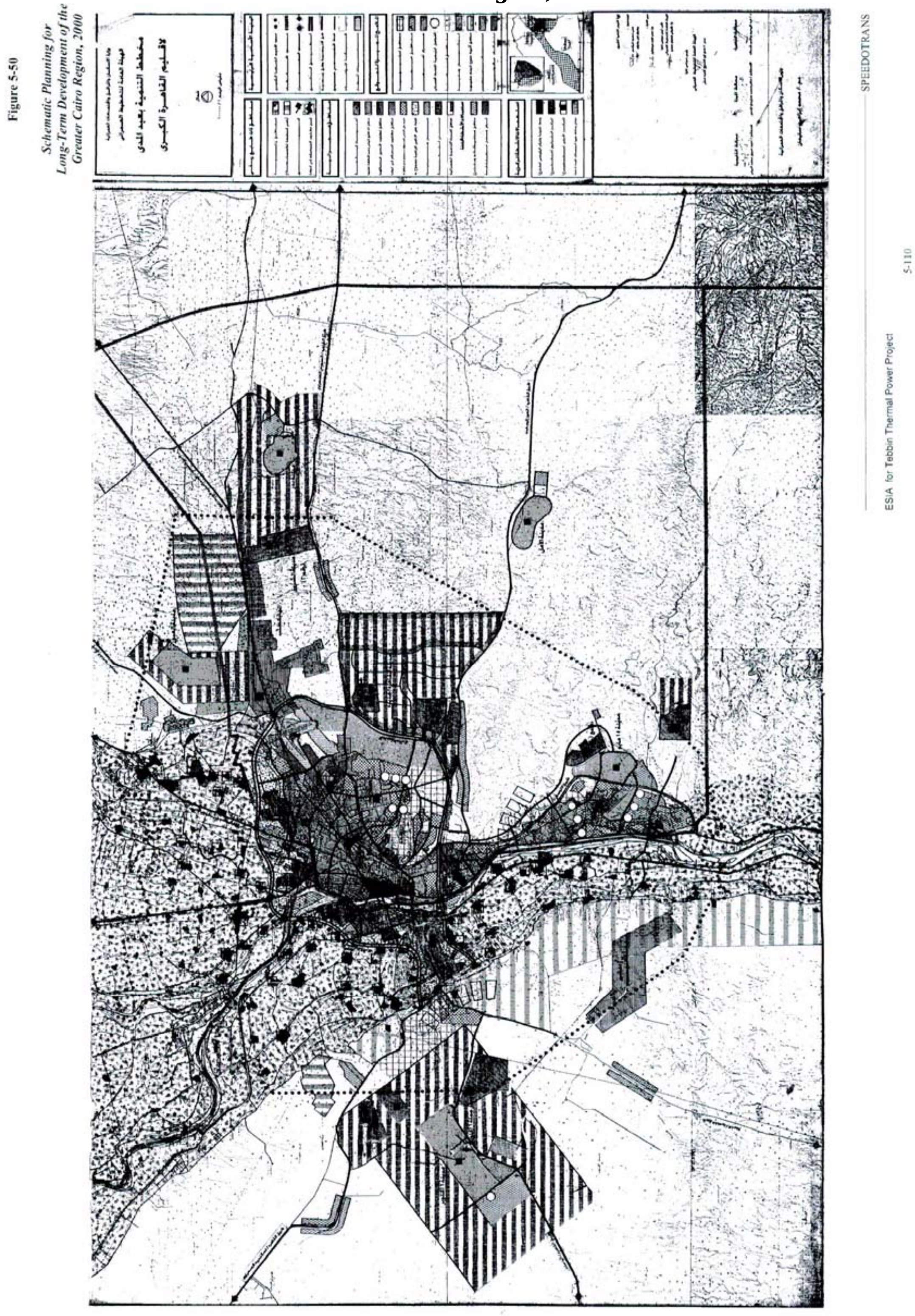


Figure 5-51

Schematic Planning for Long-Term Development of the Tebbin & Helwan Zone, 2000

Figure 5-52 (A)

General Scene of the Northern and Western Area of the Proposed Site Showing Part of the Plant's Residential Colony and the Northwestern Residential Settlement, the Intake and Discharge Area, and the Southwestern Industrial Compound along the Bankline of the Nile River

Figure 5-52 (B)

Scenic Segment of the Eastern Area of the Proposed Site Showing the Heavily Industrialized Setting of the Iron & Steel Factory

Figure 5-52 (C)

Southern Surroundings of the Proposed Site Where the Cock Factory is Located

5.10 TRAFFIC AND TRANSPORT

5.10.1 Introduction

Road transport provides the main mode of transport in the Southern Cairo Zone. The proposed power plant site will be accessed via the Cairo/Es-Saff Road and Maadi/Helwan Highway. These two roads connects the proposed power plant site to the major road network as shown in *Figure 5-53*.

Information on traffic conditions and flows have been obtained from primary assessment work conducted by the "Egypt National Institute of Transport" (ENIT), Ministry of Transport, during June 2005, and from observations made during site visit in May 2005.

5.10.2 Main Access Roads

Cairo/Es-Saff Road

Cairo/Es-Saff Road Cairo/Es-Saff Road is an arterial road in Greater Cairo Region road network extending from Cairo in the north to Beni-Sueif in the South. The road is considered dual, 4-lane carriageway (two-way, two lanes in each direction) with a 7.5-m width in each direction of flow. Both directions of travel are separated by a variable median width (mostly 50-100 cm) with a number of openings in order to provide access to different land uses on the southern side of the road. Wide sidewalks are provided on both shoulders of the road (mostly 0.5-1.5 m) despite the observed low pedestrian volume, except during peak periods only at the entrance to the area land uses. The road is characterized by a medium pavement condition and the design speed is 80 km/hr. Maximum axial load is 13 tons.

The road is made of an asphalt concrete mixture with low to moderate condition due to the high percentage of buses and trucks using the road. Rutting, humps, and holes are examples of the deteriorated condition of the road surface. It is expected that this road would undergo an extensive rehabilitation during the work associated with the construction of a surface water abstraction and discharge system. This system is to be carried out as part of the Cairo Governorate plan to implementing maintenance for major arterial roads.

The sidewalks are made mostly from cement tiles, which are considered suitable for land uses in the area. Light poles do exist at average distances 20-25 m on both sides of the road, but their working condition is moderate and requires maintenance.

Maddi/Helwan Highway

Maadi/Helwan Highway is a double road running to the north of the plant's colony. Its current width is some 29 m with proper sidewalks and light poles. It consists of 3 lanes in each direction with a lane width of 3.6 m and a shoulder of 2.5 m width in each direction. It, also, has a median width of 2.7 m. The general condition of the road is suitable for normal traffic operations. *Figure 5-54* depicts main access roads to the power plant site.

5.10.3 Regional Roads

The power plant will be supplied by heavy equipment imported from a number of seaports during construction (mainly Alexandria, Port Said, El-Ain Es-Soukhna, Suez and Damietta ports).

The main regional roads providing access to Cairo from seaports are as the following:
Cairo/Alexandria Agricultural Highway, Cairo/Alexandria Desert Highway, Cairo/Suez Desert Highway, Cairo/lsmailia Desert Highway, Cairo/Mansura/ Damietta Highway and El-Kattamiyya/El-Ain Es-Sukhna Highway. The location of the individual roads is shown in *Figure 5-53*, while geometric characteristics of main regional roads are described in *Table 5-27.*

The speed limits for all highways range between 90-100 km/hr except for EL-Kattamiyya/ El-Ain Es-Soukhna Highway, the speed limit is 120 km/hr and the lane capacity lies between 1800-2200 vehicle/hour.

As for traffic data on these roads, a time series on average annual daily traffic records (during the peroiod 1997-2004) were obtained from the General Authority for Roads, Bridges and Land Transport (GARBLT). This data is presented graphically in *Figure 5-55*. The figure clearly illustrates that Cairo/Alexandria Agricultural Highway carries the highest traffic volumes, followed by Cairo/Alexandria Desert Highway.

It is obvious that there is a continual increase in traffic volume on these roads ranges between 4% and 13% annually. Also, *Figure 5-55* shows an increase in traffic volume in the year 2001 by a high proportion of 46% on Cairo/Alexandria Agricultural Highway comparing with year 2000.

5.10.4 Traffic Conditions

Traffic data on the average annual dialy traffic (AADT) were obtained from Information Center of the General Authority for Roads, Bridges and Land Transport. Taffic counts and assessment of level of service were undertaken at three locations on the roads surrounding the power plant site during a typical working day (Tuesday, 28th June 2005) (see *Figure 5-56*). The results of these surveys are recorded in detail in ENIT's Final Report on traffic impact assessment and presented in the following.

Figure 5-53

Regional Roads from Seaports to Cairo

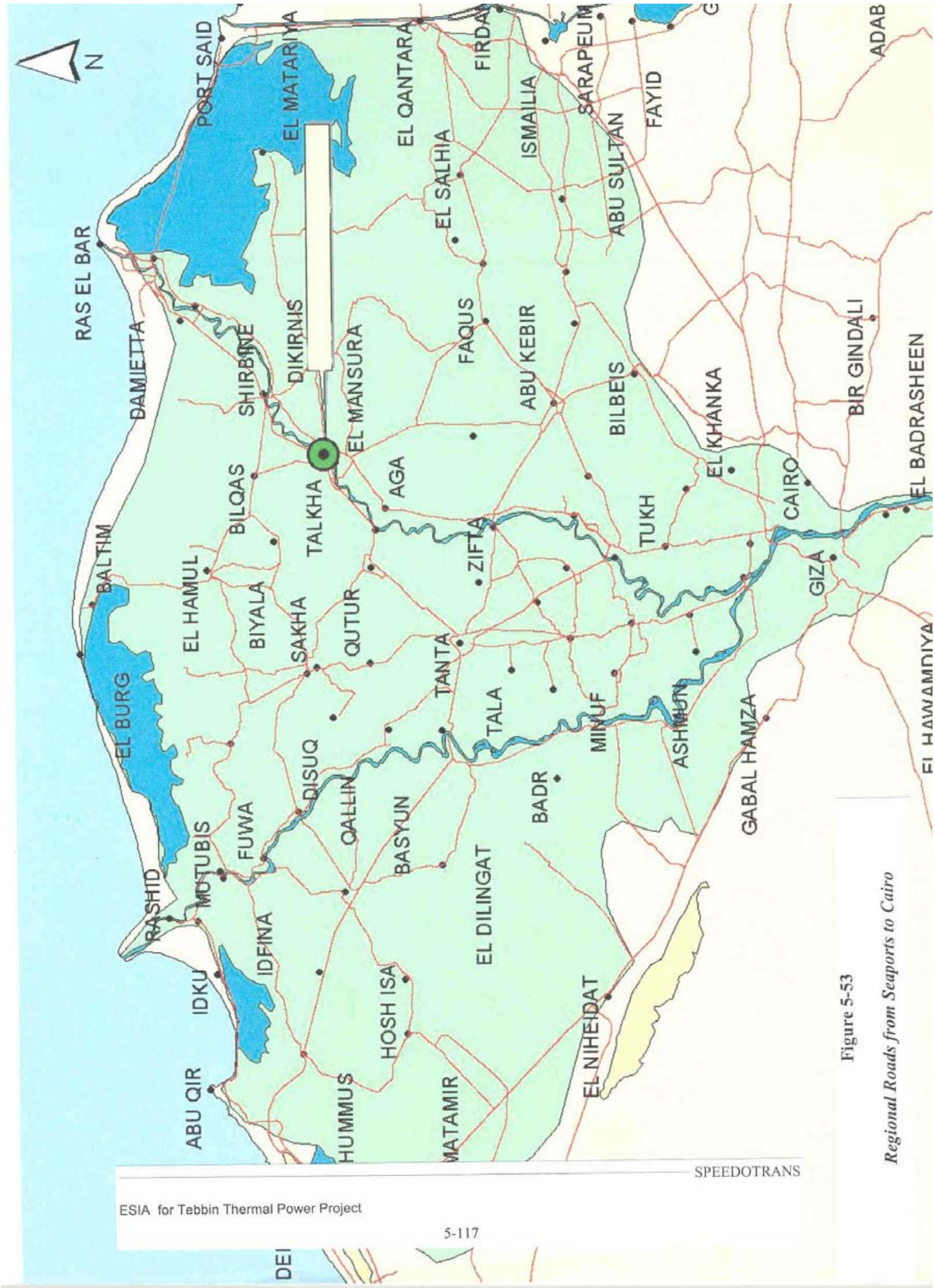
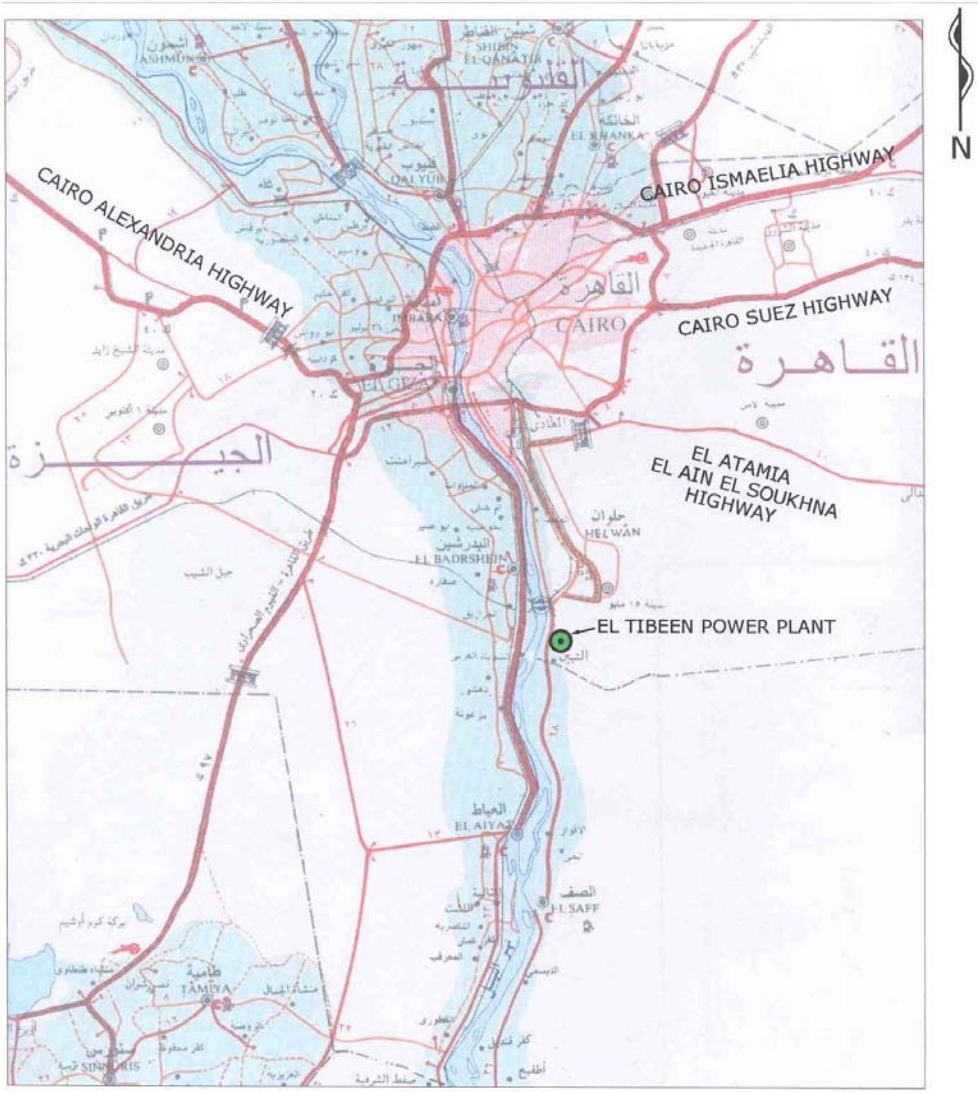


Figure 5-54

Main Access Roads to the Power Plant Site



Total 16-hour traffic flows were recorded manually at three locations on Cairo/Es-Saff Road, Iron & Steel Road and exactly befor the power plant site as depicted in *Figures 5-57* and *5-58*. Daily flow, peak flow and timing and existing traffic composition were recorded. Traffic was classified into the following categories: private car, taxi, taxi service (micro-bus), Mini-bus, private/public bus, light truck, heavy truck, and others, as a normal classification for vehicle in all related studies.

Table 5-27

Geometric Characteristics of Main Regional Roads

Road Name	Geometric Description
Cairo/Alexandria Agricultural Highway	Dual 3-lane carriageway highway (in most of its length) with a paved shoulder linking Cairo to Alexandria Seaport. The road is heavily used by passenger and freight transport. It serves local and regional traffic as it passes through cities in the Delta area. The average lane capacity is given as 1600 vehicle/hour.
Cairo/Alexandria Desert Highway	Dual 2-lane carriageway highway with a paved shoulder linking Cairo to Alexandria Seaport. Widening of the Highway to 3 lanes in each direction is undergoing to cater for the increase in traffic flow. The road is a toll road and becoming heavily used by passenger and freight transport given the urban expansion along its route. The road is generally in a very good condition. The average lane capacity is given as 1600 vehicle/hour.
Cairo/Ismailia Desert Highway	Toll, dual 2-lane carriageway highway with a paved shoulder linking Cairo to Port Said and Damietta Seaports. The section from Cairo to 10^{th} of Ramadan City has been widened recently to 3 lanes in each direction to cater for the increase in traffic flow to/from the City. The road is generally in a very good condition. The average lane capacity is given as 1800 vehicle/hour.
Cairo/Suez Desert Highway	Dual 2-lane carriageway highway with a paved shoulder linking Cairo to Suez Seaport. The road is generally in a very good condition. The average lane capacity is given as 1800 vehicle/hour.

Figure 5-55

Average Annual Daily Traffic on Regional Roads to Cairo

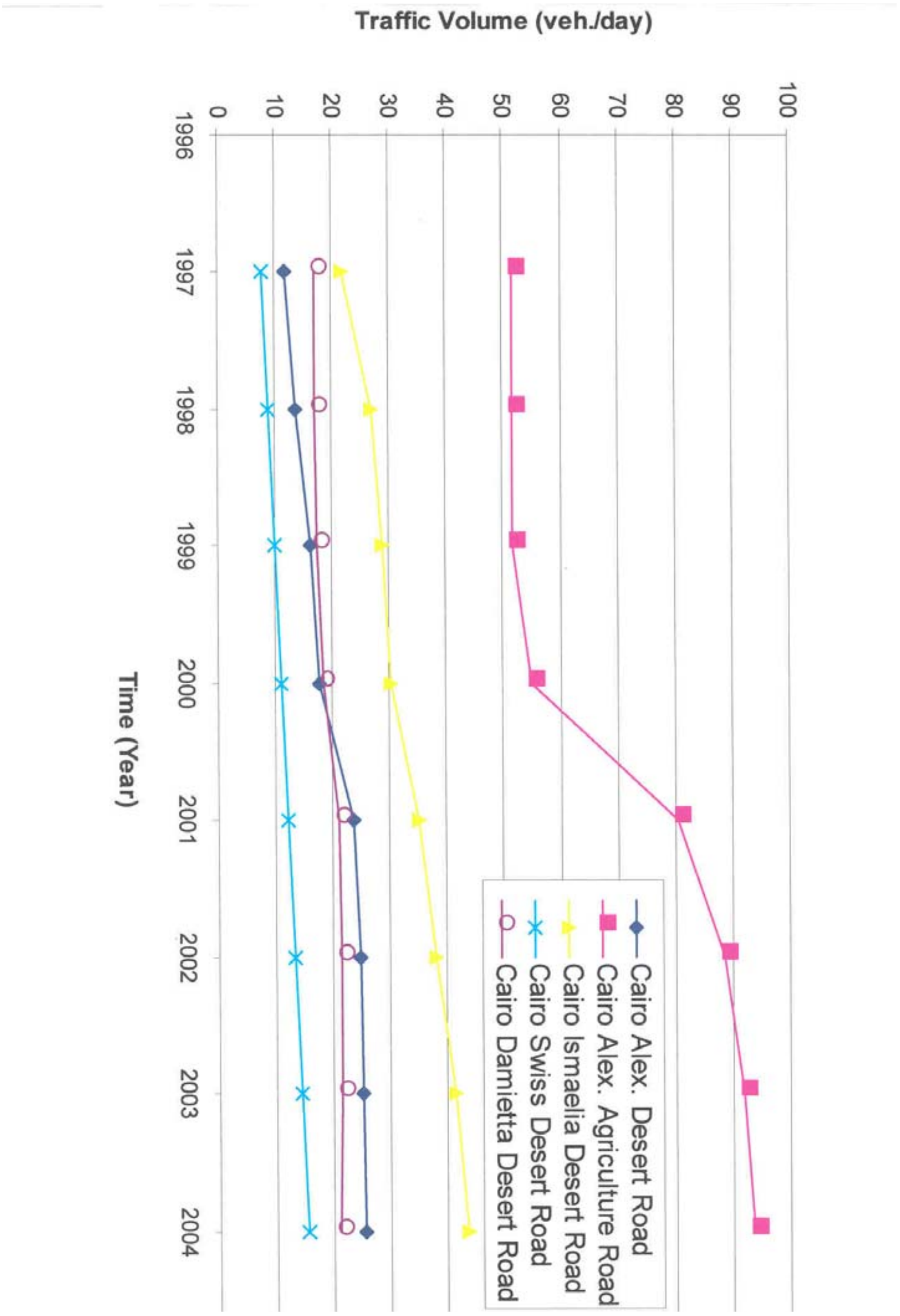


Figure 5-56

Locations of Traffic Counts

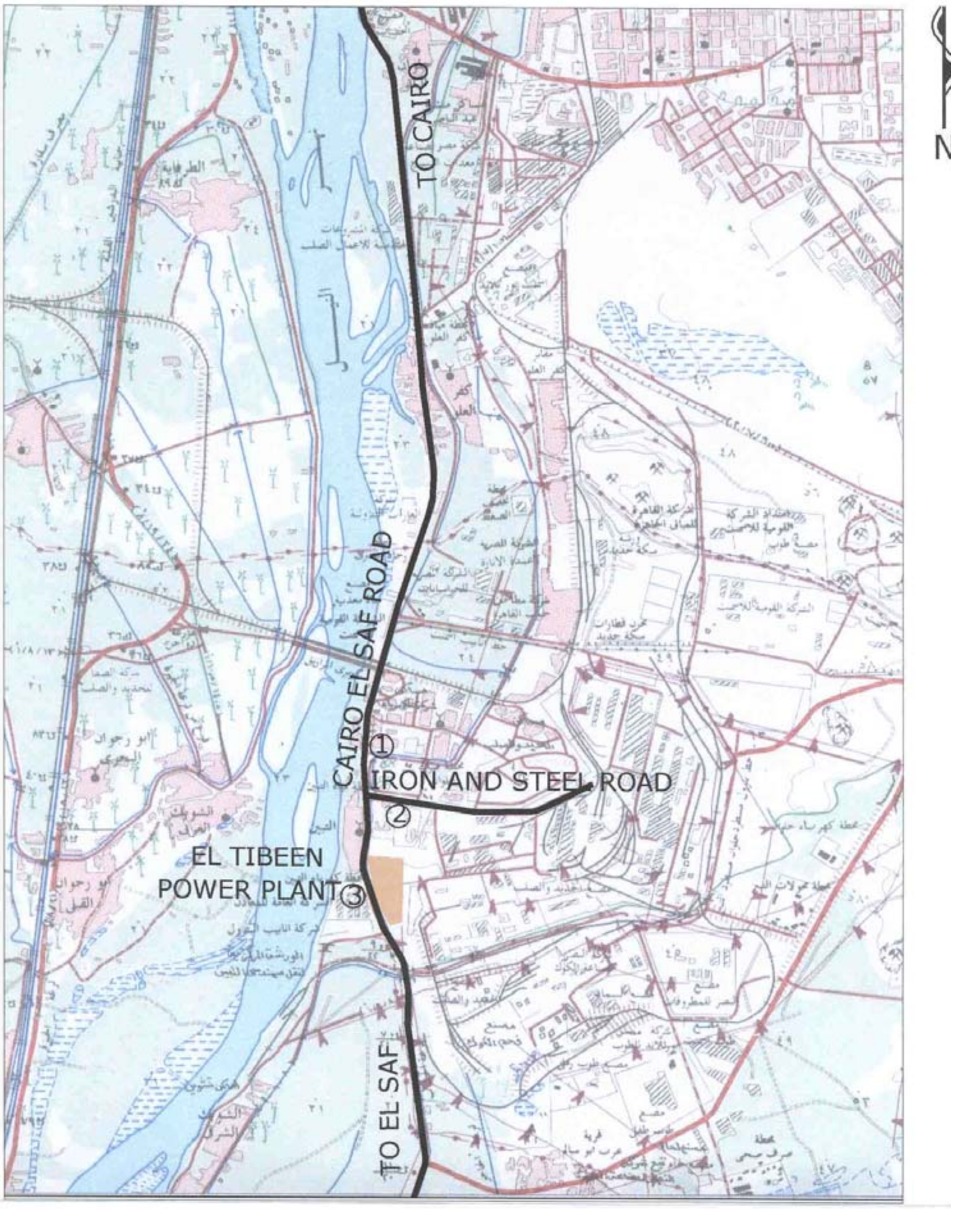


Figure 5-57

Locations of Traffic Counts on Cairo Es-Saff Raod

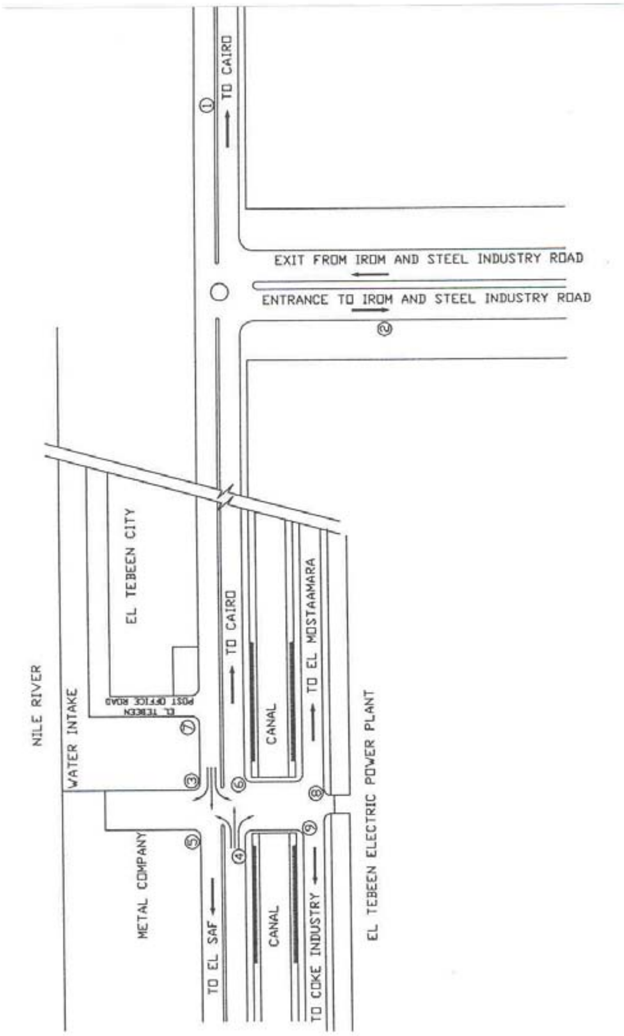
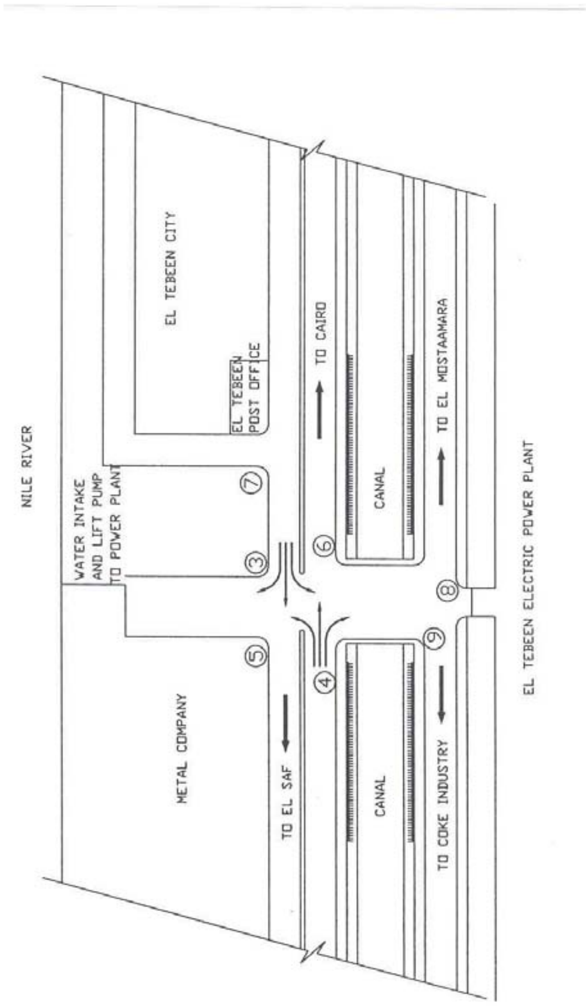


Figure 5-58

Locations of Traffic Counts
Before the Power Plant Site



- ***Cairo / Es-Saff Traffic Movement***

Characteristics of Traffic Volumes During 16 hour Count

Cairo / ES-Saff Road is composed of 2 lanes in each direction in most of its length, with a lane width of 3.75m and a shoulder of about 1.5 m width in each direction and separated by median of width at about 0.5 m. *Figure 5-59* shows the fluctuation of traffic volume in both directions during survey hours for Cairo /Es-Saff Road. The total 16-hour traffic flow was recorded as 13,677 vehicles coming from Cairo to Es-Saff and 10,884 vehicles in the reverse direction, i.e. from Es-Saff to Cairo. The volumes are considered almost balanced between both directions of travel on this road. *Figure 5-59* also illustrates the timing of the peak hours in both directions. Morning peak hour occurred during 8:00 to 9.00 am for both directions of travel, while the afternoon peak occurred during 4:00 to 5.00 pm. Also, *Figure 5-59* shows that the traffic flow during afternoon peak hours for Cairo/Es-Saff direction is twice its morning peak flow and equals twice the traffic volume in reverse direction for Es-Saff/Cairo direction. Occurrence of peak hours closely follows the normal shift hours of Tebbin power Plant.

Table 5-28 provides with peak hour flows in both directions of travel on Cairo/Es-Saff Road.

Table 5-28

Maximum Peak Hour Traffic Volume on Cairo/Es-Saff Road, Vehicle/hour

Direction	**Traffic Volume at Peak Hour (Vehicle/hour)**	
	Morning Peak	**Evening Peak**
From Cairo to Es-Saff	680	1444
From Es-Saff to Cairo	712	785

Figure 5-60 illustrates traffic composition observed at Cairo/Es-Saff Road for both directions of travel. It illustrates that pick-up vehicles and microbuses (taxi service) are the most mode of travel used on this road with 24.6% and 22% of the total volume, respectively. They are together followed by private cars and heavy trucks with 17.3% and 11.7% of the total volume, respectively, and, then followed by bus, trailer trucks, minibus and taxi with 8.7 %, 7%, 4.3% and 2.8%, respectively. Remaining vehicle types represente very low share ranging from 0.3 to1 % only.

Figure 5-59

Traffic Flow Fluctuation on Cairo/Es-Saff Road, Site No. (1)

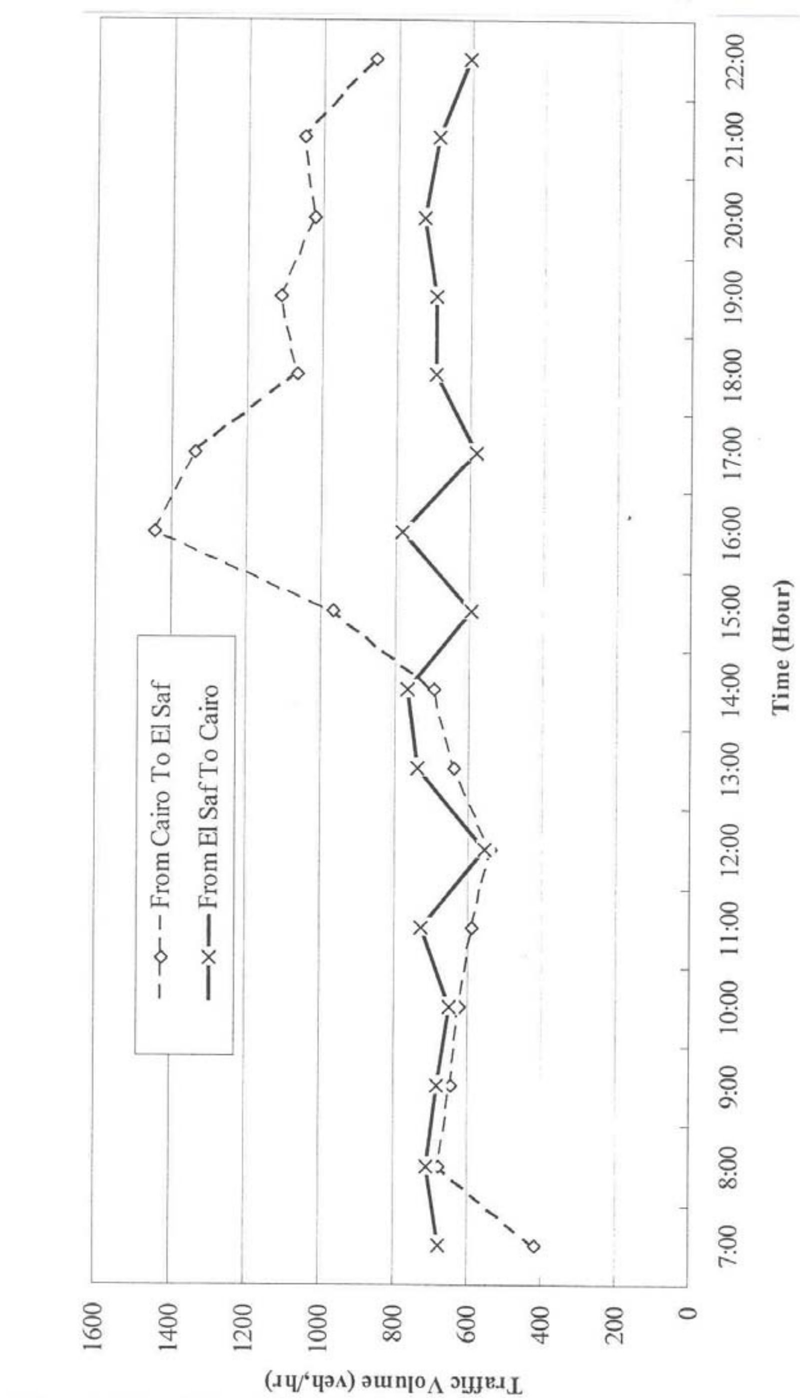
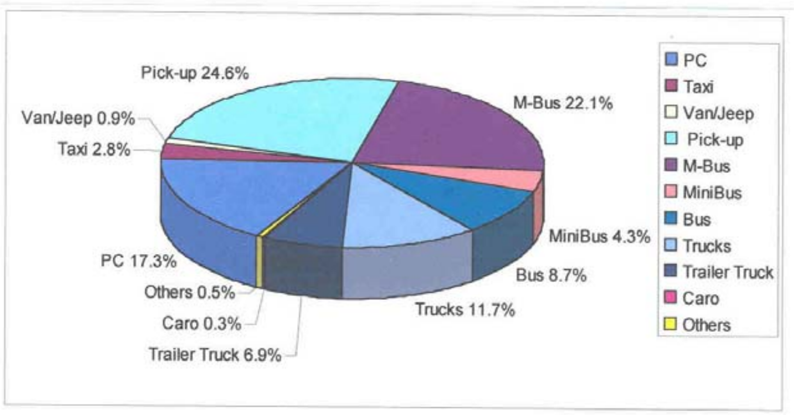


Figure 5-60

Traffic Composition on Cairo/Es-Saff Road, Site No. (1)



Traffic Volume During 24-hour

Traffic volume of Cairo/Es-Saff Road and its opposite direction are predicted during the interval between 12.00pm and 6.00 am to identify traffic characteristics and fluctuation during this interval, using available data of 16-hour count on the same road during 7.00 am – 11.00 pm and 24-hour traffic count on Maadi/Helwan Road. The following outcomes are obtained:

- Cairo/Es-Saff Direction

Figure 5-61 shows that traffic volume at 11.00 pm in this direction is 761vehicles and considered the highest traffic volume during the interval etween 11.00 pm and 6.00 am. This is followed by higher reduction in traffic volume during next two hours. An increase of traffic volume, afterwards, reaches 549 vehicles at 3.00 am, and the flow rises during the interval 5.00-6.00 am to 569 vehicles. *Figure 5-62* illustrates traffic during interval (11.00 pm -6.00 am). There is an increase of trailer truck at night on Cairo/Es-Saff direction and so do the private cars with 2%. It is observed that a little reduction for both microbuses and buses with proportion of 2% - 3% and nearly no change in heavy trucks proportion.

- Es-Saff/Cairo Direction

Figure 5-61 shows that traffic volume at 11.00 pm in this direction is 605 vehicles and it can be seen that there is a reduction in traffic volumes in this direction compared to the opposite direction. Fluctuation is almost similar in both directions. Traffic volume at 6.00 am is 452 vehicles. A difference in traffic composition between both directions is shown in *Figure 5-63*. Increase in heavy trucks with 7% above average in this interval and reduction in buses by 5% is obvious. This looks higher than that of the opposite direction. Reduction in pick-up vehicles occurred at 19.5%. There is also a 1.7% increase in trailer trucks for this direction.

Figure 5-61

Traffic Flow Fluctuation on Cairo/Es-Saff Road During 16hr Morning Traffic Count and 8hr Night Prediction

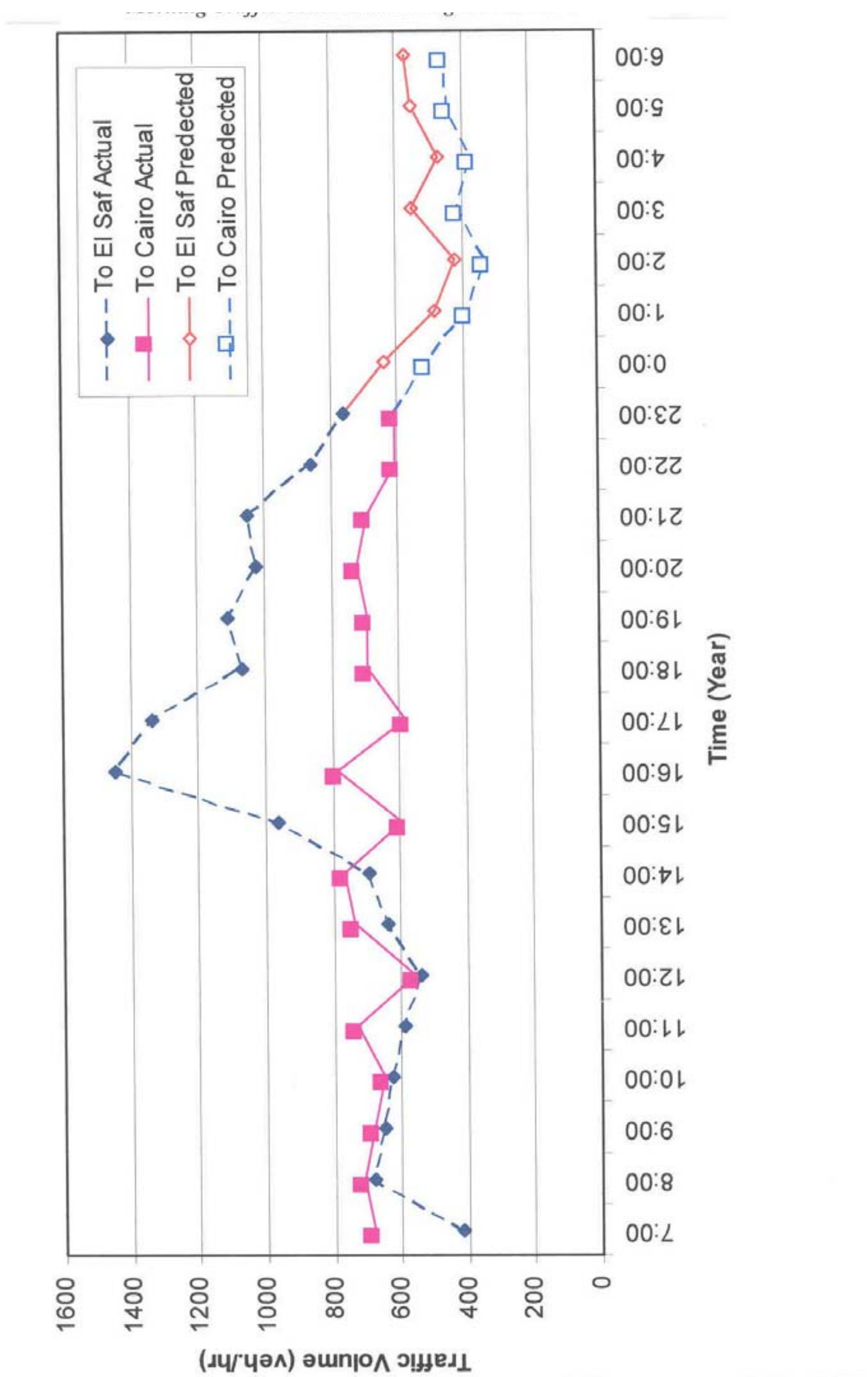


Figure 5-62

Traffic Composition on Cairo/Es-Saff Road, Site (1) at Midnight

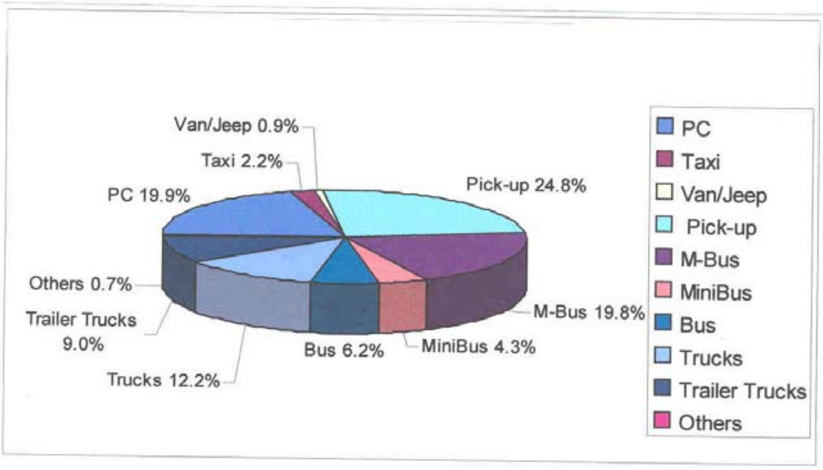
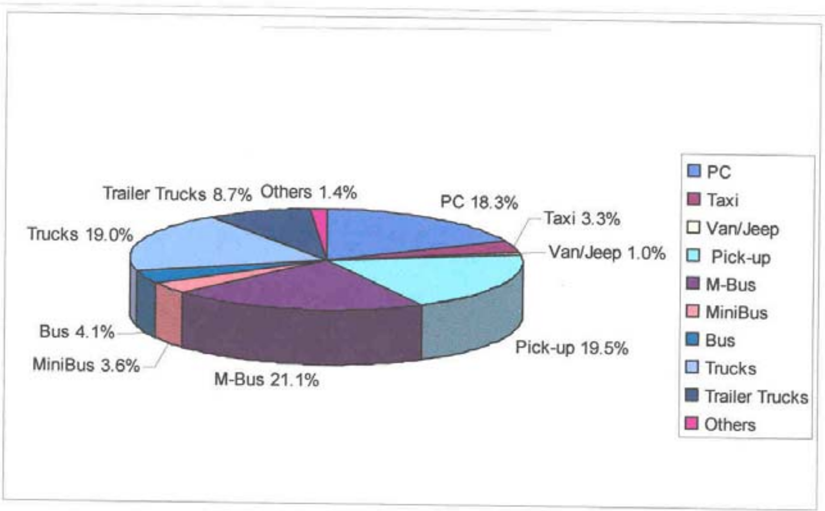


Figure 5-63

Traffic Composition on Es-Saff/Cairo Road, Site (1) at Midnight



- ***Iron & Steel Road Traffic Movement***

The Iron & Steel Road, as previously mentioned, consists of 3 lanes in each direction, with a lane width of 3.6 m and a shoulder of 2.5 m width in each direction. It is separated by median of width 2.7 m.

Figure 5-64 depicts fluctuation of the traffic volume in both directions during survey.

The total 16-hour traffic flow entering the road was recorded as 2,267 vehicles while that exit from the road was 2,560 vehicles. Volumes are considered almost balanced between both directions of travel at this road. *Figure 5-64* illustrates timing of the peak hours in both directions. Morning peak hour occurred during 8:00 am to 9.00 am for traffic entering the Iron & Steel Road and from 10.00 am to 11.00 for traffic exiting the Iron & Steel Road to Cairo /Es-Saff road, while the afternoon peak hour occurred during 2:00 pm to 3.00 pm for exiting the Iron & Steel Road. The evening peak hour occurred during 5.00 pm - 6.00 pm in both directions. It was noticed that traffic flow during Morning peak hours for the entering direction is as twice as Evening peak. Occurrence of peak hours closely follows the normal shift hours of Tebbin power plant.

Table 5-29 provides with peak hour flows in both directions of travel on the Iron & Steel Road.

Table 5-29

Maximum Peak Hour Traffic Volume on Iron and Steel Road

Direction	Traffic Volume at Peak Hour (Vehicle/hour)		
	Morning	Afternoon	Evening
Enter to Iron & Steel Road	333	121	126
Exit from Iron & Steel Road	278	235	140

Figure 5-65 illustrates traffic composition observed over the Iron & Steel Highway for both directions of travel. It depicts private cars and heavy trucks as the highest mode of travel on this Highway with 23.5% and 20.5% of the total volume, respectively. Bus and pick-up vehicles follow with percent 13.1% and 12.7% of the total volume respectively, and then microbuses, taxis and minibuses with 12.2%, 9.8% and 3.9%, respectively. Van/Jeep and trailer trucks represent the lowest ratio with 1.9%, and 1.7% of the total volume respectively.

Figure 5-64

Traffic Flow Fluctuation on the Iron and Steel Road, Site No. (2)

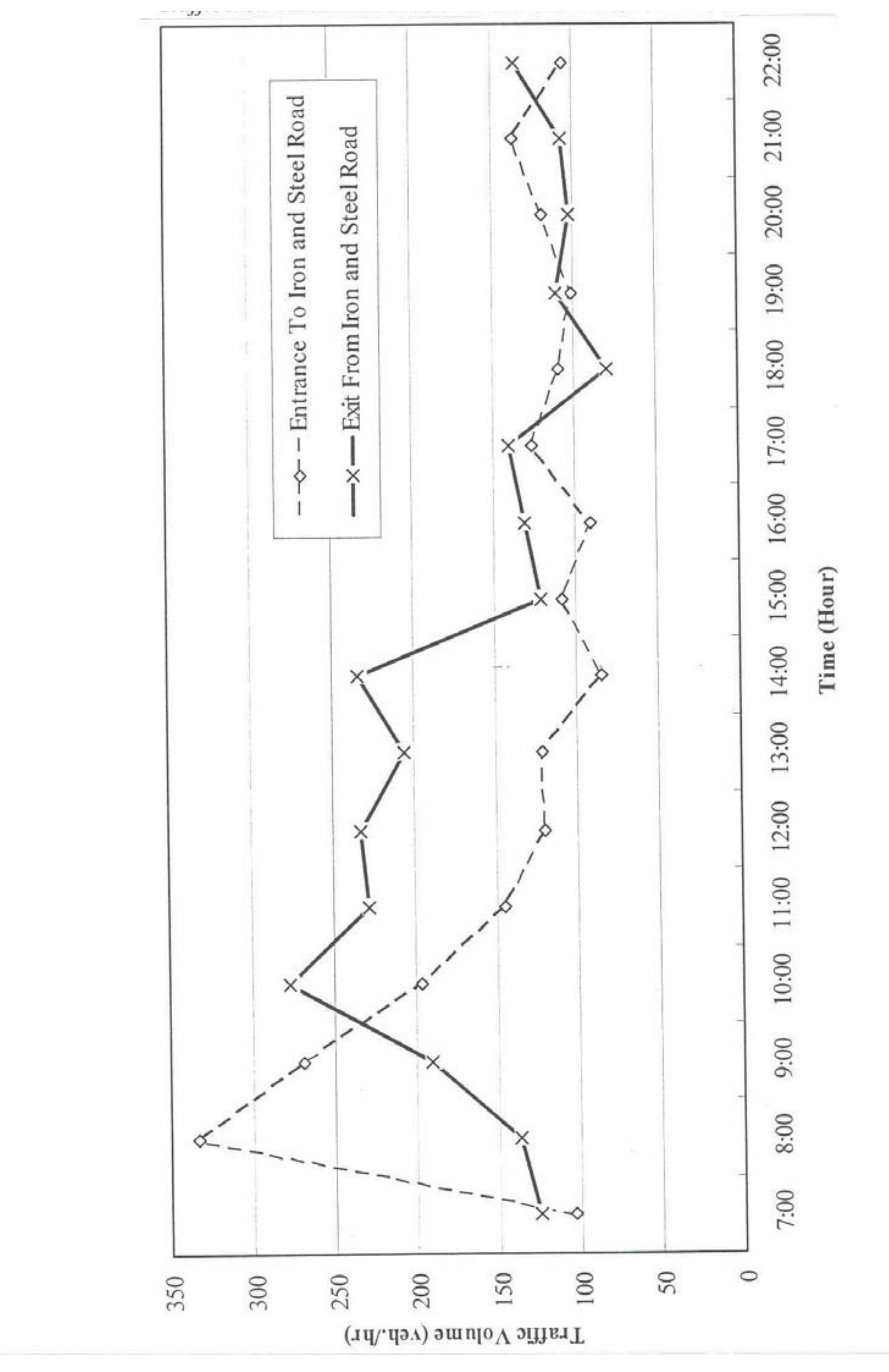
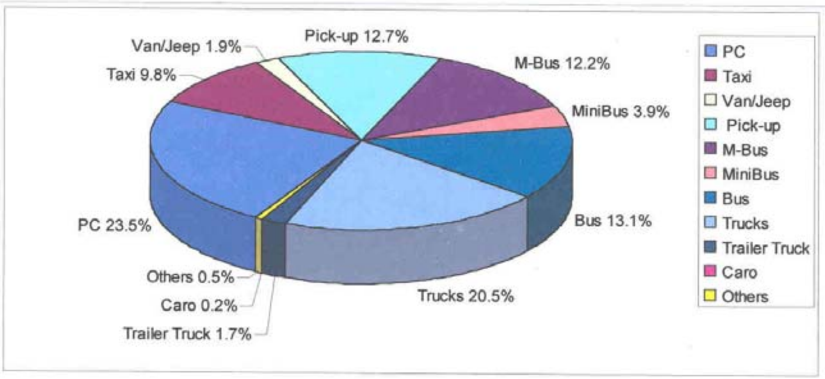


Figure 5-65

Traffic Composition on the Iron & Steel Road, Site No. (2)



- ***Anlysis of Traffic Counts Before the Plant Site***

Same analyses are performed to the traffic counts in front of the power plant site at the intersection point of Cairo/Es-Saff Road and the link to the plant itself.

Figure 5-66 presents fluctuation of the traffic volume in both directions during survey hours in each direction.

The total 16-hour traffic flow was recorded as 6,856 vehicles coming from Cairo to Es-Saff, and 7,395 vehicles in the reverse direction. *Figure 5-66* depicts timing of peak hours in both directions.

Table 5-30 provides with the peak hour flows in both directions of travel.

Table 5-30

Maximum Peak Hour Traffic Volume for the Cairo/Es-Saff Road Before the Station Site

Direction	Traffic Volume at Peak Hour (Vehicle/hour)	
	Morning Peak	Evening Peak
From Cairo to Es-Saff	680	1444
From Es-Saff to Cairo	712	785

Figure 5-67 illustrates traffic composition observed over Cairo/Es-Saff road for both directions of travel.

Figure 5-66

Traffic Flow Fluctuation on Cairo/Es-Saff Road Before the Plant Site

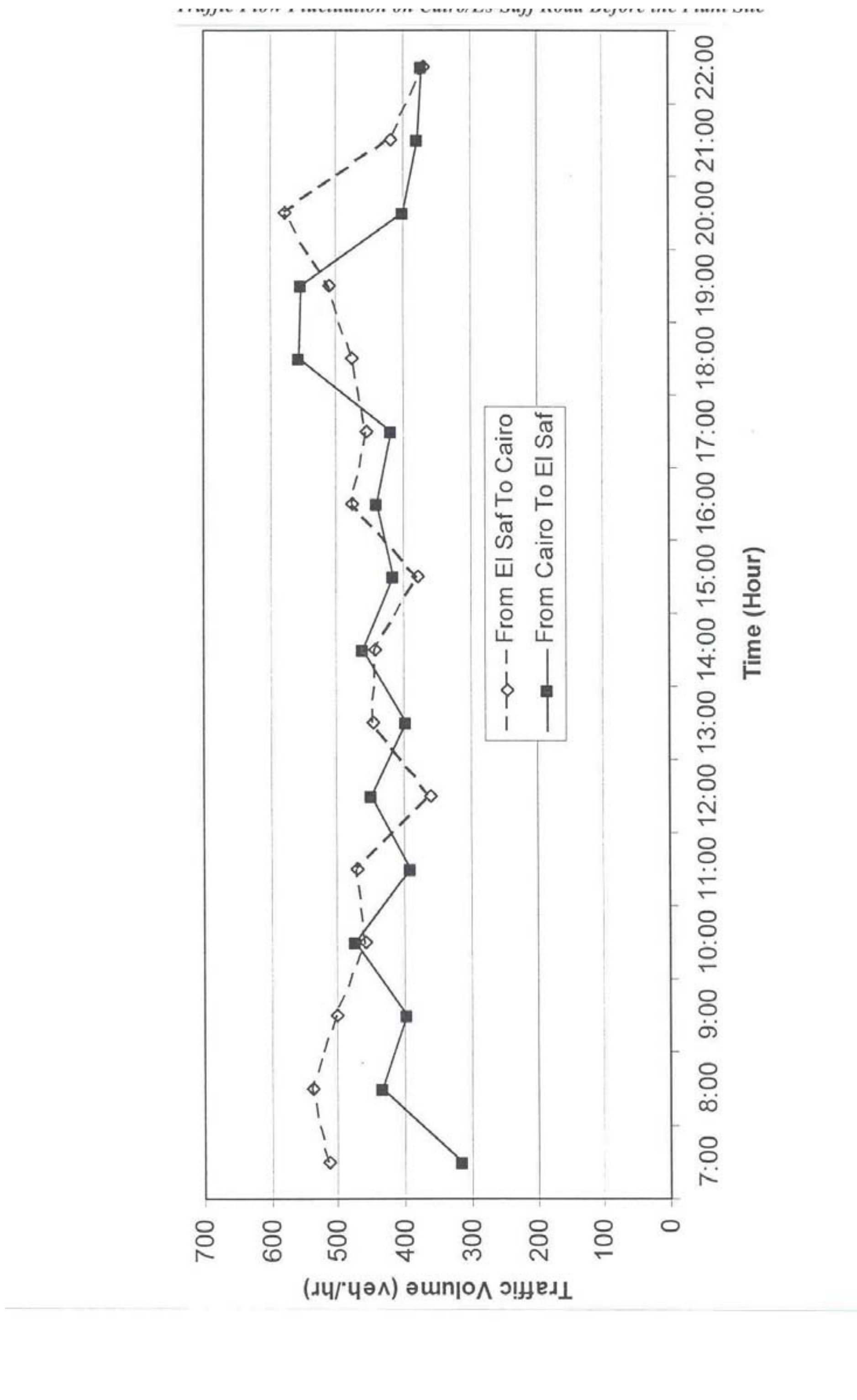
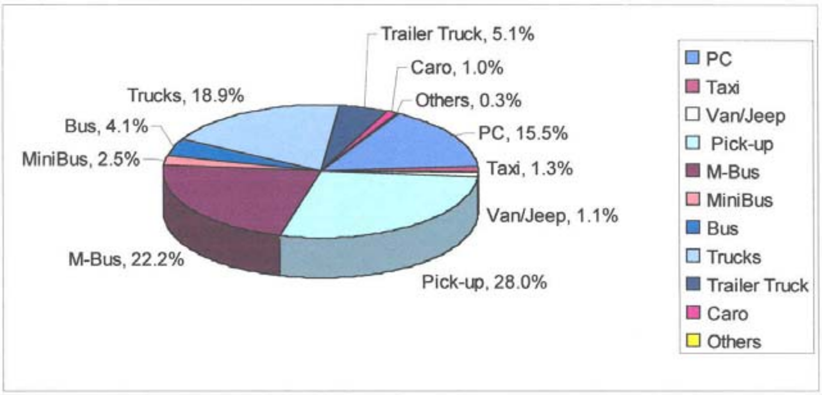


Figure 5-67

Traffic Composition on the Cairo/Es-Saff Road Before the Plant Site



- ***Traffic Volume at Intersection Point Before the Power Plant Site***

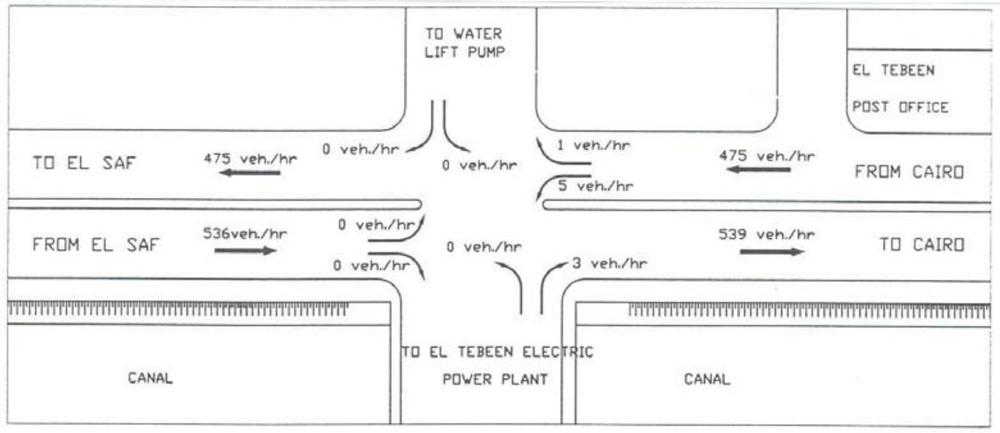
Figure 5-68 presents traffic volume at the intersection point in Morning peak hours (8.00 am – 9.00 am) for traffic directing to Cairo and (10.00 am – 11.00 am) for traffic going to Es-Saff. Afternoon peak hours at (8.00 pm– 9.00 pm) for traveling to Cairo and (6.00pm– 7.00pm) for directing to Es-Saff (vehicle/hour). It illustrates that the highest traffic volume during morning peak hours is 539 vehicle/hour for direction to Cairo and the highest traffic volume during afternoon peak hours is 577 vehicle /hour for the same direction.

5.10.5 Vidiew Mapping System

In adition to the classification survey mentioned above, road inventory survey was carried out for both roads in order to assess their characteristics and existing conditions. Road inventory was carried out by visual inspection and by video mapping system (VMS). In VMS, the study area map is digitized to a computer and a process of checking is carried out. Thereafter, the surrounding roads are video taped (using digital cameras) and then transferred to the computer by ARCVIEW program. The next step is to prepare ARCVIEW file data via importing the highway geometric characteristics and traffic volume data on this road at different survey locations. Results are illustrated in *Table 5-31*.

Figure 5-68

Traffic Volume on Intersection Point Before the Plant Site



VOLUME ON INTERSECTION INFRONT OF THE PLANT AT MORNING PEAK HOUR

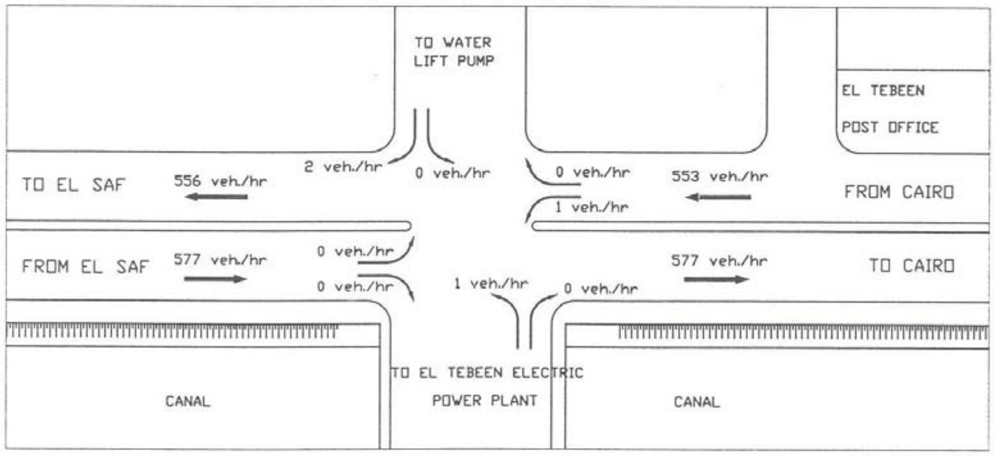


Table 5-31

Results of Road Inventory and Traffic Count Survey

Road	Direction	No. of Lanes	Road Width	Pavement Condition	Shoulder Width	Peak Hour Traffic(1)
Cairo/Es-Saff road	To Cairo	2	7.5 m	Well	1 m (unpaved)	556
	To Es-Saff	2	7.5 m	Well	1 m (unpaved)	577
Cairo/Alex. Desert R.	To Cairo	3	30 m	Good	2 m (Paved)	1275
	To Alex.	3	30 m	Good	2 m (Paved)	1275
Cairo/Alex. Agr. R.	To Cairo	3	25 m	Good	1 m (Paved)	4683
	To Alex.	3	25 m	Good	1 m (Paved)	4683
Cairo/Ism. Desert R.	To Cairo	2	20 m	Good	2 m (Paved)	2180
	To Ismaelia	2	20 m	Good	2 m (Paved)	2180
Cairo/Suez Desert R.	To Cairo	2	20 m	Good	2 m (Paved)	768
	To Suez	2	20 m	Good	2 m (Paved)	768

Notes:
(1) Provided in terms of vehicle/hour in peak hour.

5.10.6 Journey-Time Survey at Surrounding Roads

Moving Observer Method was used for identifyng the operational characteristics of the main road (Cairo/Es-Saff Road) via measuring the average journey time and speeds to this road. The length of the section was chosen 3.5Km for identifing its characteristics. The observer car recorded the following data:

- running time at this section using stopwatch;
- manual survey of traffic volume in the opposite direction of movement test car; and
- manual survey to vehicles that overtaking the test car and that be overtaken by the test car.

This has been done for 10 rounds in each direction of travel on the Cairo/Es-Saff road and also, in the opposite direction. The results of the journey time survey are given in *Table 5-32*.

Table 5-32

Average Travel Time and Speed for the Selected Section

Road	Average Trip Time (Minutes)	Average Velocity (km/hr)
From Cairo to Es-Saff	6:45	33
From Es-Saff to Cairo	7:23	29

5.11 ARCHAEOLOGICAL, HISTORIC AND CULTURAL HERITAGE

There is no available information which identifies any archaeological, historic or cultural remains of significance on the site. This is supported by the present situation which designates the site as the one that has been thoroughly investigated and surveyed for the former Tebbin steam power plant and its surrounding structures.

Historically, Greater Cairo Region has been occupied by a number of civilizations, in particular by pharaonic populations, the Greeks, Romans, Copts and Moslems. In the southern part at Giza, which is about 17km far-to the northwest-from the site, there is a highly rich archaeological and historic center created by the existence of pyramids and sphinx. Other significant archaeological sites are sprinkled around and in farther northwestern areas such as sackkara pyramid.

The archaeological sites and areas reflect the importance that the Egyptian Government attaches to preserving the wealth of historic monuments and sites of Egypt's cultural heritage.

5.12 SOCIO-ECONOMIC ENVIRONMENT

5.12.1 Population and Demography

The project site is located at the Southern Zone of Cairo Governorate, south Helwan District, on the Nile river, just beyond El-Marazique bridge which is considered the outlet point from the Southern Zone of Cairo to Upper Egypt. The closest major puplic utility is El-Tebbin Water Treatment/Purification Station. The total area of the Cairo Governorate in 2005 is 1,466km^2, out of which aroud one seventh represents the Southern Zone, where population of about 2,311,821 reside. The population in the Tebbin District is approximately 85,140.

The total population of Cairo Governorate, including all zones (North, East, Masr El-Gedidah, Middle, West, South) was estimated as 6,800,992 in 1996 , 7,113,648 in 2001 and 7,716,083 in 2005, with an increase of around 13.5% over 1996 figures.

Under the proposals set out in the Governorate's Development Plan, the population of the Southern Zone is likely to increase with the development of new industrial, commercial and residential businesses, and is expected to reach 2,832,073 by 2012. *Tables 5-33 and 5-34* show population data for Cairo Governorate, with special emphasis on Cairo Southern Zone, cobtained from both the Central Agency for Public Mobilization & Statistics (CAPMAS) and the Cairo Governorate.

Table 5-33

Population of Cairo Governorate
with Details on Cairo South Zone, Year 2005 Estimates
(based on 1996 Census)

No.	Area / Sex	Males (Capita)	Females (Capita)	Total (Capita)
Cairo Governorate		3,943,304	3,772,779	7,716,083
Cairo South Zone				
1	Es-Sayyeda Zeinab	88,272	85,479	173,751
2	El-Khalifa & Moqattam	110,766	104,002	214,768
3	Maadi	87,587	80,603	168,190
4	El-Basatin & Dar Es-Salam	378,296	356,129	734,425
5	15th May	37,469	35,426	72,895
6	El-Tebbin	41,488	43,653	85,141
7	Helwan	312,119	292,776	604,895
8	Masr El-Kadima	131,405	126,351	257,756
	Total (Southern Zone)	**1,187,402**	**1,124,419**	**2,311,821**

Source: Central Agency for Public Mobilization and Statistics (CAPMAS), Estimates based on 1996 Census.

Table 5-34

Population of the Cairo South Zone, by Age and Gender Groups with Details on Tebbin and Helwan Areas, July 2004

Area	Age Group	< 5years	5-	10-	15-	20-
Total Southern Cairo	Male	112,613	124,860	136,630	136,866	100,109
	Female	110,174	118,910	132,027	124,371	97,112
	Total	222,787	243,770	268,657	261,237	197,221
Tebbin	Male	4,665	4,786	5,635	5,325	3,695
	Female	4,982	5,101	6,127	5,502	4,085
	Total	9,647	9,887	11,762	10,827	7,780
Helwan	Male	31,364	32,492	41,883	37,556	27,227
	Female	31,074	31,540	37,694	34,735	26,635
	Total	62,438	64,032	79,577	72,291	53,862

Area	Age Group	25-	30-	35-	40-	45-	50-
Total Southern Cairo	Male	85,268	89,177	83,981	76,186	59,686	46,105
	Female	89,888	92,203	81,731	66,762	54,405	41,455
	Total	175,156	181,380	165,712	142,948	114,091	87,560
Tebbin	Male	3,005	2,517	2,081	2,109	2,085	1,524
	Female	3,220	2,558	2,804	2,450	2,025	1,576
	Total	6,225	5,075	4,885	4,559	4,110	3,100
Helwan	Male	22,396	21,691	19,768	18,446	15,278	11,656
	Female	23,283	22,644	18,987	13,888	13,578	10,559
	Total	45,679	44,335	38,755	32,334	28,851	22,215

Area	Age Group	55-	60-	65-	70-	75&above	Total
Total Southern Cairo	Male	34,534	33,144	21,988	12,796	9,821	1,163,764
	Female	27,748	27,751	14,961	10,144	7,327	1,096,969
	Total	62,282	60,895	36,949	22,940	17,148	2,260,733
Tebbin	Male	1,216	953	563	312	194	40,665
	Female	865	695	345	240	170	42,745
	Total	2,081	1,648	908	552	364	83,410
Helwan	Male	9,748	7,743	4,546	2,431	1,709	305,929
	Female	6,327	5,471	2,807	1,944	1,503	282,669
	Total	16,075	13,214	7,353	4,375	3,212	588,598

Source: Central Agency for Public Mobilization and Statistics (CAPMAS), The Statistical Year Book, 1995-2004, July 2004.

5.12.2 Employment and the Labor Market

The labor force of Cairo Governorate is around 2,133,370 with unemployment, including job loosers, at around 7.3% in 2003/2004. *Table 5-35* gives labor force data for Cairo Governorate with a special emphasis on Cairo Sourh.

In the Cairo South Zone, around 30% of the Zone total population forms the active work force, while in the District of Tebbin this ratio reaches about 50%. This labor pool is comprised of employees of industrial activities (chemicals, building and crockeries, engineering, textiles, food, metals and petroleum), employees of small industry and small business operators. Around 60% of the total labor pool can be categorized as skilled, having been trained as industrial technicians. *Table 5-36(A)* presents some details on the industrial establishments of Cairo Governorate in the year 2003/2004 and *Tables 36(B) &(C)* give some details on El-Tebbin industrial establishemts.

A considerable portion of the Cairo Governorate's economy centers on small businesses which comprise vocational activities sector as indicated in *Tables 5-37 (A) and 5-37 (B).*

Cairo South Zone acquires about 15.5% of these small businesses which provide job opportunities for about 21.42% of the total labor force linked to small businesses in Cairo Governorate.

The proposals outlined in the Greater Cairo Region Master Scheme, which corresponds to the Government of Egypt's development program for the country, are likely to offer employment opportunities through the construction and operation of the proposed businesses as well as industrial and commercial developments in the Cairo metropolitan area.

Table 5-35

Labor Force in Cairo Governorate with Details on Cairo South Zone, 2003/2004

No.	Area	Employers	Employment for their Own	Waged Employment	Non-waged Employment	Job Loosers	Un-employment	Among the Workforce
	Cairo Governorate	123,861	237,756	1,767,605	415	13,494	154,126	2,297,257
	Cairo South Zone							
1	Masr El-Kadima	4,013	9,442	58,590	31	502	6,007	78,585
2	Maddi	3,014	3,935	37,953	1	320	2,892	48,115
3	Es-Sayyeda Zeinab	3,201	5,542	43,654	5	194	3,918	56,514
4	Helwan	5,129	16,897	127,502	40	1,353	13,562	164,483
5	El-Khalifa	3,455	8,758	50,126	49	387	3,767	66,542
6	El-Basatin	12,124	27,761	164,658	22	1,391	9,580	215,536
7	El-Tebbin	669	4,136	34,740	7	86	2,988	42,626
	Total (Southern Zone)	**31,605**	**76,471**	**517,223**	**155**	**4,233**	**42,714**	**672,601**

Source: CAPMAS, 2004.

Table 5-36 (A)

Industrial Establishments in Cairo (by Activities), Year 2003

District	Chem-icals	Building Crockeries	Enginee-ring	Textiles	Food	Metals	Mining	Petrol-eum	Other
Cairo South Zone									
Es-Sayyeda Zeinab	12	-	500	7	30	900	260	3	-
El-Khalifa & Mokattam	50	350	100	800	1,200	100	-	10	8
Masr Al-Kadimah	4	8	600	1	500	0	1	10	386
El-Bassatine	15	11	6	3	8	23	3	35	28
Maadi	-	7	-	-	4	1	-	10	106
Helwan	1	4	11	2	60	9	-	1	80
Tebbin & 15th May	10	11	6	-	62	8	2	2	8
Sub Total	92	391	1,223	813	1,864	1,041	266	71	616
Remainder Cairo									
Shoubrah	5	-	32	16	41	700	-	-	44
El-Sahel	1	-	9	14	745	1459	-	-	194
Rawd Al-Farag	2	-	-	25	530	22	-	5	14
El-Sharabyyah	-	-	15	87	6876	796	-	-	6952
El-Zawya El-Hamrah	10	-	2	12	55	502	2	4	672
Zaiton	11	-	465	75	29	1	-	13	499
Hadayek El-Kobba	13	-	2247	151	3368	-	12	12	2
Total Sub-Total	92	391	1223	813	1864	1041	266	71	616
Ain Shams	15	-	7	8	508	343	-	14	101
Al-Salam	90	1-	703	302	801	42	-	-	1412
Al-Marg	25	-	-	14	34	200	-	4	158
Al-Waily	3	4	90	21	615	335	1	10	-
Manshyyet Nasser	-	-	20	-	-	58	-	-	3382
Cairo West	2	-	-	10	785	-	-	-	25
Abdine	3109	-	-	3515	2322	3435	-	-	3225
Middle	50	1	-	50	504	150	120	4	125
Masr El-Gedidah	30	10	16	6	309	23	-	40	40
Nasr City	11	38	30	31	29	12	-	10	385
Total	3,469	445	4,859	5,150	19,415	9,119	401	187	17,846
Grand Total	**3,561**	**836**	**6,082**	**5,963**	**21,279**	**10,160**	**667**	**258**	**18,462**

Source: Cairo Governorate; Work Force & Migration Department, Information & Decision Making Support Center, 2/1/2004.

Table 5-36 (B)

El-Tebbin Industrial Establishments, Year 2003

No.	Public Sector	No. of Employees	No.	Private Sector	No. of Employees
1	Iron & Steel	10,600	1	Awlaad Ayyad for Metal Operations	250
2	Malleated Products	450			
3	El-Nasr for Coke Industry	3,600	2	German Company for Street Lighting	900
4	El-Kawmyyah for Cement	13,200			
5	Electricity	360	3	Granilia Company	170
6	Al-Amma Co. for Metals	1,200	4	El-Kartoon Company	1,200
7	Tebbin Sout S/S	170	5	Oraskom	320
8	Executive Authority for Projects	370	6	Abu-Harb for Aluminium	90
9	Misr Petroleum	180			
Total		30,130	Total		2,930

Source: El-Tebbin District, Information Department, 2005.

Table 5-36 (C)

El-Tebbin Industrial Establishments, Year 2005

No.	Factory	Address	Activity	Owner Ship
1	Ayyad Co. for Metals Operatins	El-Kawmia Cement Road, Tebbin	Ferro metallic products-rolling	Private Sector
2	Iron & Steel Co.	Iron & Steel St., Tebbin	Prod. and marketing of iron Products	Public Sector
3	El-Nasr Co. for Malleated products	Tebbin El-Balad End	Malleated products	Public Sector
4	Egyptian Co. for Ceramics Helwan	Cornich El-Nile, Tebbin	Thermal brick Production	Public Sector
5	Nilcom Co. for Nile Water Ozonation	6 Cornich El-Nile St., Tebbin	Purification and packing of Nile water	Investment
6	Egybac Co. for Cartoon Industry	Kafr El-Elw, Tebbin	Cartoon industry	Private Sector
7	Al-Amma Co. For Metals	Tebbin El-Balad End	Melting and production of metals	Public Sector
8	Mills and Bakeries of Cairo South	El-Kawmyyah Cement St., Tebbin	Wheat grinding; products & commerce	Public Sector
9	Nasr Co. for Coke and Chemics Industry	Tebbin El-Balad End	Chemicals and pesticides	Public Sector
10	Granilia Marble	Cornich El-Nile St.	Grinding and production of Ca CO_3	Private Sector
11	Amir Macaroni Co.	21 Cornich El-Nile St. , Tebbin	Production of Macaroni	Private Sector
12	El-Kawmyyah Cement	El-Kawmia Cement St.	Production of cement and lika Bricks	Public Sector
13	Egyptian German Co. for Street Lighting	El-Kawmia Cement Road, Tebbine	Street lights	Private Sector
14	Arabic Co. for Steel	Cornich El-Nile, Tebbin	Ferro metallic industrialization	Private Sector
15	Egyptian Co. for Metals Operation	El-Kawmia Cement Road, Elmasaken Elgahza St.	Production of Cu & Al wires	Private Sector
16	Al-Islamyyah Co.	Cornich El-Nile St.	Production of ceramic pipes	Private Sector

Table 5-37 (A)

Vocational Activities Sector of Cairo Governorate, Year 2003/2004

District	No. of Workshops	No. of Workers
Cairo South Zone		
Es-Sayyeda Zeinab	1,080	2,980
El-Khalifa & Mokattam	2,023	6,010
Masr Al-Kadimah	628	1,381
El-Bassatine	1,285	12,400
Maadi	1,075	3,241
Helwan	406	834
Tebbin & 15th May	119	809
Sub-Total	6,616	27,655
Remainder Cairo		
Shoubrah	367	871
El-Sahel	2,422	19,059
Rawd Al-Farag	3,174	8,717
El-Sharabyyah	796	6,152
El-Zawya El-Hamrah	7,653	15,203
Zaiton	1,105	2,130
Hadayek El-Kobba	2,247	6,985
Mataryyah	648	2,626
Ain Shams	420	650
Al-Waily	585	5,050
Menshyyet Nasser	631	3,162
Cairo West	1,000	5,778
Abdine	8,375	15,934
Middle	10,661	24,930
Masr El-Gedidah	131	8,808
Nasr City	415	1,360
Sub-Total	41,502	127,415
Grand-Total	**42,660**	**129,084**

Source: Cairo Governorate; Work Force & Migration Department, Information & Decision Making Support Center, 1/7/2004.

Table 5-37 (B)

Vocational Activities Sector of Cairo Governorate, Year 2003/2004

No.	Activity	No. of Workshops	No. of Workers
1	Furniture & Carpentry	6,013	14,653
2	Shoes & Leather Products	2,148	7,451
3	Metalic & Engineering Industries	3,980	19,832
4	Carpeting	6	105
5	Sewing & Tailoring	945	1,330
6	Spinning & Weaving (Textile Industry)	5,204	18,105
7	Ready-made Clothes	1,626	4,007
8	Jewellery	1,378	4,652
9	Khan El-Khalili Hand-made Products	1,373	2,020
10	Printing & Puplishing	701	3,217
11	Mining Manufactures	6,520	24,836
12	Repair and Services	9,116	24,189
13	Chemical and Petroleum Products	1,584	11,550
14	Building & Crockeries	494	2,790
15	Food Products, Tobacco & Beverages	1,679	6,394
16	Miscellaneous Workshops	7,228	17,346
	Total	**49,995**	**162,477**

Source: Cairo Governorate; Work Force & Migration Department, Information & Decision Making Support Center, 1/7/2004.

5.12.3 Income Distribution and Socio-economic Profile

There is no published information concerning the income distribution and socio-economic profile of the population within the Cairo Governorate area. However, fieldwork carried out by EEHC & SPEEDOTRANS representatives, suggests that the local population of the Cairo Governorate is composed of a mix of professional and manual workers.

In discussions with Governorate representatives during EEHC & SPEEDOTRANS's site visit in July 2005, it was suggested that manual construction work is generally undertaken by migrant labor as there is little indigenous labor available (or willing) to carry out this work. Migrants, often from Upper Egypt, travel to Cairo attracted by the employment possibilities in the area. They are not actively recruited from outside the area by development companies. The migrants remain in Cairo until employment prospects draw them elsewhere. This migrant labor process is common in northern Egypt. All Governorate officials consulted by EEHC & SPEEDOTRANS expressed that facilities (housing, public and social services etc.) in the Cairo area are more than adequate to absorb these migrants and they do not create any social problems in the area.

5.12.4 Government and Public Services

Potable Water Supply

Table 5-38 shows water resources in the year 2003 in the Cairo Governorate. The Nile river is the principal source for potable water for the entire Cairo. Maadi, Helwan, Kafr El-Elw and Tebbin treatment/purification stations provide Cairo South Zone with actual capacity of 524,079m^3/day. Also, El-Tebbin treatment / purification station contributes to the Southern Zone supply with a considerable share of its actual capacity (214,194m^3/day). The total potable water supply for the whole Cairo area, including the Southern Zone, is 2,777,177m^3/day.

This water production is distributed and consumed as indicated in *Tables 5-38 and 5-39*.

The per capita potable water consumption in Cairo Governorate reaches an average of about 367 liters/day.

Table 5-38

Cairo Water Resources in the Year 2003 (in m^3/day)

Location of Operational Station	**Qualit y**	**Water Resources**			**Capacity (m^3/day)**	
		Surface	**Ground**	**Others**	**Nominal**	**Actual**
Rawd Al-Farag	Filtered	Nile river	-	-	950,000	862,997
El-Marg	Filtered	-	14 Wells	-	100,000	Currntly Stopped
El-Amiriyyah	Filtered	Ismailia Canal	-	-	450,000	428,133
Er-Raodah	Filtered	Nile river	-	-	144,000	187,789
Al-Foustat	Filtered	Nile river	-	-	1080,000	774,179
Maadi	Filtered	Nile river	-	-	70,000	53,096
Helwan North	Filtered	Nile river	-	-	150,000	169,763
Kafr El-Elw	Filtered	Nile river	-	-	80,000	87,026
Tebbin	Filtered	Nile river	-	-	320,000	214,194
Total					**3,344,000**	**2,777,177**

Source: Cairo Potable Water Utility, 26/6/2003.

Table 5-39

Cairo Potable Water Distribution in the Year 2003 (in m^3/year)

Network Centers	Population in 1/1/2001	Water Consumption (m3/year)	Per Capita Consumption (Liter/day)
Cairo South Zone			
Helwan		65,466,730	
15th of May City		5,909,762	
Maadi		82,059,027	
Tebbin		78,180,810	
Sub-Total		240,616,329	
Remainder Cairo			
Rawd Al-Farag		173,143,855	
Khalafawi and El-Sahel		96,425,066	
Zaiton		105,156,062	
Ain Al-Syirah and Masr Al-Kadimah		62,857,357	
Nasr city (East & West)		68,125,102	
Ain Shams		100,812,680	
Al-Salam City		22,277,928	
Al-Marg		24,159,784	
Kattamiah, Basatine and Dar Al-Salam		5,211,909	
Masr El-Gedidah and El-Nozha		85,831,463	
Sub-Total		589,317,407	
Grand Total	**7,280,392**	**975,617,535**	**367.14**

Source: Cairo Potable Water Utility, 26/6/2003.

Table 5-40

Cairo Potable Water Consumption in the Year 2003, m^3/year

Location	Businesses Sector		Private Sector	
	Customers (No.)	Consumption Capacity (m^3/year)	Customers (No.)	Consumption Capacity (m^3/year)
Cairo South Zone				
Helwan	684	21,711,141	48,412	43,755,589
15th of May City	-	-	14,549	5,909,762
Maadi	439	8,746,251	53,874	73,313,776
Tebbin	2	64,133,052	9,591	2,472,613
Sub-Total	1,125	94,590,444	126,426	125,451,740
Remainder Cairo				
Rawd Al-Farag	5,495	79,268,262	54.071	93,875,593
Khalafawi	-	-	83,687	96,425,066
Zaiton	962	33,716,860	44,157	71,439,202
Ain Al-Syirah	-	-	67,365	62,857,357
Nasr city	-	-	19,315	68,125,102
Ain Shams	-	-	69,155	100,812,680
Al-Salam City	-	-	39,344	22,277,928
Al-Marg	-	-	22,944	24,159,784
Kattamiah	-	-	10,241	5,211,909
Masr El-Gedidah	497	23,953,785	19,507	61,877,678
Sub-Total	6,954	136,938,907	429,786	607,062,299
Grand Total	**8,079**	**231,529,351**	**556,221**	**782,514,039**

Source: Cairo Potable Water Utility, 26/6/2003.

Sewage System

Table 5-41 lists the sanitary drainage facilities in Cairo Governorate in the year 2003/2004. The total drainage capacity of Cairo South Zone is 2.142 million m^3/day while the Cairo Governorate drainage capacity totals 8.814 million m^3/day. *Table 5-42* shows that the average per capita sanitary drainage capacity for Cairo districts in the year 2003/2004, including those of Cairo South Zone is about 345.7 liters/day.

Table 5-43 presents the sanitary drainage capacity planned for Cairo Governorate up to the year 2007. Waste treatment facilities exist outside the cordone of Cairo metropolitan area are also planned to be expanded in order to meet the increasing demand.

The proposed power plant will dispose of its sanitary wastewater into the drainage network already in service in the Cairo South Zone.

Table 5-41

Cairo Sanitary Drainage in the Year 2003/2004 (in m^3/day)

Districts	Station Type	No. of Drainage Stations	Drainage Network Capacity (m3/day)	Total Capacity (1000m3/day)
Cairo South Zone				
Es-Sayyeda Zeinab	Substation	1	55	360
El-Khalifa	Substation	4	60	176
Masr Al-Kadimah	Substation	11	80	356
Helwan	Substation	6	235	769
El-Bassatine & Dar Al-Salam	Substation	6	205	481
Sub-Total		28	635	2,142
Remainder Cairo				
Shoubrah	Substation	1	30	3.4
El-Sahel	Substation	3	102	157.7
Rawd El-Farag	Substation	4	60	33.4
El-Sharabyyah	Main Station	1	18	104
El-Zawya El-Hamrah	Main Station	5	76	289.3
Zaiton	Main Station	7	149	3787.2
Hadayek El-Kobba	Main Station	3	135	28
Al-Salam	Substation Main Station	6 3	85	1872.4
Masr El-Gedidah	Substation	3	56	13.5
Nasr City (East)	Substation	3	85	34.8
Nasr City (West)	Substation	7	35	77.3
Ain Shams	Substation	2	145	81
Mataryyah	Substation	2	140	63
Al-Waily	Substation	1	33	1.7
Abdine	Substation	2	25	38
Menshyyet Nasser	Substation	8	35	87.5
Sub- Total		61	1,209	6,672.2
Grand Total		**89**	**1,844**	**8,814.2**

Source: Sanitary Drainage Utility, 2003/2004.

Table 5-42

Per Capita Sanitary Drainage Capacity For Cairo Districts in the Year 2003/2004 (in Liters / day)

District	**Population in 1/1/2001**	**Sanitary Drainage Capacity ($1000m^3$/day)**	**Per Capita Share (Liters/day)**
Cairo South Zone			
Es-Sayyeda Zeinab	163,321	55	337
El-Khalifa & Mokattam	200,188	60	300
MasrAl-Kadimah	239,196	80	334
Maadi	144,014	50	347
El-Bassatine & Dar Al-Salam	697,589	205	294
Helwan	562,123	235	418
Tebbin & 15th of May	130,669	55	421
Sub-Total	213,710,0	740	350.14
Remainder Cairo			
Shoubrah	87,604	30	342
El-Sahel	349,280	102	292
Rawd El-Farag	186,335	60	322
El-Sharabeyyah	258,809	68	263
El-Zawya El-Hamrah	320,239	76	237
Zaiton	338,250	149	441
Hadayek El-Kobba	318.476	135	424
Cairo West	108,128	80	740
Abdine	82,714	25	302
Al-Mouski	29,896	18	602
Middle	143,856	34	236
Bab El-Shaaryyah	62,713	35	558
Al-Waily	163,996	33	201
Menshyyet Nasser	176,167	35	199
Masr El-Gedidah	126,539	56	443
Al-Nozha	162,093	50	308
Nasr City, West	304,975	85	279
Nasr City, East	107,587	35	325
Mataryyah	521,595	140	268
Ain Shams	490,592	145	296
Al-Salam	373,288	85	228
Al-Marg	263,155	54	205
Badr	261	0	0
Sub Total	4,976,548	1,530	(av.) 341.41
Grand- Total	**7,113,648**	**2,270**	**(av.) 345.77**

Source: General Authority for Sanitary Drainage, 2003/2004.

Table 5-43

Planned Sanitary Drainage Capacity For Cairo Districts up to the Year 2007 (in 1000 m^3/day)

District	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007	Total Demand (1000m3/day)
Cairo South Zone							
Es-Sayyeda Zeinab	0	7	23	33	41	52	157
El-Khalifa & Mokattam	0	16	34	44	52	63	209
MasrAl-Kadimah	0	11	33	45	55	67	211
Maadi	0	5	19	28	37	47	136
El-Bassatine & Dar Al-Salam	4	58	89	83	82	96	413
Helwan	0	0	36	62	74	90	262
Tebbin & 15th of May	0	0	8	18	27	37	90
Sub-Total	4	97	242	313	368	452	1,478
Remainder Cairo							
Shoubrah	0	3	12	19	24	32	90
El-Sahel	3	30	56	65	71	83	309
Rawd El-Farag	0	11	28	39	47	58	184
El-Sharabeyyah	10	28	48	57	64	75	282
El-Zawya El-Hamrah	20	40	60	68	73	83	344
Zaiton	0	0	14	37	53	71	175
Hadayek El-Kobba	0	0	18	39	53	70	181
Cairo West	0	0	0	0	0	0	0
Abdine	0	7	15	20	26	32	100
Al-Mouski	0	0	0	0	1	5	6
Middle	9	20	32	40	46	55	202
Bab El-Shaaryyah	0	0	0	0	5	13	18
Al-Waily	16	27	40	47	53	62	246
Menshyyet Nasser	18	29	43	50	56	65	261
Masr El-Gedidah	0	0	5	15	24	34	78
Al-Nozha	0	12	27	36	44	54	173
Nasr City, West	7	30	52	62	68	79	297
Nasr City, East	0	6	17	24	31	39	116
Mataryyah	17	51	78	80	81	92	398
Ain Shams	2	41	72	77	79	91	362
Al-Salam	27	48	68	74	77	87	381
Al-Marg	25	40	57	64	69	79	334
Sub Total	154	423	742	913	1,045	1,259	4,537
Grand- Total	**158**	**520**	**984**	**1,226**	**1,414**	**1,711**	**6,016**

Source: General Authority for Sanitary Drainage, 2003.

Electricity

Figure 5-69 shows the existing electrical facilities for the entire Greater Cairo Region. The figure also shows how the proposed power plant will be connected to existing electrical facilities running around the site and supplying all industrial, commercial and residential demands located in the Cairo metropolitan area. *Table 5-44* gives some details on the power generating facilities in service today in the Cairo Governorate.

Figure 5-69

Electrical Network of the Greater Cairo Region, 2005

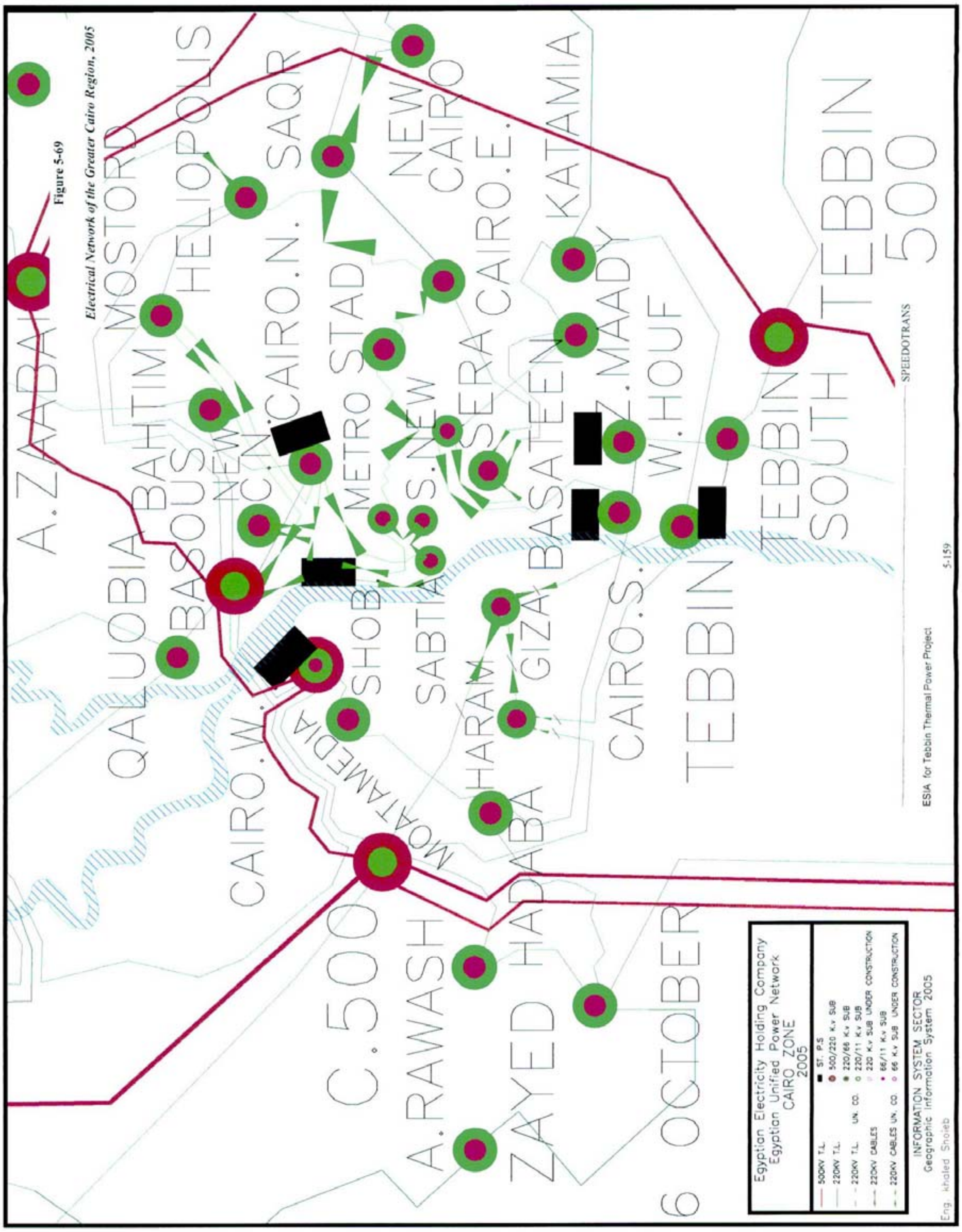


Table 5-44

Power Plants in the Greater Cairo Region, Year 2005

Location (Site)	Power Plant	Commercial Operation Date	Installed Capacity (MW)	Total Energy Generated (MWh)
Shoubrah El-Kheima (Kalyobiah)	Shoubrah (St) Unit (1) Units (2, 3) Unit (4)	 1984 1985 1988	 315 630 315	 7,433,063
Cairo West (Embaba, Giza)	Cairo West (St) Units (1,2, 3) Unit (4) Cairo West (Ext) Units (5,6)	 1966 1979 1995	 262.5 87.5 660	 1,765,460 3,683,614
Cairo South (Helwan)	Cairo South (CC1) Steam units (1,4) Steam units (5,6) Aux-units (2,3) Gas units (1,2,3) (CC2) Unit (4)	 1957 1965 1957 1989 1995	 120 120 15 330 165	 3,696,023 1,281,998
Tebbin[1] (Helwan)	Tebbin (St) Steam units (1,2) Steam unit (3) Tebbin (Gas) Gas units (1,2)	 1958 1959 1979	 30 15 46	 121,413 8,027
Wadi Hof (Helwan)	Wadi Hof (Gas) Units (1,2,3)	 1985	 100	 23,357
Cairo North (Ismailia Canal)	Cairo North (CC)	2004 2006	500 250	214,376

Notes:
(1) Closed on 8th June 2005 and will start demolition 2006.

Health and Education

Main medical facilities in Cairo Governorate consist of 11general hospitals and 7 specilized ones. The hospitals collectively support approximately 5125 beds, they are well equipped for most types of surgery and convalescence and are staffed by more than 2500 physicians, 200 dentists and 2130 nurses covering all medical specializations. Many other private hospitals, clinics, kidney washing facilities and physical therapy units are distributed over the Cairo area. The Cairo South Zone comprises 7 governmental hospitals, including 5 main general hospitals and 2 specialized shown in *Table 5-45*. *Table 5-46* shows that the Tebbin includeds 34 private clinics covering all medical specializations and staffed by at least three physicians and two nurses each, 4 urban medical centers, one hospital for single-day surgery and 16 private pharmacies. *Table 5-47* presents the nearest medical establishments within 7-10m radius from the power plant.

The educational status of the Cairo Governorate population is given by *Tables 5-48* and *5-49.* About 13.3% of post-graduate degrees are found in the Cairo South Zone which reflects the high education concerns of population in this area.

The educational facilities available within the Cairo Governorate include 3148 Nursery (ages under 6) and Elementary schools (age 6-12) for both boys and girls and 648 Preparatory (ages 12-15) and 554 Secondary (ages 15-18) schools In addition, to 83 Special Education Schools.

Table 5-49 gives more details on the undergraduate education in Cairo Governorate with special emphasis on the Cairo South Zone. *Table 5-50* gives El-Tebbin social establishments including educational ones. Also, *Table* 5-51 provides with data on the number of high education institutions in the Greater Cairo Region. In the year 2003/2004, the number of the new comers joined Cairo, Ain-Shams and Helwan universities, which are located in the Greater Cairo Region, reached 68,378 and the number of enrolled students, graduated, enrolled for post-graduate studies and graduated from higher (post-graduate) education was 437,031 ; 72,762 ; 56,940 and 12,772 respectively. The three universities are staffed by 20,690 members during the same year. No information was available on such details for Al-Azhar University, located at Nasr City, which provides with Islamic studies in addition to all other scientific & art disciplines as well as social sciences education.

Table 5-45

Main General and Specialized Hospitals in Cairo Governorate Including Cairo South Zone, Year 2003/2004

District	Hospital	No. of Beds	No. of Doctors	No. of Dentists	No. of Farmac -uticals	Nursing Staff
Cairo South Zone						
General Hospitals						
Es-Sayyeda Zeineb	Al-Mounirah	261	266	15	8	176
El-Khalifa	Al-Khalifa	232	193	11	4	126
Masr Al-Kadimah	Dar Al-Salam	109	166	14	6	78
Helwan	Helwan El-Gedidah	345	155	8	7	185
15th of May	15th of May	110	88	5	3	100
Specialized Hospitals						
Helwan	Hommyyat Helwan	259	43	7	3	68
Es-Sayyeda Zeinab	Al-Kahera Skin	66	132	-	2	33
	Sub-Total	1,382	1,043	60	33	766
Remainder Cairo						
General Hospitals						
Shoubrah	Shoubrah	315	174	15	6	170
El-Sahel	Al-Khazindarah	141	203	20	6	117
El-Zawia	El-Zawi	169	138	9	5	129
Cairo West	Boulak Abu-El-Ela	275	224	14	5	122
Masr El-Gedidah	Manshyyet El-Bakry	359	384	-	-	321
Al-Salam City	Al-Salam	270	206	12	8	170
Specialized Hospitals						
El-Sahel	Ramad Rawd Al-Farag	200	48	20	7	93
Nasr City, West	Sadr El-Abbassia	1052	48	20	7	93
	Hommyyat El-Abbassia	852	93	12	8	129
Middle	Ramad Al-Azhar	-	5	9	-	7
	Ramad Kalaoon	110	33	13	1	16
	Sub-Total	3,743	1,556	144	53	1,367
	Grand Total	**5,125**	**2,599**	**204**	**86**	**2,133**

Source: Information and Decision Taking Sapport Center, Cairo Governorate, 2003/2004.

Table 5-46

El-Tebbin Medical Establishments, 2005

No.	Establishment	Number	Location	Total
1	Hospitals for single-day surgery	1	Masaken Es-Solb El-Gedidah	1
2	Urban Medical Centers	3 1 1	Marazique Masaken Es-Solb El-Gedidah El-Tebbin El-Bahary	4
3	Private Medical Units (Clinics)	14 6 4 4 3 3	Marazique Housings El-Tebbin El-Bahary El-Tebbin El-Balad Marazique Bridge El-Tebbin El-Shaabiyyah Es-Safa wa Al-Marwa	34
4	Pharmacies	5 2 4 1 4	Masaken Es-Solb El-Tebbin El-Balad El-Tebbin El-Bahary Es-Solb El-Kadimah Marazique Bridge	16

Source: El-Tebbin District's Council, July 2005.

Table 5-47

Nearest Medical Establishments with 7-10km Radius from the Power Plant, 2005

No.	Establishment
1	General Helwan Hospital
2	Helwan Fevers Hospital
3	Helwan Chest Medical Unit
4	El-Nasr Health Insurance Hospital (Omar Abdel-Aziz Street, Helwan)
5	Military Production Hospital (Military Factory no. 360)
6	Medical Center for Military Production (Ezbet Zein, Helwan)
7	15^{th} May General Hospital, City of 15^{th} May (El-Mogawrah (Block) no. 3)
8	Hospital of Helwan University (Beside Japanees Garden)
9	Al-Hoda Hospital, Masaken Atlas, Helwan
10	Al-Amal Hospital, Helwan
11	Dar Esh-Shefaa Hospital
12	Al-Fath Al-Islami Hospital, Helwan
13	Behman Hospital for psychological and nervious illnesses

Source: El-Tebbin District's Council, July 2005.

Table 5-48

Some Details on the Undergraduate Education in Cairo Governorate, Including Cairo South Zone, Year 2003

	Nursery			Elementary			Preparatory			Secondary									Special Education			Total		
										General			Commercial			Industrial								
	Sch.	C.R.	Pup.	Sch.	C.R.	Pup.	Sch.	C.R.	Pup.	Sch.	C.R.	Pup.	Sch.	C.R.	Pup.	Sch.	C.R.	Pup.	Sch.	C.R.	Pup.	Sch.	C.R.	Pup.
Cairo South Zone																								
Es-Sayyeda Zeinab	27	90	2967	25	298	14317	12	316	11597	12	227	8824	7	161	5603	6	152	5057	9	44	415	119	1388	48780
El-Khalifa & Mukattam	25	92	2676	42	531	19928	24	342	13707	13	132	4289	8	160	6168	1	25	807	2	13	165	115	1295	47736
Masr Al-Kadimah	20	56	1756	29	443	18622	21	260	14632	10	202	8345	4	99	3655	3	48	1531	3	22	203	90	1230	48745
Maadi	26	139	4434	42	681	28774	39	342	20435	19	247	10214	3	102	4039	1	14	373	1	8	61	131	1623	68394
El-Bassatine & Dar Al-Salam	41	204	6633	72	1265	61737	47	651	31268	10	112	4802	2	63	2610	3	138	4584	-	-	-	175	2433	112734
Helwan	39	133	4531	83	1264	60788	62	9124	41465	18	310	12702	7	232	9302	6	116	2776	9	49	493	224	3118	133057
Tebbin & 15th of May	14	64	2023	20	343	14246	19	250	11238	6	106	4606	222	23	1191	4	112	3640	1	8	62	66	916	37006
Sub-Total	192	778	25020	313	4825	218412	224	11285	144342	88	1336	53782	253	840	32568	24	605	18768	25	144	1399	920	12003	496452
Remainder Cairo																								
Shoubrah	16	65	2144	26	251	8141	4	141	4752	4	75	2842	2	21	767	2	43	1378	-	-	-	63	596	20024
El-Sahel	34	116	4386	58	718	25937	7	473	19490	7	231	10011	5	1190	4424	9	327	10073	8	64	797	145	2048	75118
Rawd Al-Farag	23	102	3371	49	500	15856	11	353	13521	11	227	8833	5	84	3024	5	73	2330	2	11	93	122	1350	47028
Zaiton	34	174	5488	67	863	30204	17	623	25409	17	358	16892	7	229	9104	1	89	3270	8	42	398	181	2378	90765
Hadayek El-Kobba	26	128	4149	54	837	33735	9	545	21919	9	210	9786	8	99	3754	1	100	3194	-	-	-	133	1919	76537
EL-Sharabyyah	8	28	967	26	414	16531	2	274	12524	2	40	1847	4	93	3516	-	-	-	-	-	-	54	849	35385

Sch.= Schools; C.R. = Class Rooms; Pup.=Puples

Table 5-48 (Contd.)

Some Details on the Undergraduate Education in Cairo Governorate, Including Cairo South Zone, Year 2003

	Nursery			Elementary			Preparatory			Secondary									Special Education			Total		
										General			Commercial			Industrial								
	Sch.	C.R	Pup.	Sch.	C.R	Pup.	Sch.	C.R	Pup.	Sch.	C1R	Pup.	Sch.	C.R	Pup.	Sch.	C.R	Pup.	Sch.	C.R	Pup.	Sch.	C.R	Pup.
El-Zawia El-Hamrah	10	19	666	23	447	20277	2	335	15721	2	76	3852	2	76	2918	1	55	1617	-	-	-	50	1008	45051
Cairo West	24	110	3833	36	421	13958	20	283	8717	20	189	6692	5	50	1732	2	27	837	2	12	97	117	1092	35866
Abdine	17	61	2022	25	266	8624	13	221	6505	13	132	4559	2	37	1280	2	41	1296	2	16	188	82	774	24474
Cairo Middle	24	80	2630	37	274	12865	8	257	9577	8	78	2833	6	109	4299	2	58	1970	1	8	47	97	964	34221
Bab Al-Shaaryyah	9	38	1391	11	132	4868	7	72	2938	7	85	2881	3	71	2803	1	25	777	1	8	78	38	431	15736
Al-Waily	43	167	5349	52	538	18644	20	382	12827	20	274	9101	13	218	8431	8	171	5769	9	47	569	184	1797	60690
Manshyyet Nasser	2	9	324	18	440	21208	1	171	10525	1	9	406	1	4	87	2	32	950	-	-	-	31	665	33500
Masr Al-Gedidah	32	118	3863	41	387	14126	33	288	11791	26	301	12568	3	48	1557	1	37	1104	-	-	-	136	1179	45009
Al-Nozha	33	203	6428	39	591	21214	39	374	14039	28	332	13216	1	21	572	1	23	731	7	35	368	148	1579	56568
Nasr City, East	64	370	10722	80	1120	39364	66	685	23300	44	464	16235	5	48	1434	7	133	3832	8	34	272	274	2854	95159
Nasr City, Wast	2	7	234	9	86	3555	9	67	2535	5	43	1347	2	25	845	-	-	-	-	-	-	27	229	8516
Mataryyah	27	148	4751	54	1266	59719	33	685	36146	6	184	10039	4	54	2056	-	-	-	4	31	394	128	2368	113105
Ain Shams	32	226	6575	50	1134	50054	43	740	34809	13	287	14476	6	145	5625	-	-	-	3	22	240	147	2554	111779
Al-Salam City	38	184	4351	56	1045	39492	42	611	24563	15	196	6309	5	124	4529	9	189	6171	3	18	158	168	2367	85573
Al-Marg	34	140	3588	43	696	36298	38	393	20779	3	77	4158	4	122	4715	1	24	796	-	-	-	123	1452	70334
Sub-Total	532	2493	77232	854	12426	494714	404	7699	335376	261	3868	158883	93	2868	67472	55	1392	44478	58	348	3699	2398	72909	1135387
Grand-Total	724	3271	102,248	1177	17552	713082	648	11238	477830	349	5204	212665	126	2647	100040	79	2052	65927	83	492	5098	3368	42456	167890

Table 5-49

Educational Status of Cairo Governorate Population, Including Cairo South Zone, Year 2003

District	Illiterate	Read and Write	Primary Certificate	Pre-Middle Certificate	Middle Cert.	Post-Middle Cert.	University Degree	Post Univ. Degree	Underaged
Cairo South Zone									
Es-Sayyeda Zeinab	34,098	30,364	7,158	13,179	32,924	3,820	19,177	623	24,478
El-Khalifa & Mukattam	52,052	33,999	13,381	17,038	34,043	4,324	14,110	392	34,556
Masr Al-kadimah	63,938	36,216	15,559	16,628	26,090	4,570	26,730	1,328	41,039
Maadi	26,848	20,024	12,489	11,356	23,158	2,850	28,193	1,841	29,155
El-Bassatine & Dar Al-Salam	144,182	101,801	59,832	55,488	108,483	14,461	49,367	1,333	164,109
Helwan	116,804	84,307	55,228	50,567	95,727	10,295	31,535	1,242	125,819
Tebbin & 15th of May	22,874	25,317	10,061	12,516	28,578	2,933	8,104	392	34,580
Sub-Total	460,796	332,028	173,708	176,772	349,003	43,253	177,216	7,151	453,736
Remainder Cairo									
Shoubrah	18,436	10,483	18,436	7,762	7,325	17,635	3,210	11,139	260
El-Sahel	65,457	46,186	65,457	33,789	75,470	11,880	41,769	1,258	49,795
Rawd Al-Farag	41,260	28,587	41,260	16,767	35,132	5,287	18,882	492	25,846
Zaiton	46,852	50,097	46,852	34,872	70,917	10,875	44,158	1,421	58,975
Hadayek El-Kobba	66,060	63,343	66,060	24,912	60,786	8,454	30,506	983	55,878
EL-Sharabyyah	68,314	41,191	68,314	24,367	44,828	6,048	11,113	383	44,155
El-Zawia El-Hamrah	72,365	48,926	72,365	33,461	57,649	7,714	13,402	258	59,928
Cairo West	27,376	22,909	4,537	8,410	17,996	1,921	14,623	1,157	13,825
Abdine	13,507	15,289	3,984	6,636	18,052	2,313	12,592	513	8,844
Cairo Middle	39,610	26,159	9,066	13,700	26,661	3,605	10,095	293	22,228

Table 5-49 (Contd.)

Educational Status of Cairo Governorate Population, Including Cairo South Zone, Year 2003

District	Illiterate	Read and Write	Primary Certificate	Pre-Middle Certificate	Middle Cert.	Post-Middle Cert.	University Degree	Post Univ. Degree	Underaged
Bab Al-Shaaryyah	16,238	13,982	3,604	4,472	11,930	1,668	5,278	162	9,758
Al-Waily	25,048	25,639	9,820	12,460	41,646	4,890	26,769	763	19,747
Menshyyet Nasser	69,494	27,918	11,813	9,561	12,262	1,013	1,835	51	45,256
Masr Al-Gedidah	8,641	12,908	8,549	9,136	24,934	2,787	43,246	2,223	15,575
Al-Nozha	8,793	12,541	11,441	11,754	31,019	3,236	31,306	2,861	23,515
Nasr City, East	26,888	29,445	19,301	17,725	51,979	4,841	84,953	6,990	63,218
Nasr City, Wast	16,365	16,982	6,452	6,765	27,470	1,867	15,573	606	20,993
Mataryyah	99,994	89,182	46,204	55,862	94,770	13,297	29,580	666	115,082
Ain Shams	79,221	74,716	33,990	44,483	90,297	13,550	53,305	1,631	107,453
Al-Salam City	87,484	81,128	20,035	21,241	52,796	7,341	19,421	519	90,140
Al-Marg	28,225	43,244	21,268	21,665	39,836	5,829	12,402	374	70,437
Sub-Total	925,628	780,855	588,808	719,800	893,755	679,051	524,018	53,810	920,908
Grand Total	**1,386,424**	**1,102,913**	**762,516**	**896,572**	**1,242,758**	**722,304**	**701,234**	**60,961**	**1,374,644**

Table 5-50

El-Tebbin Social Establishments Including Educational Ones, 2005

No.	Establishment	Number	Type	Total
1	Schools	6	Primary Schools	16
		1	Prototype General School	
		4	Preparatory Schools	
		1	Secondary Industrial School	
		2	Secondary General Schools	
		1	Steel Training Centes	
		1	Vocational Preparation Center	
2	Nurseries	6	School-based Nurseries	34
		28	NGOs-based Nurseries	
3	Clubs	1	Iron & Steel Club	2
		1	Tebbin Power Station Club	
4	Youth Centers	1	Tebbin Youth Center	1
5	Worship Houses	21	Mosques	23
		2	Churches	
6	Social Associations	48	Non-Governmental Organizations	48

Table 5-51

High Education Institutions in Cairo Governorate Area, Year 2003/2004

No.	High Education Institution	Scientific Sector	Engineering Sector	Scientific & Engineering Sector	Art and Social Sciences Sector
1	Cairo University • Colleges • Institutes	9 3	3	1	9
2	Ain Shams University • Colleges • Institutes	6 2	2	2	6
3	Helwan University • Colleges	2	4	2	11
4	Zagazig University • Colleges			1	
5	Al-Azhar University	Colleges on Islamic Studies as well as all other Scientific, Art and Social Sciences Disciplines			
6	Labor University • Branches	2 (Technology & Industrial Relations)			
7	Private Institutes (4 years or More)	3	20	2	36
8	Private Institutes (2&3-years)	1 (3 Years) + 5 (2 Years)			
9	Technical Institutes (2 Years)	2		6	4

Communications and Transportation

Table 5-52 lists the available communication services in Cairo Governorate and *Table 5-53* gives the available telephone lines today. Cairo South Zone includes 13 main Telephone Centrals and about 24.66% of the entire Cairo telephone lines which totals 2,070,102. The Governorate is currently in the process of providing additional telephone lines for about 103,505 list-waited customers.

The transportation network available within the Cairo Governorate include 7,674.25 km main paved roads, 69 km highways and 6,998.3 km local streets with about 93% of its total kilometers in a good condition (i.e. paved streets). This network is served by 22 bridges and 17 tunnles.

About 3130 buses run throughout 444 buslines within all over the Cairo. Their transport capacity is about 4 million. *Table 5-54* lists roads and highways of Cairo Governorate. *Table 5-55* shows post facilities currently being in service in Cairo Governorate.

Security and Tribunals

The Cairo South Zone comprises 7 police centers and 10 police points. 8 Extingwishing centers are also available and served by 14 extingwishing cars and 977 extingwishing taps. The Cairo South Zone has one tribunal located at Es-Sayyeda Zeinab.

Non-Governmental Organizations (NGOs)

Table 5-56 lists 48 NGOs existed in and around El-Tebbin Area.

Table 5-52

Communication Services in Cairo Governorate, Including Cairo South Zone, Year 2003/2004

District	Telephone Central					Communication Services (Cabines)				
	Automatic		International		Telex No.	Egyptian Communication Company			Minatel Comm. No.	Nile Comm. No.
	No.	Capacity	No.	Capacity		Int. No.	Cov. No.	Local No.		
Cairo South Zone										
Es-Sayyeda Zeinab	-	-	-	-	-	-	-	-	-	-
El-Khalifa & Mokattam	3	78,000	-	-	-	8	-	31	145	44
Masr Al-Kadimah	1	70,000	-	-	-	23	-	56	221	130
Maadi	3	101,157	-	-	-	21	-	33	190	102
El-Bassatine & Dar Al-Salam	2	137,364	-	-	-	17	-	25	219	59
Helwan	2	82,000	-	-	-	17	-	46	158	101
Tebbin & 15th of May	2	42,000	-	-	-	-	-	5	122	27
Sub-Total	13	510,521	-	-	-	86	-	196	1055	463
Remainder Cairo										
Shoubrah	-	-	-	-	-	-	-	-	-	-
El-Sahel	1	96,000	-	-	-	4	2	17	186	115
Rawd El-Farag	1	30,000	-	-	-	-	1	3	28	31
Zaiton	1	130,000	-	-	-	15	8	71	214	149
Hadayek El-Kobba	-	-	-	-	-	-	-	-	-	-
El-Sharabeyyah	1	80,000	-	-	-	4	2	18	118	36
El-Zawya El-Hamrah	1	60,000	-	-	-	1	-	2	66	16
Cairo West	2	69,000	-	-	-	20	-	73	288	138
Abdine	3	180,000	1	6.646	1	63	-	221	718	352
Al-Mouski	-	-	-	-	-	-	-	-	-	-
Cairo Middle	-	-	-	-	-	-	-	-	-	-
Bab Al-Shaaryyah	-	-	-	-	-	-	-	-	-	-
Al-Waily	1	90,903	-	-	-	11	1	40	245	175
Manshyyet Nasser	-	-	-	-	-	-	-	-	-	-
Masr El-Gedidah	1	123,938	-	-	-	18	-	30	211	251
Al-Nozha	3	160,000	-	-	-	53	13	104	217	107
Nasr City, East	1	86,000	-	-	-	-	2	35	200	134
Nasr City, West	4	137,168	-	-	-	7	4	2	177	32
Mataryyah	1	100,000	-	-	-	4	-	40	116	58
Ain Shams	1	80,000	-	-	-	2	-	-	202	49
Al-Salam City	10	76,572	-	-	-	4	-	17	127	44
Al-Marg	1	60,000	-	-	-	2	2	6	9	8
Sub Total	3	1,559,581	1	6,646	1	208	35	679	312,2	1,695
Grand- Total	46	2,070,102	1	6,646	1	299	35	875	4,177	3,158

Table 5-53

Telephone Service Distribution in Cairo Governorate, Including Southern Cairo Zone, Year 2003/2004

District	Total No. of Available Tel. Lines	Total No. of Customers	Total No. of List-Waited Customers
Cairo South Zone			
Es-Sayeda Zeinab	-	-	-
El-Khalifa & Mokattam	78,000	53,683	10,302
Masr Al-Kadimah	70,000	59,431	Open
Maadi	101,157	86,942	4,088
El-Bassatine & Dar Al-Salam	137,364	110,287	Open
Helwan	82,000	77,832	16,717
Tebbin & 15th of May	42,000	28,327	Open
Sub-Total	510,521	416,502	31, 107
Remainder Cairo			
Shoubrah	-	-	-
El-Sahel	96,000	74,366	1,396
Rawd El-Farag	30,000	25,311	Open
Zaiton	130,000	118,465	4,941
Hadayek El-Kobba	-	-	-
El-Sharabeyyah	80,000	65,606	Open
El-Zawya El-Hamrah	60,000	56,933	Open
Cairo West	69,000	47,833	Open
Abdine	180,000	165,759	Open
Al-Mouski	-	-	-
Cairo Middle	-	-	-
Bab Al-Shaaryyah	-	-	-
Al-Waily	90,903	83,611	1,993
Menshat Nasser	-	-	-
Masr El-Gedidah	123,938	111,117	Open
Al-Nozha	160,000	149,508	17,550
Nasr City, East	86,000	72,411	Open
Nasr City, West	137,168	936,642	Open
Mataryyah	100,000	75,099	6,695
Ain Shams	80,000	68,847	Open
Al-Salam City	76,572	50,680	12,641
Al-Marg	60,000	44,488	27,182
Sub Total	1,559,581	2,146,676	72,398
Grand- Total	**2,070,102**	**2,563,178**	**103,505**

Table 5-54

Roads and Highways of Cairo Governorate, Year 2003 (Length in km)

District	Main Paved Roads (km)	Highways (km)	Local Streets Paved (km)	Local Streets Dusty (km)	Total Length (km)	Ratio of Paved to Total (%)
Cairo South Zone						
Es-Sayeda Zeinab	215	-	175	15	405	96
El-Khalifa & Mokattam	285	6	175	90	556	84
MasrAl-Kadimah	194	3	151	10	358	97.2
Maadi	193	4	170.4	20.6	388	94.7
El-Bassatine & Dar Al-Salam	172	-	149.5	11	332.5	97
Helwan	184	15	124	105	428	75.5
Tebbin & 15th of May	192	5	137	20	354	94.3
Sub-Total	1,435	33	1,081.9	271.6	2,821.5	(av) 91.24
Remainder Cairo						
Shoubrah	212.5	-	180.2	20.3	413	95
El-Sahel	132.5	-	135.2	13.3	281	95
Rawd El-Farag	185.5	-	153.2	15.5	354.2	95.6
Zaiton	170.35	-	145.15	19.2	334.7	94
Hadayek El-Kobba	131	-	130	12	273	95.6
El-Sharabeyyah	190.7	-	130.5	15.2	336.4	95.4
El-Zawya El-Hamrah	189.2	-	145.15	19.2	353.55	94.5
Cairo West	230	-	190	15	435	96.5
Abdine	160	-	149.5	6	315.2	98
Al-Mouski	128	-	125	5	258	98
Cairo Middle	150	3	159.6	6	318.6	98
Bab Al-Shaaryyah	132	-	130	11	273	96
Al-Waily	319	2	299	10	630	98.4
Menshat Nasser	273	4	252.2	91.4	620.6	85.3
Masr El-Gedidah	520	19	432	150	1,121	86.6
Al-Nozha	420	-	163	30	613	95
Nasr City, East	763	4	435	200	1,402	86
Nasr City, West	623	4	288	190	1,105	83
Mataryyah	244	-	170	30	444	93
Ain Shams	339	-	264	160	763	79
Al-Salam City	551	-	285	100	936	89
Al-Marg	175.5	-	155	15	345.5	95
Sub Total	6,239.25	36	4,516.7	1,134.1	11,925.75	(av) 92.81
Grand- Total	**7,674.25**	**69**	**5,598.6**	**1,405.7**	**14,747.25**	**93.3**

Table 5-55

Post Offices and Post Agencies in Cairo Governortate, Including Cairo South Zone, Year 2000

District	Governmental Post Offices (No.)	Post Agencies (No.)
Cairo South Zone		
Es-Sayyeda Zeinab	4	8
El-Khalifa & Mokattam	9	18
Masr Al-Kadimah	7	5
Maadi	7	16
El-Bassatine & Dar Al-Salam	8	33
Helwan	20	25
Tebbin & 15th of May	15	9
Sub-Total	70	144
Remainder Cairo		
Shoubrah	4	17
El-Sahel	6	32
Rawd El-Farag	6	10
Zaiton	5	26
Hadayek El-Kobba	6	28
El-Sharabeyyah	6	21
El-Zawya El-Hamrah	5	17
Cairo West	20	17
Abdine	12	20
Al-Mouski	1	6
Cairo Middle	8	1
Bab Al-Shaaryyah	2	10
Al-Waily	11	18
Manshyyet Nasser	4	-
Masr El-Gedidah	11	23
Al-Nozha	10	4
Nasr City, East	14	31
Nasr City, West	8	3
Mataryyah	6	21
Ain Shams	10	44
Al-Salam City	7	5
Al-Marg	2	5
Sub Total	164	340
Grand- Total	**234**	**473**

Table 5-56

Social Associations and Charities in the Tebbin Area

No.	Name of Society	Address
1	Es-Solb City Development Association	Es Solb El-Kadima City Building 32 Flat 4
2	Electricity General Services Society	Tebbin Power Plant
3	Charity for El-Nasr Coke Workers	El-Marazique, Building 17, Flat 6
4	Association of Local Society Development	El-Marazique, Tebbin
5	Pilgrim Facilitation Society for Iron & Steel Co.	Egyptian Iron & Steel Co.
6	Zagazig Population Society	6 El-Tawheed St., El-Marazique
7	Social Care for Workers of Industrial and Metallic Projects	Industrial and Metallic Projects Executive Authority Building
8	El-Monofia Society for Development of Society	Near El-Tebbin Youth Club
9	El-Swefiyyah Charity Society	14 El-Twheed St., El-Marazique
10	Daqahliyyah and Damietta Charity Society	7 El-Gameyat El-Khairiah St.
11	Tebbin Demostic Unit Society	El-Tebbin El-Seha St.
12	El-Auxour and Esnad Population Society	45 Marazique
13	Islamic Society for Mosques Building	El-Marazique, Hossein Saad House
14	Souhag Society for Social Care	El-Marazique
15	Graduates of Japanese Universities Society	Researches & Development Minerals Center
16	Association of Tebbin Institute for Metallurgical Studies Staff Club	Iron & Steel St., Institute for Metallurgical Studies
17	E-Twhidiyyah Islamic Society	El-Marazique, El-Tawheed Mosque
18	Ed-Dessoukiyyah Charity	2 Al-Auxour St.
19	Egyptian Charity for Graduates Youth Employment	35 Gaber Abdel-Ghani St.
20	Egyptian for Industrial Laser Applications	Iron & Steel St., Tebbin Institute for Metallurgical Studies
21	Social Services Society	Iron & Steel St., Tebbin Institute for Metallurgical Studies
22	Retired Population Society	5 Abdel-Latif St., Tebbin Misr El-Gedidah
23	Charity for Asiut Population	El-Marazique, Mogamaa El-Gameiah St.
24	Arabic Society for Protection and Development of Environmental Species	Iron & Steel St., Institute for Metallurgical Studies
25	Egyptian Society for Thermal Treatment of Metals	Iron & Steel St., Tebbin Institute for Metallurgical Studies
26	Islamic Badr for Development of Society	El-Marazique Bridge

Table 5-56 (Contd.)

Social Associations and Charities in the Tebbin Area

No.	Name of Society	Address
27	El-Fayyomiyyah Charity for Aids	El-Marazique Area
28	Dououf El-Rahman Society	6 Fathi Abed St., El-Marazique Area
29	Societys Steel Development Association	Es-Solb Elgedidah City
30	Charity for Tebbin Population	El-Kawmiyyah St.
31	Pilgrim Facilitation Society in El-Nasr Co.	El-Nasr Co.
32	Islamic Tebbin in Marazique	El-Marazique Bridge
33	Charity for Ed-Dana El-Islamiyyah	14 Abdel-Ghany El-Saiyyed St.
34	Pilgrim Facilitation Society in Es-Solb Mosque	Saad El-Zahr St., Es-Solb El-Gedidah
35	Popular Integration Society	13 Tebbin El-Balad St.
36	Local development Society in Arab El-Tebbin El-Bahary	El-Masged St., El-Tebbin El-Bahary
37	Charity for Workers in Sand Brick Factory	Autostorad Road
38	Pilgrim Facilitation Society for Cement El-Kawmiayyah	El-Kawmiyyah Cement Co.
39	Islamic Society for Development in Esh-Sheikh Mahfouz	El-Sheikh Rizk St., El-Tebbin El-Kebly
40	El-Fayd Al-Azim Society for Development	7 El-Kaaed St., El-Tebbin El-Bahary
41	El-Ataa for Environmental Protection	29 Abdel-Daayem Abel-Maksoud, El-Tebbin El-Bahary
42	Lilat El-Ghad Society	Toraah St., El-Tebbin
43	Charity Abnaa for General Development	Abdel-Khalek Said, El- Tebbin El-Bahary
44	Kottab El-Ghourfa Society	Osman Ibn Affan St.
45	El-Sarh Society in Tebbin	El-Marazique House
46	El-Shamekha Society in Tebbin	3 Fathi Aiyed St.

6. ENVIRONMENTAL IMPACT ASSESSMENT

6.1 ENVIRONMENTAL IMPACT PROCESS

6.1.1 Introduction

This section identifies and evaluates the primary environmental and social impacts of the proposed construction and operation of the Tebbin Power Plant.

For each subject area (i.e. air quality, noise etc.), the nature of the impact is discussed along with its potential significance, given the existing characteristics of the site and the Egyptian and World Bank Guidelines for New Thermal Power Plants(1). Where potentially significant adverse impacts are identified, possible mitigation measures are suggested wherever possible, to ameliorate the impact to an acceptable level. Where identified, beneficial or positive impacts/effects of the project are also highlighted.

6.1.2 Assessment Methodology

Identification and assessment of impacts has been undertaken through a process comprising consultation, on site observations, literature review and experience of other similar projects. In addition, several impact models were carried out by SPEEDOTRANS representatives as follows:

- atmospheric dispersion modeling of the stack emissions (carried out by EDF, France; Direction Research Department (DRD));
- thermal modeling of the water cooling discharge system (carried out by the Hydraulics Research Institute, National Water Research Center, Ministry of Water Resources and Irrigation;
- noise levels modeling of the power plant during operation (carried out by M.B. Consultant, Prof. of noise and vibration engineering, Ain Shams University, on behalf of SPEEDOTRANS;
- transport Impact modeling (conducted by the Egypt National Institute of Transport, Ministry of Transport;
- ecological assessment of impacts that may occur due to the power plant operation (carried out by Expert Ecologist, Ain Shams University on behalf of SPEEDOTRANS); and

(1) World Bank Group, Pollution Prevention and Abatement Handbook- Thermal Power Guidelines for New Plants, July 1998.

- seismic investigation of impacts which may affect the power plant during its overall life time carried out by the National Research Institute of Astronomy and Geophysics (NRIAG) and the Arab International Environmental Services Corporation "Enviro-Pro").

These modeling results have been reviewed, verified and commented on by SPEEDOTRANS as part of the preparation of this ESIA report. The results of this process are documented in this ESIA along with further work and investigations that have taken place.

The potential impacts associated with the demolition, construction and operation of the Tebbin Power Plant are listed in *Table 6-1.*

Table 6-1

Environmental, Health and Safety Issues Relating to Demolition, Construction and Operation of Tebbin Power Plant

Subject Area	Potential Impacts During Demolition and Construction	Potential Impacts During Operation
Air Quality	Dust from demolition and construction activities. Traffic-related air quality impacts.	Impacts of emissions from stacks on ambient air quality. Traffic-related air quality impacts. Global warming potential.
Aquatic Environment	Control and management of site drainage. Wastewater discharge. Sewage disposal and foul drainage.	Thermal water discharge. Water requirements for power plant operation. Discharge of process and wastewater. Operation of drainage systems on site. Discharge of storm water, sewage and drainage.
Noise and Vibration	Noise from demolition and construction activities.	Noise from power plant operations on surrounding land uses.
Flora and Fauna	Loss of habitat or species due to landtake. Disturbance or damage to adjacent habitat of species.	Disturbance or damage to adjacent habitat. Effects of structures on bird migration routes.

Table 6-1 (Contd.)

Environmental, Health and Safety Issues Relating to Demolition, Construction and Operation of Tebbin Power Plant

Subject Area	Potential Impacts During Demolition and Construction	Potential Impacts During Operation
Land Use, Landscape and Visual Issues	Land use on site. Land use in the surrounding area. Effects of demolition and construction activities on landscape character. Visual impact of demolition and construction activities.	Land use on site. Land use in the surrounding area. Effects on landscape character. Visual impact of operating facilities.
Soils, Geology and Hydrogeology	Effects on soils and geological features. Ground contamination. Effects on groundwater.	Ground contamination. Effects on groundwater.
Traffic	Traffic conditions/disruption to road users. Traffic-related air quality. Traffic-related noise.	Traffic conditions/disruption to road users. Traffic-related air quality impacts. Traffic-related noise impacts.
Natural Disaster Risk	Seismic risk. Flood risk.	Seismic risk. Flood risk.
Major Accident Hazards	Risk to third-party hazardous industry.	Risk to third-party hazardous industry. Risk to power plant of third-party hazardous industry.
Solid and Hazardous Waste Management	Contamination of Soils and Water. Hazards to Workers Health. Accident Risks.	Contamination of Soils and Water. Hazards to Workers Health. Accident Risks.
Occupational Health and Safety	Accidents. Effects on health of workforce. Safety at work.	Accidents. Effects on health of workforce. Safety at work.

6.1.3 Assessment Content

The following items are examined in the corresponding sub-sections of this Section:

- Air Quality;
- Aquatic Environment ;
- Noise and Vibration;
- Flora and Fauna;
- Land use, Landscape and Visual Impacts;
- Soils, Geology and Hydrology;
- Traffic;
- Socio-economics and Socio-cultural Effects;
- Archaeology, Historic and Cultural Heritage;
- Natural Disaster Risks;
- Major Accident Hazards;
- Solid and Hazardous Waste Management;
- Public Health Effects;
- Occupational Health and Safety; and
- Associated Infrastructure.

For each of these items, a concise description and evaluation of the significance of potential impacts of the project is presented. Where modeling has been undertaken, a description of the model as well as corresponding maps summarizing the results of the assessment are provided.

If mitigation measures are considered to be necessary, these measures are presented and taken into account in order to estimate the predicted environmental and social impacts of the power plant.

6.2 AIR QUALITY

6.2.1 Introduction

One of the more significant impacts of the power Plant on environment is the impact on the air quality. During demolition and construction activities and power plant operation, several pollutants will be released to the atmosphere including:

- intermittent fugitive emissions of dust during the demolition and construction period;
- emissions from the exhausts of vehicles used for the transport of the workers, the transport of demolition wastes and construction materials and of basic equipment as well as transport during the power plant operation (light fuel trucks); and
- stack emissions during the power plant operation (particularly of nitrogen oxides (NOx).

The power plant will burn natural gas as the main fuel. As a result, emissions of particulate matter and sulfur dioxide during normal operation of the power plant will be very low.

Atmospheric dispersion modeling of stack emissions has been carried out in order to assess the impact of the power plant operation on ground level concentrations of nitrogen oxides (NOx), sulfur dioxide (SO_2) and carbon monoxide (CO) and to determine the scale of any impact on air quality, relative to accepted criteria.

Whilst the plume from the power station may travel ultimately over many hundreds of kilometers, the impacts in terms of increments to ground level concentrations of nitrogen dioxide will be confined to an area within a 5-8 km radius of the power station site (see air quality dispersion modeling). This then may be regarded as the “airshed”, to use the terminology from the World Bank guidelines on thermal power plants.

6.2.2 Atmospheric Emissions during Demolition and Construction Activities

Dust Emissions

Dust generated during demolition and construction can be significant locally. The following activities have the potential to result in the generation of dust during construction:

- demolition operations on site (for buildings and other structures);

- “earthmoving” operations on site (excavation and removal of superficial sands);

- earthworks engineering;

- site stripping;

- wind blow; and

- circulation of vehicles and trucks for the export of the demolition wastes, for the import of the construction materials, for the export of excavated soil, for the transport of the workers and the transport of the equipment. This is a particularly significant source of dust emissions on unmade roads.

In the climate type experienced in this region as well as the relatively low quality of background air, existing concentrations of airborne dust are high. Relative to these existing levels, the contribution of additional dust from demolition and construction will be low.

Other Emissions

The movements of vehicles will also result in the emission of airborne pollutants, from the exhausts of the vehicles. The amount of such emissions will depend on the number of the vehicles concerned, vehicle type and the volume of traffic.

Mitigation Measures

In order to limit the impact of the construction activities on air quality, the following mitigation measures will be implemented:

- Demolition of building and structures would generally be in the reverse order to that of construction, progressive, level by level, having regard to type of construction. Wherever possible, external non-load bearing cladding shall be removed first.

- All asbestos containing materials (ACM), if found, shall be removed as per the ACM management plan under supervision of asbestos specialist prior to commencement of demolition works, wherever possible. Other ACM may need to be removed as access is gained to particular areas and as the demolition progresses.

- Debris to be removed at frequent intervals and stockpiles shall not be allowed to build up. Waste shall be removed on a daily basis as far as reasonably practicable

- The use of all mobile cranes must be strictly controlled to ensure that cranes of adequate capacity will be used for lifting under different loading conditions. The Contractor shall also arrange for a competent EHS person to be dedicated at site all times during demolition and construction and inspect the scaffolding work, and to make any adjustments as the work proceeds, to ensure its stability and safety in line with statutory requirements, particularly the Construction Site (Safety) Regulations and the Code of Practice for Scaffold Safety.

- demolition of buildings and other structures on the site will be undertaken such as dust emission is minimized;

- demolition and construction waste transfers, land transfers and stock piles of material will be managed to minimize the risk of wind blown material and dust;

- the construction phase will begin with the construction of the access roads (in order to minimize dust from vehicle movements;

- roads during construction will be compacted and graveled if necessary;

- roads will be maintained in good condition;

- access to the site will be regulated;

- vehicle speed will be limited on site; and

- vehicles will correspond with Egyptian pollutant emission standards.

6.2.3 Atmospheric Emissions during Power Plant Operation

Pollutants Emitted

The Tebbin power plant will burn primarily natural gas or heavy fuel oil (HFO) (No. 6 fuel oil) as an occasional substitute in an emergency. Both primary and alternate fuels for the power plant project will be purchased from GASCO and the Egyptian General Petroleum Corporation (EGPC) under a Fuel Supply Agreements.

The steam power plant will have two modes of operation with regard to fuel type. The normal, and preferred mode is firing with natural gas. This will be the case for the majority of the time. In case of an interruption of the gas supply, the power plant will use heavy fuel oil as an alternate fuel.

The principal pollutant when burning natural gas will be oxides of nitrogen (NOx). Use of no. 6 fuel oil will also result in emissions of particulate matter

(PM) and sulfur dioxide (SO_2), along with trace amounts of some other pollutants.

The characteristics of the emissions of the steam plant of the Tebbin power project are described below according to the fuel supply (natural gas or no. 6 fuel oil as an alternative).

Operation with Natural Gas

The concentrations of SO_2 will depend directly on the sulfur content in the fuel. The natural gas used as primary fuel is practically free from sulfur, and emissions of SO_2 will be negligible when firing natural gas fuel during normal operation.

Egyptian regulations and requirements of the World Bank (1998) for stack emissions will be complied with when firing with the main fuel. *Tab1e6-2* summarizes this.

Table 6-2

Stack Emissions for Firing with Natural Gas
[Ceiling Values of both the Egyptian & the W.B. Standards (whichever stringent) will be Guaranteed per Design Process]

Pollutant	Estimate Value	Egyptian Requirement (1)	World Bank Guideline (1),(2)
NOx	≤ 300 mg/Nm^3	300 mg/m^3	320 mg/Nm^3
SO_2	≤ 300 mg/Nm^3 ≤ 118,25 t/d	2500 mg/m^3	2000 mg/Nm^3 2.0 t/d/MW for the first 500 MWe Plus 0.1 t/d/MW additional over 500 MWe
Particulate Matter (all size)	≤ 50 mg/Nm^3	200 mg/m^3	50 mg/Nm^3

Notes:

(1) Values taken at 3% of O_2 in dry fumes parameters of natural gas :S% pds = 0%, Particulate Matter : nil, N% pds = 0.2%.

(2) World Bank Pollution Prevention Handbook, Thermal Power-Guidelines for New Plants, July 1998.

Operation with Emergency Fuel

Firing with heavy fuel oil as a substitute fuel will occur for only a limited number of hours per year (a maximum of 170 hours per year) and only if natural gas is not available.

As the power plant will fire heavy fuel oil for less than 2% of operating time, Egyptian and World Bank emission standards are not applicable. Nevertheless, estimated values of emissions in these circumstances are presented, for information, in *Table 6-3* below. It shows that the Egyptian regulations and guidelines of the World Bank (1998) for stack emissions will be complied with.

Table 6-3

Stack Emissions for Firing with Heavy Fuel Oil
[Ceiling Values of both the Egyptian & the W.B. Standards (whichever stringent) will be Guaranteed per Design Process]

Pollutant	Estimated Value (1), (2)
NOx	$\leq$ 300 mg/Nm^3
SO_2	$\leq$ 2000 mg/Nm^3
Particulate Matter (all size)	$\leq$ 50 mg/Nm^3

Notes:
(1) Values taken at 6% of O_2 in dry flue gases.
(2) Parameters for fuel oil:
- Total Nitrogen, % wt. pds max = 0.2
- Total Sulfur, % wt. pds max = 2.7%.
- Ash content, % wt. pds max = 0.3%

In addition, SPEEDOTRANS has undertaken modeling of the normal (operational) fuel and the results of the analysis are given below.

Mitigation Measures

Several specific measures have been taken to reduce stack emissions from the power plant and to comply with Egyptian and World Bank standards. The power plant will fire natural gas as main fuel which is the least polluting fuel available, (with negligible sulfur dioxide emissions and low particulate matter emissions). Heavy fuel oil will only be used as an emergency fuel. In order to reduce NOx emissions when firing natural gas or heavy fuel oil, low-NOx burners will be used on the boilers. Low-NOx burners reduce NOx emissions by:
- shortening gas residence time in the high temperature zone; and
- lowering the oxygen concentration in the combustion zone.

This is achieved by:

- staggering combustion (modification of the location of burners in the furnace); and
- excess air control (modification on the regulation of the total air to the furnace).

Conclusion

The pollutant emissions of the power plant will comply with all requirements when firing natural gas.

No mitigation measures will be implemented for potential exceedences of TSPs and SO_2 when firing on HFO. The exceedence of air quality standards might be due to the already existed background levels and could not be attributed to the plant. The costs of reducing these emissions would not be economically viable given the minor benefits to air quality that measures would bring. In addition, the alternate fuel will only be used for a maximum of 2% of the operating time. The World Bank Guidelines for New Thermal Power Plants states that all of the maximum emissions levels should be achieved for at least 95% of the time the plant is operating. The remaining 5% is assumed to be for start-up, shut down or emergency fuel use. This is the stance also taken by the EEHC.

6.2.4 Atmospheric Dispersion Modeling

The height of the stack will comply with Egyptian requirements and World Bank guidance on Good Engineering Practice (GEP). The height of the stack has been fixed by EEHC in the design criteria of the power plant project. The stack of 152 m was defined in the preliminary conceptual design according to the screening dispersion modeling undertaken for the Tebbin power plant feasibility study in 2004.

Purpose

Atmospheric dispersion modeling has been carried out by EDF-DRD (Direction Research and Development of EDF) in order to determine power plant impacts on local air quality, when firing natural gas.

This modeling is able to quantify the impact of stack emissions on local air quality, define the areas where the maximum impact will occur and enable the evaluation of the concentrations of nitrogen oxides, particulate matter and sulfur dioxides in the air against the ambient air quality standards.
As heavy fuel oil will be used only as emergency fuel, less than 2% of the operating time, the modeling has been restricted to the case of firing on natural gas.

Description of the Model ADMS3

ADMS3 (Atmospheric Dispersion Modeling System, version 3) is a computer program designed to simulate atmospheric dispersion processes over long periods, in order to estimate ambient concentration levels of air pollutants resulting from any set of gas emission sources or suspended particulate matter emission sources. It concerns mainly stack emissions, but can be applied to other stationary emission sources.

It is appropriate for application to a wide variety of problems (in particular regulatory applications) related to industrial source complexes, with transport distances up to 50 km in flat or rolling terrain.

The model is mainly based on the Gaussian plume dispersion equations as described by Pasquill, Gifford and Turner, as well as the Brigg's plume rise equations. It includes several sets of dispersion coefficients, alternative plume rise equations, and various options concerning plume downwash, such as buoyancy-induced dispersion and terrain adjustment.

Computations are made with an hourly time step and allow if necessary hourly variations in the pollutant emission rates. For every day over the period for which meteorological data are used as input to the model, concentrations are calculated over three different averaging times including between one hour and 24 hours. At the end of the simulation the program output provides the following outputs for each receptor considered over the study zone:

- the mean concentration over the period, with the contribution of various sources (if any);
- the maximum value for each of the three averaging times; and
- the breakdown into pollution classes for the concentrations related to each of the averaging times.

In addition, detailed information about the highest concentrations is computed over the period.

From such results, various maps of pollution or contour plots can be established and comparisons can be made with current air quality standards.

Method of App1ication

All the simulations have been performed over a period of 5 years (2000-2004) with the time series of meteorological data provided by the Cairo station.

In each case, the additional concentrations arising from the plant emissions are estimated within a 10 km radius airshed and based on the source of emission (see pollution maps in *Figures 6-5* and *6-6*). The receptor grid used is such that the concentrations of pollutants in the ambient air are computed over a set of about 10,000 points covering the area.

Figures 6-1 and *6-2* provides with a localization map for the modeled project and a plant layout for the stack location within site arrangement. *Figure 6-3* depicts receptor grid used in air quality modeling. Also, *Figure 6-4* illustrates wind rose of meteorological data used for the period 2000-2004 in performing modeling exercise.

Modeling Assumptions

The results have been obtained using the following assumptions:

- the plant is running continuously at full load;
- the standard volume flow rate of exhaust gas (per unit, at 100% load) is about 954,000Nm^3/hr for both of the gas firing and mazout firing (3% O_2, dry gas);
- the actual volume flow rate of exhaust gas (per unit, at 100% load) is about 1,497,600m^3/hr for gas firing and about 1,526,400m^3/hr for mazout firing;
- the internal flue diameter is 4.25m for both of the gas firing and mazout firing;
- the flue gas exit velocity (100% load) is 29.4m/sec. for gas firing and 29.9m/sec. for mazout firing;
- the temperature of gas at stack exit is 103^{o}C for gas firing and 128^{o}C for mazout firing;
- the emission concentration of NO_2 is 300mg/Nm^3 for both of the gas firing and mazout firing (3% O_2, dry gas);
- the operating mode taken into account is as follows:
  - Gas firing operating period during 8190 hr/year:
  - Mazout fining period during 170 hr/year:
    - * From 0hr the 1st of January until 18hr30 the 2nd of January,
    - * From 0hr the 1st of April until 18hr30 the 2nd of April,
    - * From 0hr the 1st of July until 18hr30 the 2nd of July,
    - * From 0hr the 1st of October until 18hr30 the 2nd of October,
  - Outage period during 400 hr/year:
    - * Outage from 0hr the 24th of October until 16hr the 9th of November for the first unit,
    - * Outage from 0hr the 31th of October until 16hr the 16th of November for the second unit; and
- the conversion rate (i.e. NO to NO_2) during the time it takes the plume to reach the receptor is equal to 80% (almost certainly an overestimate).

The simulations were performed using the following model features:

- Brigg's plume rise formulas;
- classical "urban" dispersion parameters (Pasquill, Gifford);
- stack-tip downwash (Briggs);
- buoyancy-induced dispersion (Pasquill); and
- flat terrain.

It should be noted that hours of calm, i.e. no wind, have been left out of the computations. To compensate for these 'missing' hours, the wind speed has been set at 1 m/sec. at the emission level, with a random direction, according to the frequency distribution observed at the station for low winds (1 to 2 m/sec.).

Modeling Results and Comparison with the Guidelines

The concentrations of NOx has been computed hour by hour at each of the 10,000 receptor point covering the study area.

At the end of each simulation, the impact of the plant can thus be described in statistical terms, in the form of frequency distributions of hourly and daily mean concentrations. It is then possible to establish, at each of these receptor points, the levels reached by a certain "percentile" of these frequency distributions. From this, the corresponding pollution maps can be drawn.

The results obtained over a period of five years can be considered as representative of an average year from the meteorological viewpoint. They can be directly compared to the air quality standards, themselves expressed in term of limit values fixed either for the annual averages or for the percentiles (1) related to annual cycles.

For the principal pollutant concerned i.e. NOx, "contour plots" expressing the contribution of the plant to local concentrations have been produced, in order to compare the concentrations to the Egyptian requirements and the World Bank standards for air quality. These presented in the following figures:

- *Figure 6-5 :* annual mean concentrations; and
- *Figure 6-6 :* daily mean concentration levels.

The highest concentrations for each of these two averaging periods under consideration (annual, daily), in addition to hourly average are found to the south-east of the site. This is because the winds are overwhelmingly from the north and northwest for most of the time. Maximum annual concentration of NOx emissions in the ambient atmosphere due to operation of the Tebbin

(1) For example, the 98th percentile concentration is that which is exceeded on 2% occasions in the year, which could either be expressed as 175 hours or 7 years, depending on the averaging period specified.

power plant will not exceed 10 μg/m^3 (highest annual maximum is 9.6 μg/m^3 at the location [300m, - 300m]) and the maximum daily reaches 56.8 μg/m^3 at a distance of 141 m southeast the powerhouse. Maximum "One-hour Average" concentration of NOx emissions in the ambient atmosphere reaches 96.3μg/m^3 at the location [130m, 95m]. *Figure 6-7* depicts the locations of the First Five Maximums of daily average of NOx concentrations.

Also, continuous background air quality measurements undertaken by the EEAA at the Tebbin area during the year 2004 were obtained and their averages were considered as a real representation of the background status. These background levels were used because they cover a whole year, actually the most recent complete year. These background air quality levels and the EAAQLs are presented in *Table 6-4.*

A comparison of the estimated maximum concentrations with the relevant standards is given in *Table 6-5*.

Although it is not required to model fuel oil firing for less than 5% of the operating time (the Tebbin plant will fire mazout for less than 2% of the operating time), a screening modeling has been carried out in order to estimate the Tebbin power plant impacts on local air quality when firing Heavy Fuel Oil. This modeling has been performed under the same assumptions and with the same meteorological data. Results are presented in Table 6-6.

The results of this atmospheric dispersion modeling show that each parameter (SO_2, NO_2, CO and PM_{10}) comply with both the Egyptian standards and World Bank guidelines.

Background Air Quality Levels

The model-predicted maximum concentrations were added to the representative ambient background concentrations in order to compare with the Egyptian Ambient Air Quality Limits (EAAQLs). The total maximum combined impact levels should be lower than the corresponding EAAQLs. The EAAQLs are defined in Law #4 of 1994 (Law for the Environment) established by the Egyptian Environmental Affairs Agency.

The representative onsite background air quality concentrations for the Tebbin Project were compiled and reported by the Air Pollution Preclusion Department, National Research Center in June 2005. Those background levels were collected at five monitoring stations located within the Tebbin site (see *Figure 5-26*). The averages of the monitored levels were treated as air quality levels representing background status at the Tebbin site for a one single day during 2005. NO_2, SO_2, and particulate matter (PM) background levels were

Figure 6-1

Localization Map Used for Dispersion Modeling

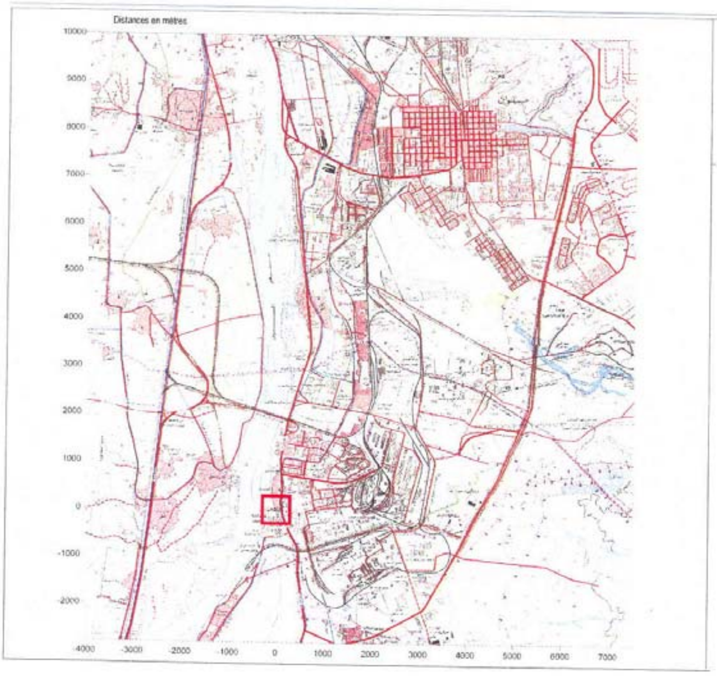


Figure 6-2

Plant Layout for the Stack Location within Site Arrangement

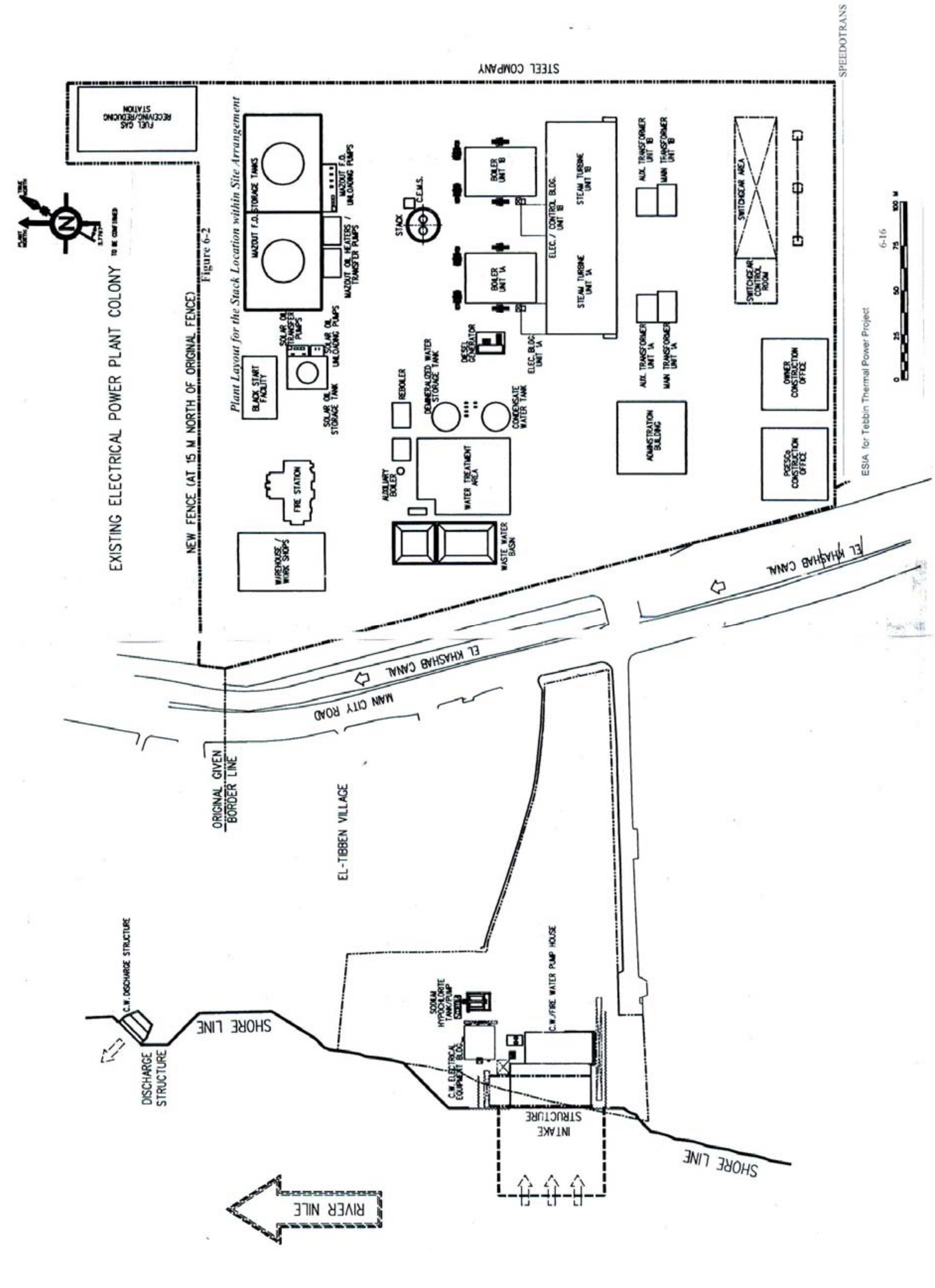


Figure 6-3

Receptor Grid Used in Air Quality Modeling

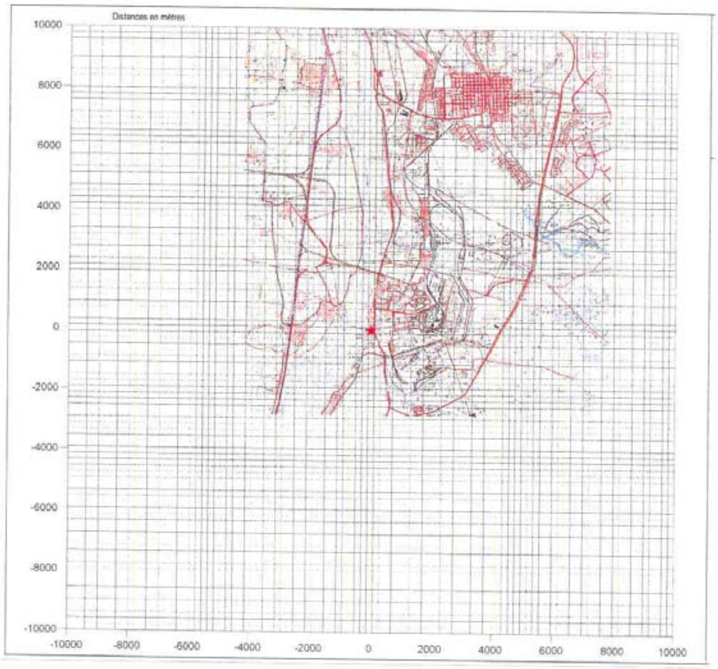
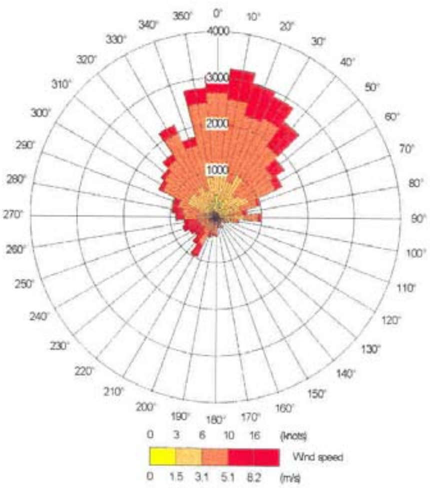


Figure 6-4

Wind Rose Representing Meteorological Data Used for Modeling, 2000-2004



Les secteurs présentés indiquent la provenance du vent

Figure 6-5

NOx-Annual Mean Concentrations

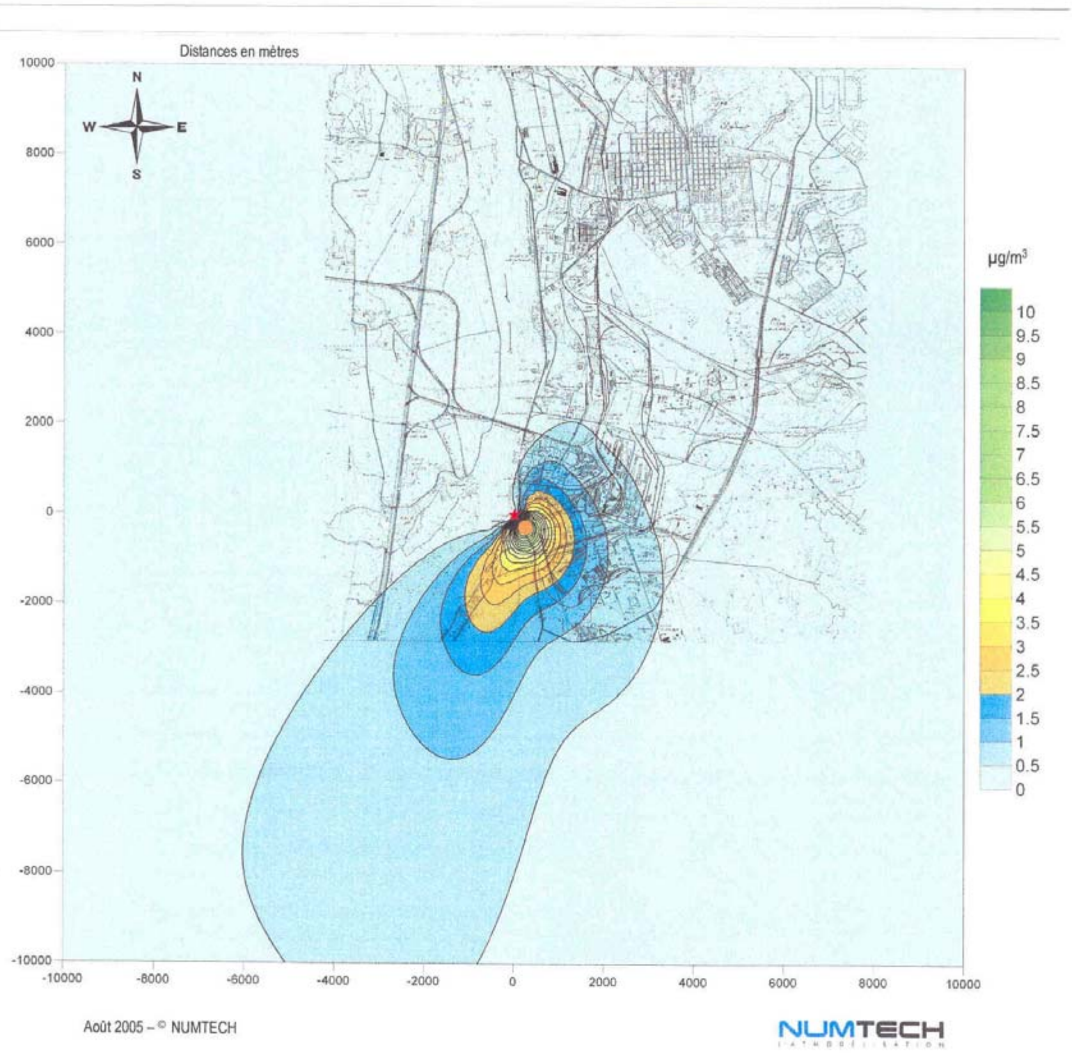


Figure 6-6

NOx-24 Hr (Daily) Mean Concentrations

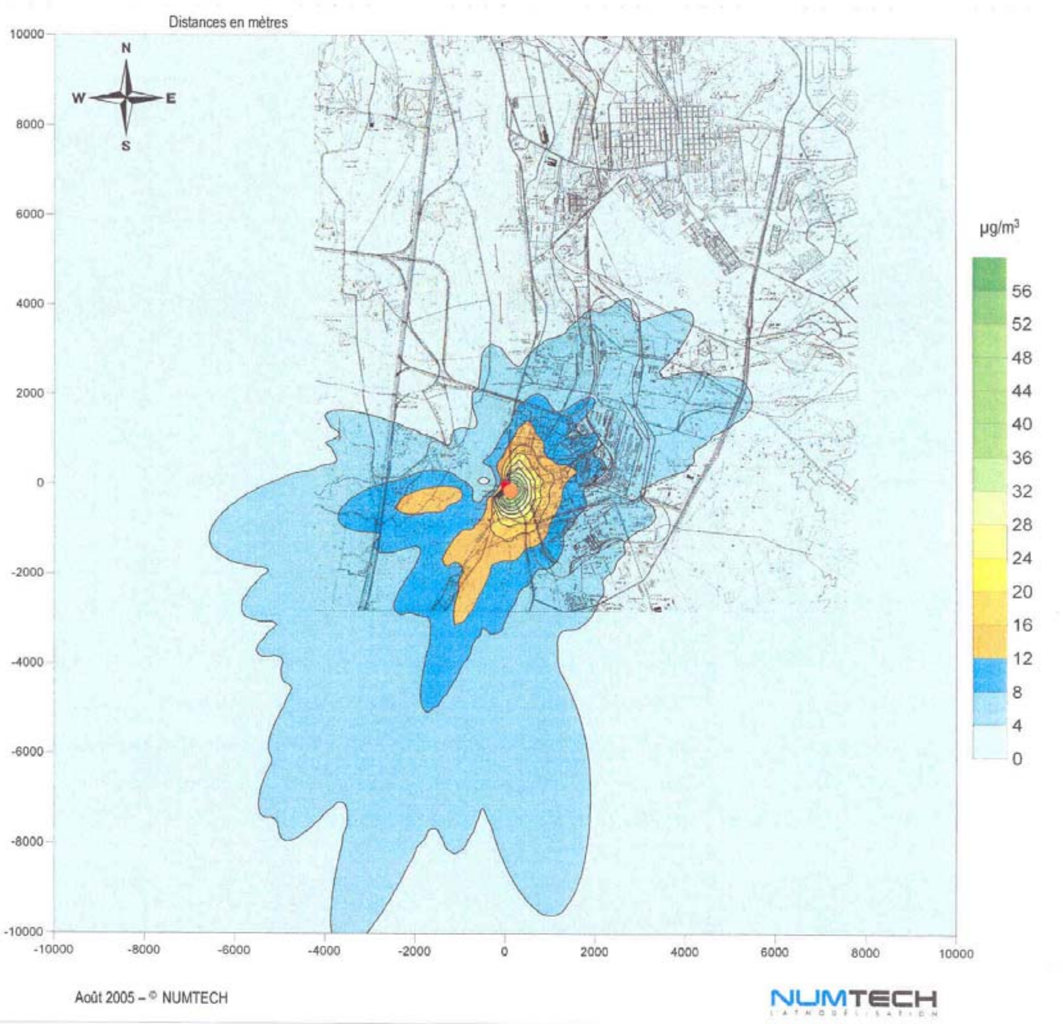
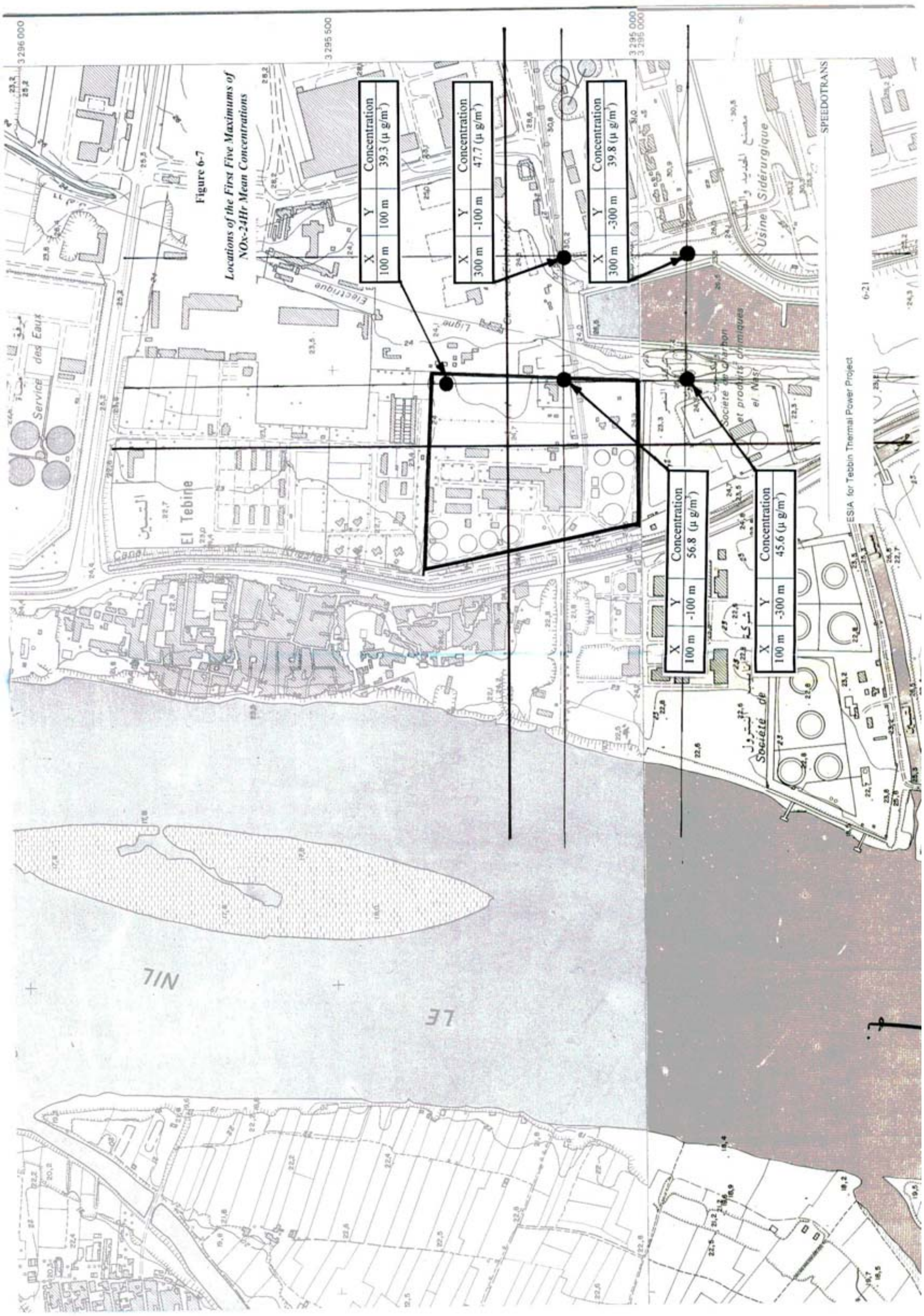


Figure 6-7

Locations of the First Five Maximums of NOx-24Hr Mean Concentrations



measured on 24-hour basis, while the CO levels were measured on 8-hour basis. In order to obtain the 1–hour, 3-hour, and annual averaging background levels, the U.S. Environmental Protection Agency (EPA) suggested conversion factors (EPA, 1995) were used. Although other conversion factors are also available (Turner 1994), the EPA-suggested factors are more conservative; therefore, they were used in the study.

Commulative Impacts

Many significant existing sources of pollutants are placed in the wider area of the Tebbin site. Combined effects from the proposed El-Tebbin power project and the surrounding sources for nitrogen oxides (NOx) have been obtained using the background NOx measurements recorded for the Tebbin area via air quality monitoring stations operated by the EEAA during 2004 (*Table 6-4*).

As indicated in *Table 6-7*, the maximum total combined 24-hour impact level (83.42 $\mu g/m^3$, including the background level) is far less than the Egyptian 24-hour limit of 150 $\mu g/m^3$. The maximum 24-hour impact level of the Tebbin power project was 56.8 $\mu g/m^3$ (excluding the background level). This amount is about 68% of the maximum 24-hr combined impact level (83.42 $\mu g/m^3$). Therefore, the 24-hour combined impact levels are shared significantly by contributions from the surrounding industry. This conclusion remains the same if we consider the highest 24-hr average of NOx concentrations during the year 2004 (i.e. average of highest values occurred in each single month). The maximum total combined 24-hour impact level (109.3 $\mu g/m^3$, including the plant and the background levels) is still less than the Egyptian 24-hour limit of 150 $\mu g/m^3$ and represents only 72.86% of it.

The maximum combined 1-hour impact level, including average of the highest average values during 2004, is 185.2 $\mu g/m^3$. The Tebbin plant contributed 96.3 $\mu g/m^3$ at this location. This amount is about 51.9% of the combined impact level (185.2 $\mu g/m^3$). Therefore, the 1-hour combined impact levels are also dominated by the contributions from the surrounding sources.

As can be seen from the Tables, whichever standard is selected, the additional concentrations are a relatively acceptable fraction of the value required to equal that which would cause an exceedence, even allowing for the existing concentrations.

Mitigation Measures

On the basis of the dispersion modeling results, no further mitigation measures are required to reduce stack emissions (i.e. beyond the use of natural gas and low-NOx burners). The stack height (152 meters) has been designed to reduce pollutant air concentrations and optimize atmospheric dilution of the stack plume and is more than adequate for this purpose.

Conclusion

Although these concentrations of pollutants have been established for the worst case operating conditions of the plant (continuous operation of both steam units at full load) using the primary fuel, they still remain below the Egyptian requirements and the World Bank guidelines corresponding to the air quality standards. Their addition to the existing background concentrations will not cause these standards and guidelines to be exceeded. Even the Tebbin area is considered a relatively polluted area, given its industrial setting, the plant will have no significant impact on the ambient air quality.

6.2.6 Fugitive Emissions from Fuel Storage Tanks

There will be two principal fixed-roof fuel storage tanks on the power plant site for storage of heavy fuel oil and one for storage of light fuel oil. Fugitive emissions from fixed-roof tanks may occur as a result of evaporation of the liquid fuel into the space between the roof and the liquid surface. This vapor may be emitted to the atmosphere through vents during the tank filling process. However, since the fuel oil consists of low volatility liquid and the tanks will only be filled infrequently (as these fuels will only be used if natural gas is unavailable), the potential for significant releases through venting of the tanks is limited and therefore the potential to cause odor nuisance is not considered to be significant. Additionally, the nearest receptors are far away.

Final Results

The executive regulations of the Egyptian Law No. 4 of the year 1994, article-42, item B regarding the elevations of chimneys, bullet No. 2 states the following:

"Chimneys from which a total of gaseous wastes reaches more than 15000 kg/hr: the height of the chimney shall be more than at least two and a half times the height of surrounding buildings, including the building served by the chimney".

Therefore the minimum stack height for El-Tebbin Power Plant in accordance with the Egyptian Law No. 4 of the year 1994 is equal to approximately 37 x2.5 = 92.5 meters (where 37 m is the highest surrounding building). This is near to the stack height calculated by the GEP method.

Even though GEP height of stack is around 115 m, the stack height is designed to be 152 m considering the relatively degraded air quality of the Tebbin area.

Also, since the main pollutant emitted by the gas-fired Tebbin Project is nitrogen oxides (NOx), computations are made also with the designated GEP stack height of 152 m for obtaining the highest concentrations for each of the three averaging periods under consideration (annual, daily, hourly). The results obtained over the period of five years are presented in *Table 6-7*.

Based on the results presented in *Table 6-7,* the maximum annual impact area consistently occurred about 135^o from plant north at a distance of 424 m from the Tebbin power location. The majority of the 24-hour maximum impact areas due to the operation of the two Tebbin thermal units occurred between 45^o and 165^o at distances between 130 m and 450 m. The maximum 1-hour impact levels are very similar among the five years (2000-2004) considered. The majority of the maximum impact areas occurred between 40^o and 170^o from plant north and at a distance of about 360m. A comparison of the estimated maximum concentrations with the relevant standards is given in *Table 6*-7.

Table 6-4 (A)

Egyptian Ambient Air Quality Limits, Law #4 ($\mu g/m^3$)

Averaging Time	**SO_2**	**CO**	**NO_2**	**TSP**	**PM_{10}**
1-hour	350	30,000	400	N/A	N/A
8-hour	N/A(1)	10,000	N/A	N/A	N/A
24-hour	150	N/A	150	230	70
Annual	60	N/A	N/A	90	N/A

Notes:

(1) N/A = Not Available.

Table 6-4 (B)

El-Tebbin Background Air Quality Levels [(1)] ($\mu g/m^3$), Measured by the National Research Center within the Site Boundaries

Averaging Time	SO_2	CO	NO_2	TSP	PM_{10}
1-hour	103	1610	176	N/A	N/A
8-hour	N/A[(2)]	1187	N/A	N/A	N/A
24-hour	61	950	103.8	284	28.4[(3)]
Annual	8.3	N/A	14	38.5	N/A

Notes:

(1) Reference: Air Pollution Preclusion Department, National Research Center; Cairo, May 2005.
(2) N/A = Not Available.
(3) Calculated 10% of TSP.

Table 6-4 (C)

El-Tebbin Background Air Quality Levels [(1)] ($\mu g/m^3$), Measured by the EEAA at the Tebbin Area

Averaging Time		NO_2	SO_2	PM_{10}
1-hour	Average[(2)]	45	30.4	172.7
	Average of Highs[(3)]	88.9	66.1	343
24-hour	Average	26.62	17.96	101.93
	Average of Highs[(3)]	52.5	39	202.37
Annual	Average	3.6	2.4	13.82
	Average of Highs[(3)]	7.1	5.3	27.44

Notes:

(1) Reference: The Egyptian Environmental Affairs Agency; Tebbin Background Air Quality Measurement Station, the Tebbin Station Logbook, 2004.
(2) Average of each month is calculated, then average of 12 months is calculated.
(3) Highest value during the month is selected, then average of 12-highs is calculated.

Table 6-5 (A)

Estimated Maximum Average Concentrations of Nitrogen Dioxide, $\mu g/m^3$

Daily Averages (First Five Maximums)			Annual Averages (First Five Maximums)		
Concentration	**X**	**Y**	**Concentration**	**X**	**Y**
56.8$\mu g/m^3$	100m	-100m	9.6$\mu g/m^3$	300m	-300m
47.7$\mu g/m^3$	300m	-100m	9.4$\mu g/m^3$	100m	-300m
45.6$\mu g/m^3$	100m	-300m	8.1$\mu g/m^3$	300m	-500m
39.8$\mu g/m^3$	300m	-300m	7.9$\mu g/m^3$	100m	-500m
39.3$\mu g/m^3$	100m	100m	7,8$\mu g/m^3$	300m	-100m

Table 6-5 (B)

Estimated Maximum Average Concentrations of Nitrogen Dioxide Compared with the Egyptian Standards and World Bank Guidelines, $\mu g/m^3$

Pollutant	NO_x	NO_x	NO_x
Averaging Period	1 hr	24-hr	Annual
First Maximum	96.3	56.8	9.6
Egyptian Limit	400	150	N/A (1)
World Bank Regulations	No Limit	150	100

Notes:

(1) N/A = Not Available.

Table 6-6

Estimates for Maximum Concentrations of Main Pollutants when Burning Heavy Fuel Oil (HFO), $\mu g/m^3$

Pollutant	**Averaging Period** (1)	**Estimated Maximum Impact** (*$\mu g/m^3$*)	**Egyptian Standard** (*$\mu g/m^3$*)	**World Bank Guideline** (*$\mu g/m^3$*)
NO_2	1 Hr.	100.3	400	-
	24 Hr.	59.2	150	150
SO_2	1 Hr.	84.7	350	-
	24 Hr.	50	150	150
PM_{10}	24 Hr.	4	70	150
CO	8 Hr.	35	10,000	-

Notes:
(1) Annual Average is not applicable.

Table 6-7

Commulative Effect of the Proposed Tebbin Gas-Fired Power Project (Air Dispersion Modeling Results) and the Background levels on the Background Air Quality (Stack Height = 152 m)

Pollutant	**NO_x**	**NO_x**	**NO_x**
Averaging Period	1 hr	24-hr	Annual
First Maximum	96.3 (130m-95m)	56.8 (100m-100m)	9.6 (300m-300m)
Background Level (measured by NRC) [(2)]	176	103.8	14
Background Average (measured by the EEAA)	45	26.62	3.6
Background Average of Highs (measured by the EEAA)[(3)]	88.9	52.5	7.1
Total (considering NRC measurements)	272.3	160.6	23.6
Total (considering EEAA average)	141.3	83.42	13.2
Total (considering EEAA average of highs)	185.2[(3)]	109.3[(3)]	16.7[(3)]
Egyptian Limit	400	150	N/A[(4)]

Notes:

(1) NO_2 : There are no NOx Egyptian Standards for ambient air quality.
(2) NRC = National Research Center.
(3) NRC measurements were confined to the power plant site only and one single day only. The EEAA measurements were obtained for the wider area and for one complete year. Therefore EEAA measurements are considered representable for the Tebbin area.
(4) N/A = Not Available.

6.3 AQUATIC ENVIRONMENT

6.3.1 Introduction

This section considers the significance of potential impacts to the aquatic environment from the construction and operation of the Tebbin power plant. The section is based on preliminary design work undertaken by PGESCo and survey and modeling work undertaken by the Hydraulics Research Institute (HRI).

6.3.2 Potential Demolition and Construction Impacts

Demolition Site Run-off and Surface Water Drainage

As the majority of the site has a hard concrete covering, the area of potentially exposed soil will be minimal. Such areas and the accumulation of dust and fine waste material shall be kept to a minimum to reduce the potential for siltation, contamination of run-off, and erosion. Run-off related impacts associated with demolition work and other general activities can be all readily controlled through the use of appropriate mitigation measures which include:

- The use of sediment traps, where appropriate; and
- The adequate maintenance of drainage systems to prevent any overflow.

Critical areas within the site shall be clearly marked and provided with protective measures to control site run-off. Temporary channels shall be provided to facilitate run-off discharge into the appropriate discharge pathway, via a silt retention pond. Permanent drainage channels shall incorporate sediment basins or traps and baffles to enhance deposition rates.

Wheel washing facilities will be installed to ensure no earth, mud and debris is deposited on roads. Sand and silt in the wash water from such facilities shall be settled out and removed in line with effluent discharge standards discharging the used water into appropriate discharge pathway.

Debris and rubbish on site should be collected, handled and disposed of properly to prevent such material from mixing with liquid effluents. The solid waste management requirements are presented below.

The effects on water quality from these demolition activities are not likely to be provided given that no such discharges will find its way to the Nile river or water table. Site practice is observed to ensure that litter and fuels are managed, stored and handled properly.

Demolition workforce sewage discharges on site should be connected to the existing sewer or sewage treatment facilities where possible. Assuming that temporary water and portable toilet facilities are utilized throughout the demolition works no adverse water quality impacts should arise from the demolition workforce sewage.

Quantities of groundwater or leachate cannot be accurately predicted but if they are low it is possible that limited quantities could be discharged to the sewer. However the contractor shall not discharge directly or indirectly into any public sewer stormwater drain any effluent or contaminated water without the prior written consent of the site engineer in consultation with the Assistant Plant Manager (APM). In granting this permission the APM may require the contractor to maintain suitable works for the treatment and disposal of such effluent or contaminated water (surplus groundwater or leachate). The contractor shall therefore make provisions to include for treatment of surplus groundwater or leachate to reduce chemical concentrations in order to comply with the standards.

Potential Construction Impacts

The potential impacts on the aquatic environment during construction are likely to occur as a result of:

- laying of pipes across the bank;
- dredging process for the intake and outfall structures;
- construction of the inlet and discharge structures;
- natural surface drainage of contaminants and sediments (if any) ; and
- discharge of solid wastes and industrial liquid effluents into the Nile river.

The potential impacts that can be anticipated as a result of these activities are summarized in *Table 6-8* below.

Physical Aquagraphy

The construction methodology for the discharge and intake structures remains to be defined. Dredging will, however, be required for both the intake and discharge structures. This is likely to result in very local alteration of the prevailing currents immediately adjacent to the dredging works. This in turn will result in some local and limited changes to scouring and deposition rates adjacent to the dredging works.

The impacts identified are considered acceptable and no mitigation measures are proposed. The construction method for the intake and discharge structures will include an acceptable operational procedure which will minimize the impacts from dredging and construction on sedimentation. This should be included in any contract which CEPC commission.

Table 6-8

Summary of Potential Construction Impacts on the Aquatic Environment

Activity	Potential Impacts
Dredging	• Elevated suspended sediment levels. • Elevated concentrations of pollutants released from sediments into water column. • Loss of aquatic habitat. • Disturbance to benthic animals. • Disturbance to mobile animals including fish and birds. • Disturbance due to disposal of dredged materials. • Disturbance to fishing. • Navigational constraints.
Construction of discharge and intake structures	• Discharge of effluents to the Nile river. • Permanent loss of aquatic habitat. • Navigational constraints. • Disturbance to fishing. • Elevated suspended sediment levels. • Alteration of sediment transport regime.
Water runoff	• Elevated suspended sediment levels. • Oily water effluent discharge. • Elevated concentrations of pollutants released from sediments into water column.
Construction of pipeline across bank	• Temporary disturbance to bank habitat. • Elevated suspended sediment levels. • Elevated concentrations of pollutants released from sediments into water column. • Disturbance to birds.

During construction, soils dredged will be disposed of via a licensed contractor. No special permit is required and no significant impacts are anticipated.

Impacts on Water Quality

Any dredging will mobilize sediments into the water column and result in an increased suspended sediment load.

Heavy metal concentrations in Nile sediments measured at the site, can be compared with standards applied in Holland and which are commonly used on a global basis (1). The heavy metal concentrations measured at the five sample locations at Tebbin Nile segment, are compared with these reference values in *Table 6-9* below.

Table 6-9

Comparison of Measured Sediment Concentration (mg/kg) with Dutch Standards

Parameter	Measurements Taken at the Proposed Site					Dutch Guidelines		
	Site 1	Site 2	Site 3	Site 4	Site 5	Reference Value	Testing Value	Signaling Value
Cd	0.5	0.07	0.05	0.03	0.01	0.8	7.5	30
Cr	0.32	0.40	0.29	0.31	0.26	100	480	1000
Pb	0.16	0.21	0.12	0.21	0.22	85	530	1000
Ni	0.33	0.40	0.36	0.38	0.32	35	45	200
Zn	1.22	2.05	1.05	0.88	0.86	140	1000	2500

Explanatory Notes:
Sediments containing metals in concentrations below the "reference value" are considered uncontaminated, and are suitable for general disposal if present in dredged material at these concentrations.

Contaminant concentrations between the "reference value" and the "testing value" are considered moderately contaminated, and can be disposed of in open water under suitable conditions.

Sediments containing chemical concentrations between the "testing value" and the "signaling value" are heavily contaminated, and can only be disposed of under controlled conditions.

If the "signaling value" is exceeded, then the material is considered toxic waste, and is not suitable for Nile disposal.

The pollutant concentrations are for all parameters below the reference value shown in the Dutch Standards. These concentrations are below the reference value and are therefore considered uncontaminated. The Dutch guidelines recommend that uncontaminated sediments are suitable for general disposal if present in dredged material at these concentrations.

It is anticipated that disposal of dredged materials will take place via a licensed contractor (no permit will be required).

(1) Andries Krijgsman, Classification systems for sediment quality and dredged material handling, disposal and beneficial use in the Netherlands, November 1996.

Water Quality and Effluents

Construction activities could potentially also result in the release of solid wastes and effluents to the Nile river or ground water. A stormwater collection system, which is discussed in more details in Section 6.7.3, will be provided that will include oil interceptors. Sanitary effluents will be disposed of via City sewer system. Solid wastes will be disposed of by a licensed contractor.

Aquatic Ecology

There are a number of impacts associated with the construction of the intake and discharge channels:

- temporary loss of bank habitat;
- permanent loss of aquatic habitat;
- new bank surface habitat will be generated due to the material used in the construction of the intake and outfall structures and will be colonized by algae and organisms and may encourage fish species; and
- disturbance of benthic and mobile fauna and flora as a result of settlement of suspended sediments through interference with feeding mechanisms, gills and reduction of photosynthetic activity.

With regard to the loss and disturbance to benthic fauna and flora the following should be noted:

- the area where losses may occur is relatively small in the context of the Nile river, the construction of the cooling water structures will disturb a very limited area. The sensitivity of the benthos in this area is low, since much of the riverbed being degraded with poor biodiversity;
- much of the losses are temporary in nature and it can be expected that dredged sediments will be re-colonized within a relatively small period; and
- field survey information did not identify any fauna, flora or habitats of conservation importance.

The impacts of the power plant on birds is discussed in Section 6.5.

Fish and Fisheries

The impacts on fish and commercial fisheries are expected to include the short term and local effects due to elevated concentrations of suspended sediments and pollutants in the water column. The natural dilution and dispersion in the area of construction will ensure that the suspended sediment load and elevated pollutant levels are rapidly reduced to background levels. The survey of the project indicated that the area was limited in fish populations.

In addition to suspended sediment and pollutant loads there may be physical disruption to fishing activity due to dredging. However, given that the area adjacent to the power plant is not currently used for commercial fishing, the overall impact is not considered significant.

The impacts identified relating to water quality are considered not significant and no mitigation measures are proposed.

With regard to river / bankal birds, construction activities will cross landflats from the Nile river to the steam turbine condenser during laying of water intake and discharge pipes. The Nile bank affected will however be restored, using material which has been excavated. Significant impacts to birds in this area are therefore considered unlikely (see Section 6.5).

Access to Nile Bank

The area of Nile bank affected by the construction of the cross bank pipelines and discharge / intake structures is not currently used for leisure or recreation. The construction activities are not therefore expected to affect Nile bank access.

6.3.3 Potential Impacts During Power Plant Operation

The potential impact of the power plant on the aquatic environment could be the result of:

- the presence of new structures;
- the temperature of effluents discharged into the Nile river; and
- the chemical composition of effluents discharged.

The potential impacts related to the operation of the power plant are summarized in *Table 6-10* and are discussed in further detail below.

Table 6-10

Operation Related Environmental Impacts

Issue	Impacts
Presence of new structures	• Sediment scour. • Disruption to sediment transport along river bank. • Navigational constraints. • Fisheries constraints.
Discharge	• Impact of elevated temperatures on water quality and aquatic ecology (oxygen saturation in particular). • Discharge of chemicals.
Intake	• Entrainment of fish and mobile organisms.

Physical Aquagraphy

The presence of the intake and discharge structures will result in local changes to the current regime and attendant changes in scouring and deposition.

Physical aquagraphy has been investigated by the Hydraulics Research Institute (HRI). This work indicates that the impacts identified are however considered to be minor.

Therefore no mitigation measures are proposed.

Impact of Operational Discharge on Water Temperature

Day-to-day practice in Egypt (as given by the MWRI/HRI), considers that a maximum distance of about 150 m is sufficient for water discharged to the River Nile to have mixed and diluted to fall to at least 5^oC above ambient at 150 m. The World Bank standards state that the effluent should result in a temperature of no more than 3^oC above ambient conditions at the edge of the zone where initial mixing and dilution take place. Where this zone is not defined, 100 m from the point of discharge is used when there are no sensitive aquatic ecosystems within this distance.

The edge of the mixing zone has been defined by the MWRI/HRI to range between 100 and 150m from the point of discharge with the maximum (150m) used for the Nile river. This definition is conventionally used in Egypt for the mixing and dilution of effluent discharges in a body of water.

The thermal discharge as modeled and presented in *Figure 6-10* through *Figure 6-21*, satisfies the Egyptian standard for discharge temperature of a temperature increase of no more than 5^oC above ambient at about 20-50m from the point of discharge. Therefore the discharge as modeled satisfies the World Bank Standards.

Physical modeling, using a physical built model developed by the Hydraulics Research Institute (HRI) (March-July 2005) was considered the best way to have a direct insight of the flow phenomena under consideration.

A well-designed hydraulic scale model (see *Figure 6-8*) has been constructed for gaining a more in-depth investigation of hydraulic behavior of the cooling system under consideration.

The study aimed at testing the performance of the cooling system under two operational modes of power plant pumping station:

- the pumping station is operational at its full capacity, i.e. with flow rate 20.0 m^3/sec and the temperature rise will accordingly be 9.3^oC above ambient at the point of discharge; and
- the pumping station is operational at a lower capacity of 10.0 m^3/sec with a temperature rise above ambient of 9.3^oC.

A number of modeling assumptions have been made:

- there will be no cumulative effects due to other discharges;
- the simulation includes single configuration of the outlet structure via designed passing discharges into the Nile river;
- the Egyptian standards for discharge of warm water stipulated by the Egyptian Ministry of Water Resources and Irrigation, *Law No. 48, 1982* and the *"Law for the Environment" No. 4, 1994* are that the discharge be $\leq$5^oC above the ambient temperature outside the mixing zone with maximum absolute value of 35^oC at the point of discharge. The maximum natural water temperature of the Nile river at the Tebbin Power Plant site varies between 27 and 29^oC, and the temperature rise along the plant condensers is approximately 8.0^oC. A mixing zone therefore is required to obtain sufficient temperature reduction to meet stipulated standards. Although the mixing zone is not limited by the Law, it is defined always by the line of 5.0^oC above the ambient, and should not be extended to a more than one half of the Nile width at specified location (source: MWRI/HRI);
- the length/area of the mixing zone should be minimal and the warm water plume should not reach the intake structure, i.e. no re-circulation is permissible;
- the cross flow that may result from intake or outlet structures should be less than 0.3m/sec in order to ensure safe navigation in the vicinity of intake and outlet structures;

- the problem of bed sediment intrusion to the intake pumping station, which could harm pumps' propeller, may be solved via vertical submerged vanes located before the intake structure. Therefore, tests should be applied in order to study their behavior with respect to bed load as well as their effects on flow characteristics.

- the rules set by the Ministry of Water Resources and Irrigation stipulate that a user of the River Nile or any of its waterways must:
  - not affect the morphology of the Nile or any of its waterways;
  - not affect the bank stability;
  - take into consideration the maximum and minimum anticipated levels or discharges (see Section 5.5).
  - follow temperature standards.

- the river discharges and water level records as issued officially by the Ministry of Water Resources and Irrigation are as follows:
  - the river conditions vary along the year. During the wintertime, the flow is brought to minimum. Throughout this period, the river discharge is 472m^3/s and the water level is kept at 16.26m (MSL). In the winter flow period, the ambient water temperature is 15^{o}C.
  - for most of the year the discharge of the river is 995m^3/s. The water level at the station in the period of dominant flow is 18.00m (MSL). During this period the maximum water temperature might be taken equal to 25^{o}C.
  - During the maximum flow condition, the discharge of the river is 1863m^3/s. The water level at the power plant site in the period of maximum flow is 19.34m (MSL). This period is correspondent to the hottest period of the year and the water temperature is taken equal to 28^{o}C.

Under the above conditions a physical model was constructed according to Froude similarity rules and calibrated through measuring velocity distribution over five cross sections along with the prototype. The physical modeling study is included in Annex G.

Ten tests have been run on a conceptual cooling system design provided by PGESCo based on once-through system. The intake structure is designed to have a flow velocity of 0.137m/s during the minimum river flow period. The intake structure has been provided with a sill, which is 1.50m above the average bed level of the river in the intake vicinity. The level of the crest of this sill is + 14.00m above the MSI. The function of this sill is to prevent sediment bed load from entering the pump. The width of the proposed intake structure is 64.4m. The discharge structure has the following characteristics.

The outfall velocity is 0.6 m/s during the low water level which is 16.26m MSI. The dominant flow level is 18.00 m MSL and the outfall velocity is 0.34 m/s. During the maximum flow level which is 19.34 m MSI, the outfall velocity is 0.25 m/s. The aspect ratio of the outfall which is the depth of water above the crest of the outfall wier divided by the half width of the outfall structure ranges between 0.126 during the low water level, 0.3 in the dominant flow period and 0.434 in the maximum flow period. The Densimetric Fraude Number is 3.4 in the winter time and 0.72 in the dominant and maximum flow period. The angle of inclination of the outfall structure with the main river flow is 60^o. The crest level of the outfall structure is kept at + 15.00 m above MSL.

The outfall structure is located at a distance of 3.45 m (model scale) which is 172.5m of prototype scale downstream the intake structure.

Three main flow conditions of the Nile river were tested namely: winter flow, dominant flow and maximum flow. *Table 6-11* presents test program implemented for cooling system physical modeling study.

Analysis of Results

The area of interest extends for 24 m length (1.2 km in prototype) and its width varies according to the measured cross section. In order to determine accurately both velocity and heat profiles, the modeled area has been divided into several cross sections in the longitudinal and transversal directions. The distance between each cross section in the longitudinal direction is 0.1 m (5m in prototype), whilst it is 0.15 m (7.5 m in prototype) in the transversal direction. Consequently, a virtual mesh of 92 cross sections in the longitudinal direction and 40 in the transversal direction were formed. This mesh covers the whole modeled area. This is shown in *Figure 6-9*.

- Heat Distribution

The water surface temperature was sensed over 92 cross sections. The distance between these cross sections differs according to their locations. Emphasis was placed on the locations just before the outlet structures. In these locations, cross sections were spaced by a distance of 0.1 m (5 m in prototype). On the other hand, cross sections in the vicinity of the intake structure, and in the area located between the intake and outlet structure, were spaced by a distance of 0.2 m (10 m in prototype).

In each cross section nearly 40 readings were recorded according to the width of the river at specified location.

<u>Test (1)</u>

This test represents discharge of the warm water into the Nile river in winter period from the power units, assuming they are functioning in their full capacity. In this period, the total inflow of water to the cooling system is $20.0m^3/s$, whereas the river flow is 472 m^3/s, i.e. the cooling system is about

4.24% of the main river flow. Isothermal lines of this test are shown in *Figure 6-10* and the area occupied by the thermal plume in the river is shown in *Figure 6-11*. These figures reveal that there is no warm water recirculation in the vicinity of the intake structures. The mixing zone of the heated water, which is pounded by isotherm 5^{o}C, is small (about 50m max.). The warm effluent of the power plant does not adversely affect river environment and works efficiently from the operational point of view.

Test (2)

This test is in the winter period where only one unit of the power plant is functioning, while the other is kept shut down. The cooling system discharge is 10.0 m^3/s which represents 2.12% of the river flow. Isothermal lines of this test are shown in *Figure 6-12* and the area occupied by the thermal plume in the river is shown in *Figure 6-13.* These figures reveal that there is no warm water recirculation in the vicinity of the intake structures. The mixing zone of the heated water, which is pounded by isotherm 5^{o}C, is small (about 50m max.). The warm effluent of the power plant does not adversely affect river environment and works efficiently from the operational point of view.

Test (3)

This test represents the discharge of the warm water into the Nile river from the power units in the dominant flow period, assuming the plant is running at full load. In this period, the total inflow of water to the cooling system is 20.0 m^3/s, whereas the river flow is 995 m^3/s, i.e. the cooling system is about 2.01% of the main river flow. Isothermal lines of this test are shown in *Figure 6-14* and the area occupied by the thermal plume in the river is shown in *Figure 6-15*. These figures reveal that there is no warm water recirculation in the vicinity of the intake structures. The mixing zone of the heated water, which is pounded by isotherm 5^{o}C, is smaller than formed in the winter period (about 40m max.) due to the additional momentum of the river flow. The warm effluent of the power plant does not adversely affect river environment and works efficiently from the operational point of view.

Test (4)

This test is in the dominant flow period where only one unit of the power plant is functioning, while the other is kept shut down. The cooling system discharge is 10.0m^3/s, which represents 1.0% of the river flow. Isothermal lines of this test are shown in *Figure 6-16* and the area occupied by the thermal plume in the river is shown in *Figure 6-17*. These figures reveal that there is no warm water recirculation in the vicinity of the intake structures. The mixing zone of the heated water, which is pounded by isotherm 5^{o}C, is very small (about 40m max.). The warm effluent of the power plant does not adversely affect river environment and work efficiently from the operational point of view.

Test (5)

This test represents the discharge of the warm water into the Nile river in the maximum flow period from the power units, assuming they are functioning with their full capacity. In this period, the total inflow of water to the cooling system is $20.0m^3/s$, whereas the river flow is 1863 m^3/s, i.e. the cooling system is about 1.07% of the main river flow. Isothermal lines of this test are shown in *Figure 6-18* and the area occupied by the thermal plume in the river shown in *Figure 6-19*. These figures reveal that there is no warm water recirculation in the vicinity of the intake structures. The mixing zone of the heated water, which is pounded by isotherm 5^oC, is very small ($\leq$ 20m max.). The warm effluent of the power plant does not adversely affect river environment and works efficiently from the operational point of view.

Test (6)

This test is in the dominant flow period where only one unit of the power plant is functioning while the other is kept shut down. The cooling system discharge is $10.0m^3/s$, which represents 0.53% of the river flow. Isothermal lines of this test are shown in *Figure 6-20* and the area occupied by the thermal plume in the river shown in Figure *6-21*. These figure reveal that there is no warm water recirculation in the vicinity of the intake structures. The mixing zone of the heated water, which is pounded by isotherm 5^oC, is very small ($\leq$20m max.). The warm effluent of the power plant does not adversely affect river environment and work efficiently from the operational point of view.

These tests show that the effluent-ambient discharge ranges from 0.53% in the maximum flow period, whilst it is 4.2% in the low flow period. The discharge of warm water from the thermal power plant does not adversely affect the aquatic environment of the river Nile. Moreover, there is no warm water recirculation within the intake vicinity, which means that the power plant is functioning efficiently from the operational point of view.

- Velocity Distribution

Velocity profiles were measured accurately in the main and transverse direction in six cross sections distributed along the model length and for each test. Three cross sections for the velocity profile were recorded in the vicinity of the intake structure and three cross sections in the vicinity of the outfall structure. The first cross section is upstream the intake structure at a distance of 0.6m (model scale) which is 30 m prototype scale. The second cross section is in the centerline of the intake structure. Finally, a third cross section is 0.6 m (model scale) downstream the centerline intake structure. Also, three cross sections were recorded for the outfall structure. The first cross section is 0.6 m (model scale) or 30 m (prototype scale) upstream the outfall structure. One cross section is in the middle of the outfall structure and the third one is downstream the outfall with a distance of 0.6 m (model scale).

At each cross section the flow velocity was measured starting from the left bank and moving towards the right bank. The distance between each two measurement points is 0.5 m (25 m in prototype).

At each cross section the flow velocity was measured at the mid-water depth and recorded for both the main and cross flow directions. All the recorded velocities in both directions were drawn for each cross section against the distance, starting from the left bank and moving towards the right bank. Hence, a clear picture of the situation across the river width could be drawn.

The velocity measurements, in this study, were performed in order to check the navigation safety in the segment of the river attached to the cooling system and the navigation is found possible.

Velocity profiles shown in *Figures 6-22* through *6-25* illustrate that the cross flow velocity does not exceed the allowable velocity, which is 0.30 m^3/s. Leaving a space of the entire width of the river, which makes navigation possible away from the turbulence caused by the discharge of warm water into the river.

Table 6-11

Test Program Including All Test Conditions

Test	River Conditions		Power Plant Operational				River Water Temp. (^oC)	Flow Conditions
			325 MWe Steam Unit		325 MWe Steam Unit			
	Q (m^3/s)	Level (m)	Q (m^3/s)	Δ_t (^oC)	Q (m^3/s)	Δ_t (^oC)		
1	472	16.26	10.0	9.3	10.0	9.3	15	Winter Flow, Two units are operating
2	472	16.26	10.0	9.3	-	9.3	15	Winter Flow, One unit is operating
3	995	18.0	10.0	9.3	10.0	9.3	25	Dominant Flow, Two units are operating
4	995	18.0	10.0	9.3	-	9.3	25	Dominant Flow, One unit is operating
5	1863	19.34	10.0	9.3	10.0	9.3	28	Maximum Flow, Two units are operating
6	1863	19.34	10.0	9.3	-	9.3	28	Maximum Flow, One unit is operating

The modeling results of all six tests indicate that the proposed design of the cooling system is hydraulically and environmentally sound under both modes of operation.

The modeling results provide with the following conclusions:

- cooling water discharge ranges between 0.53 and 4.2% of the river flow. It is 4.2% when the river flow is minimum and 0.53% when it is maximum;

- isothermal lines drawn for each test show that the performance of the cooling system does not adversely affect river environment. This is not only when the flow in the river is maximum but also when it is minimum. This performance dominates, when the two units are operating and when the plant works with one pump mode of operation as well;

- no warm water recirculation is recorded in the vicinity of the intake structure, i.e. the system works efficiently when the plant is operational;

- width of the mixing zone in the area surrounding the outfall structure of the two units does not exceed one fifth of the river width. Mixing zone's width decreases with increase of the river flow;

- proposed intake structure is sufficient for the required discharge for the cooling system; and

- no cross flow more than the critical value occurred inside the navigation path in winter flow condition.

The modeling results, eventually, establish the following recommendations:

- The cooling system structures (intake and outfall) as proposed by PGESCo and used by HRI are recommended.

- Buoys are required to fix the boundaries of the navigation path in the vicinity of the plant.

- Warning signs are also required upstream and downstream of the plant.

- Fishermen boats are to be kept away from the outfall structure to avoid the effect of high cross currents caused by the discharge of warm water into the river.

Figure 6-8

Hydrothermal Model Layout

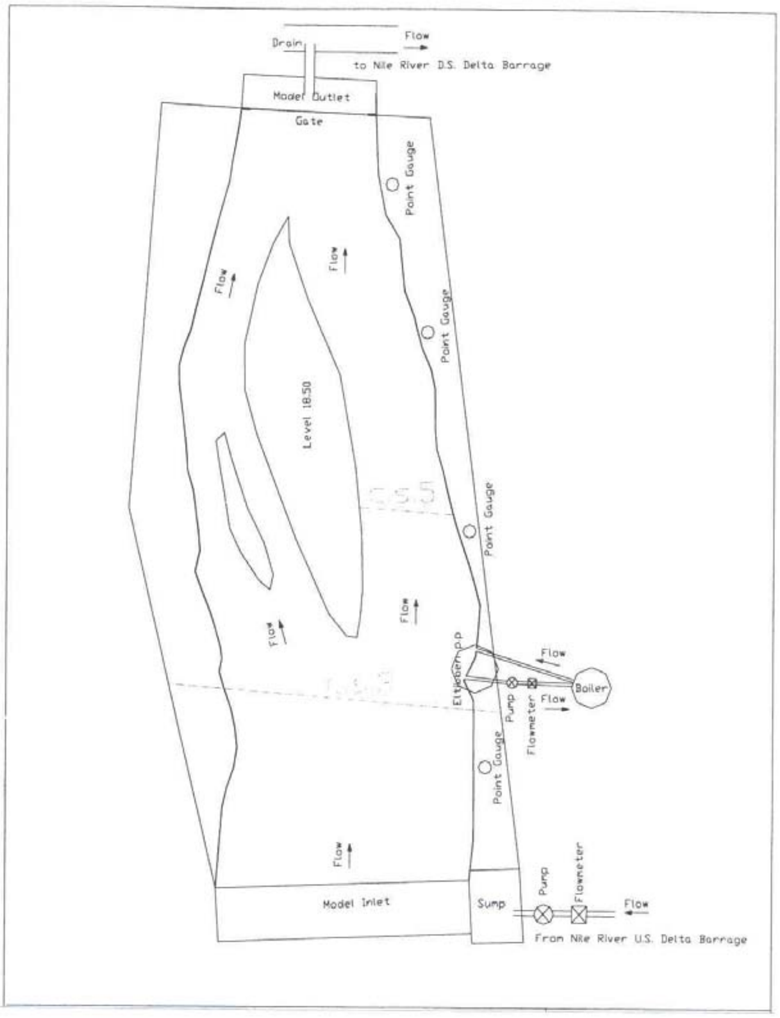


Figure 6-9

Area of Temperature Measurements

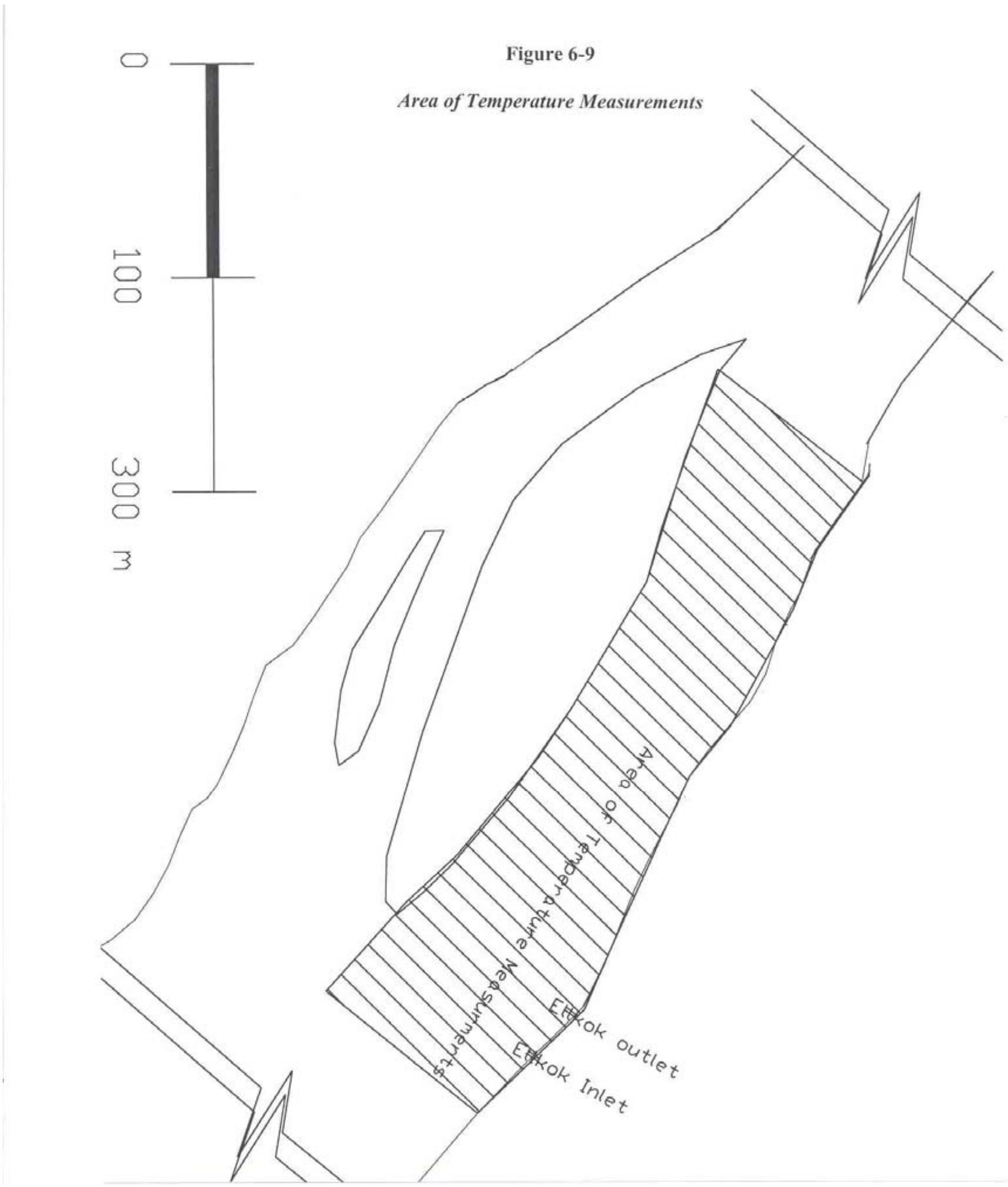


Figure 6-10

Predicted Surface Isotherms, Winter Flow
(Two Units in Operation)

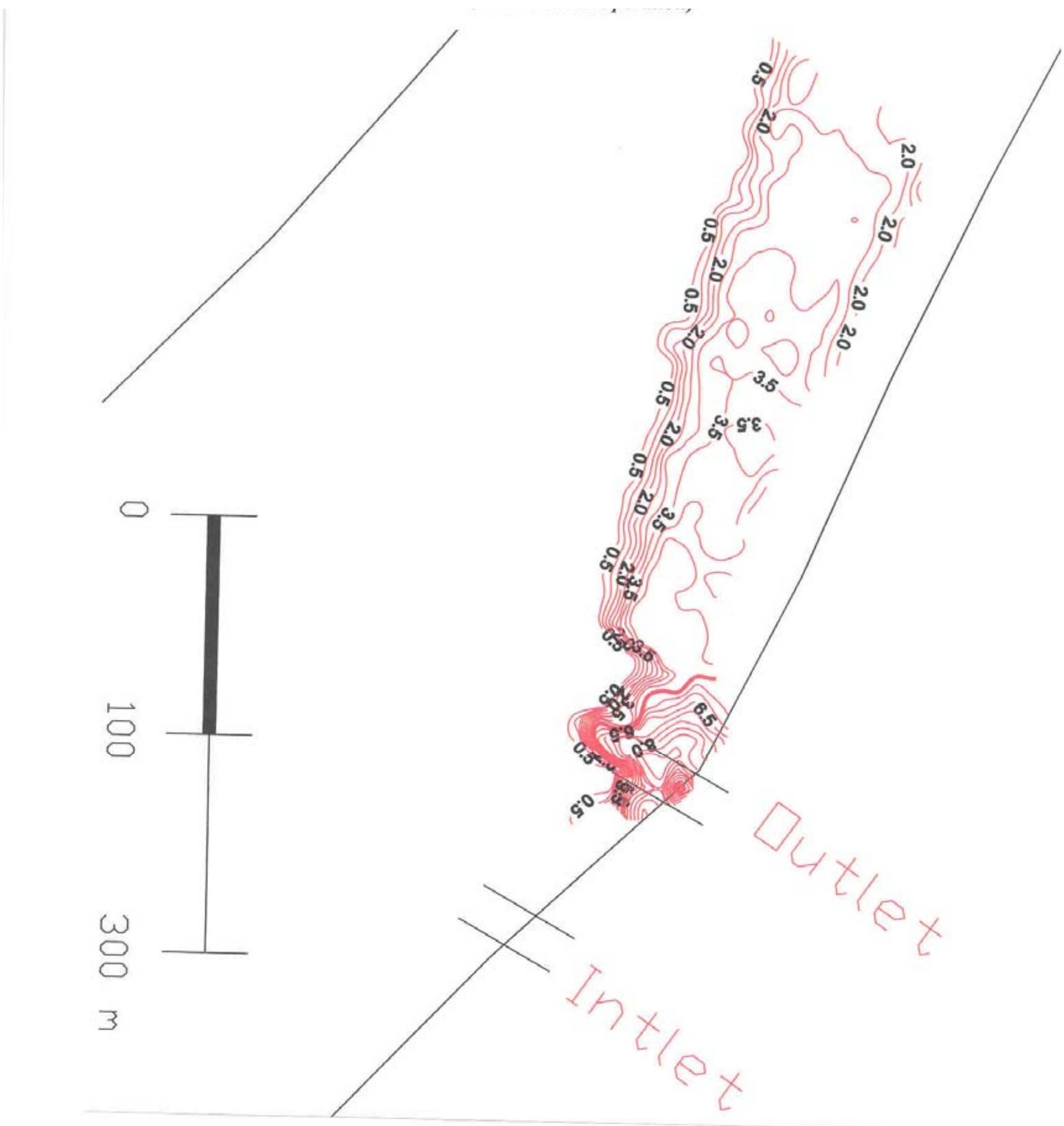


Figure 6-11

Predicted Thermal Plume (in ^{o}C), Winter Flow (Two Units in Operation)

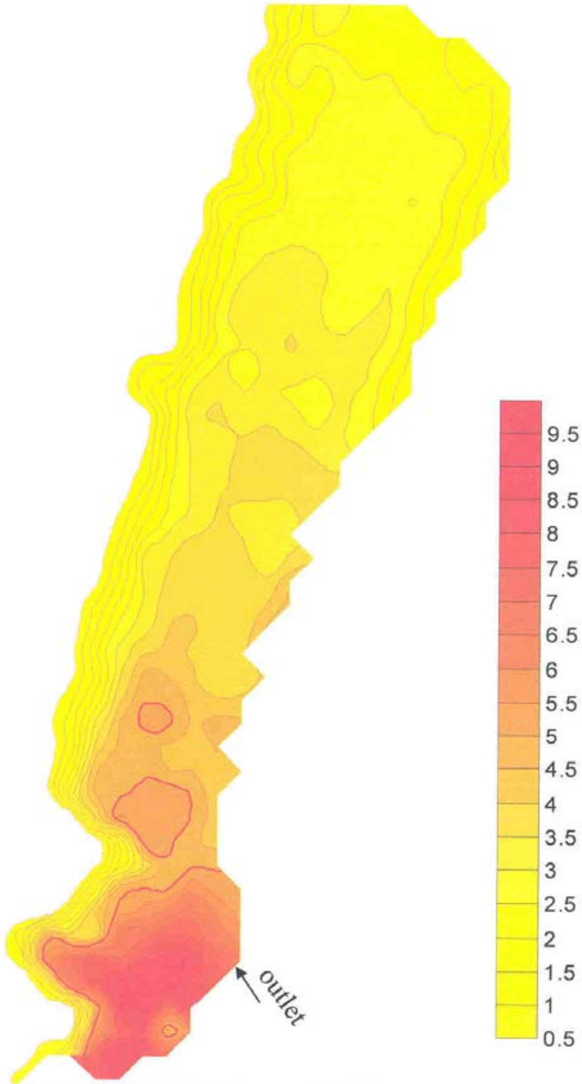


Figure 6-12

Predicted Surface Isotherms, Winter Flow
(One Unit in Operation)

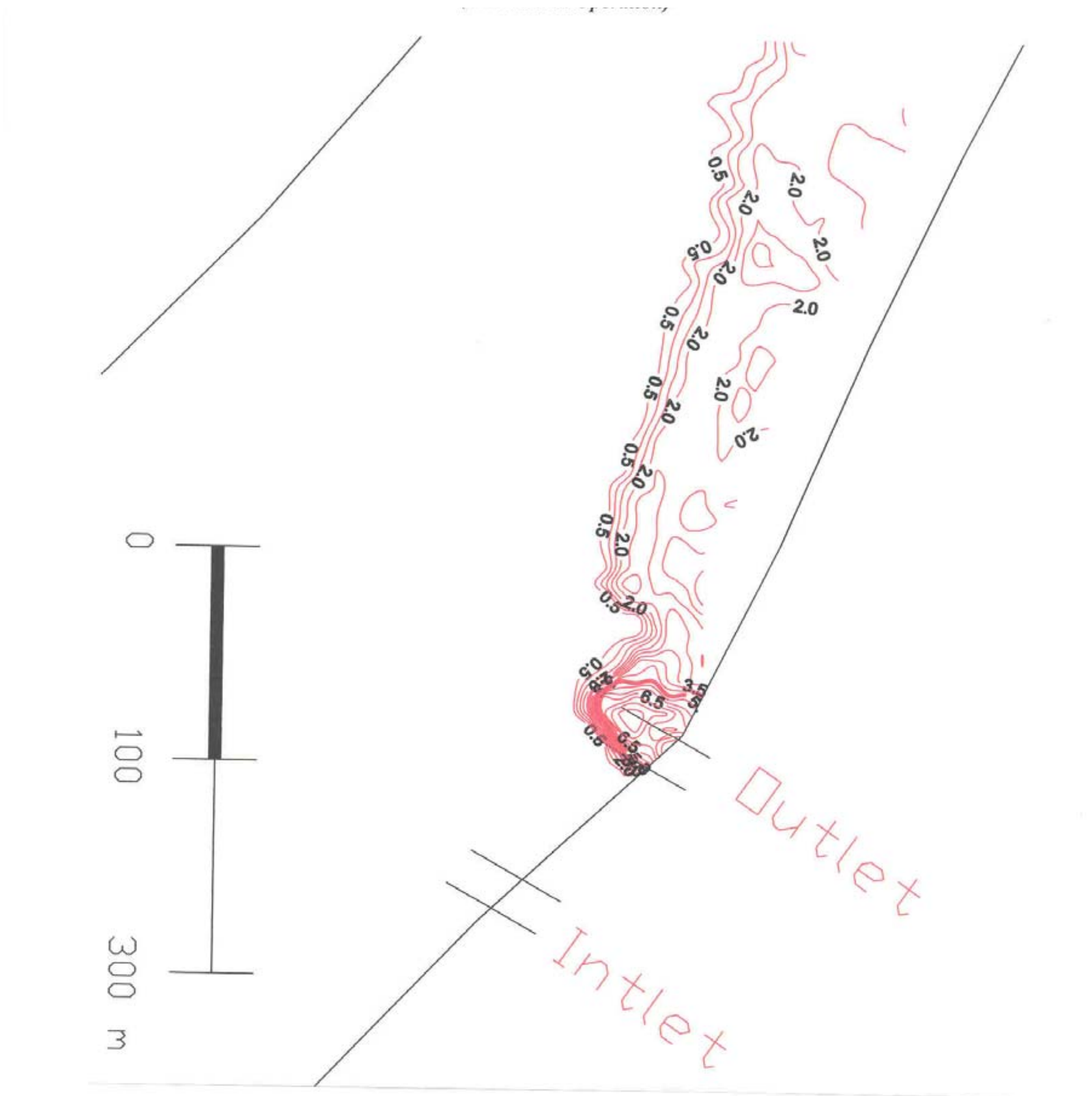


Figure 6-13

Predicted Thermal Plume (in ^{o}C), Winter Flow
(One Unit in Operation)

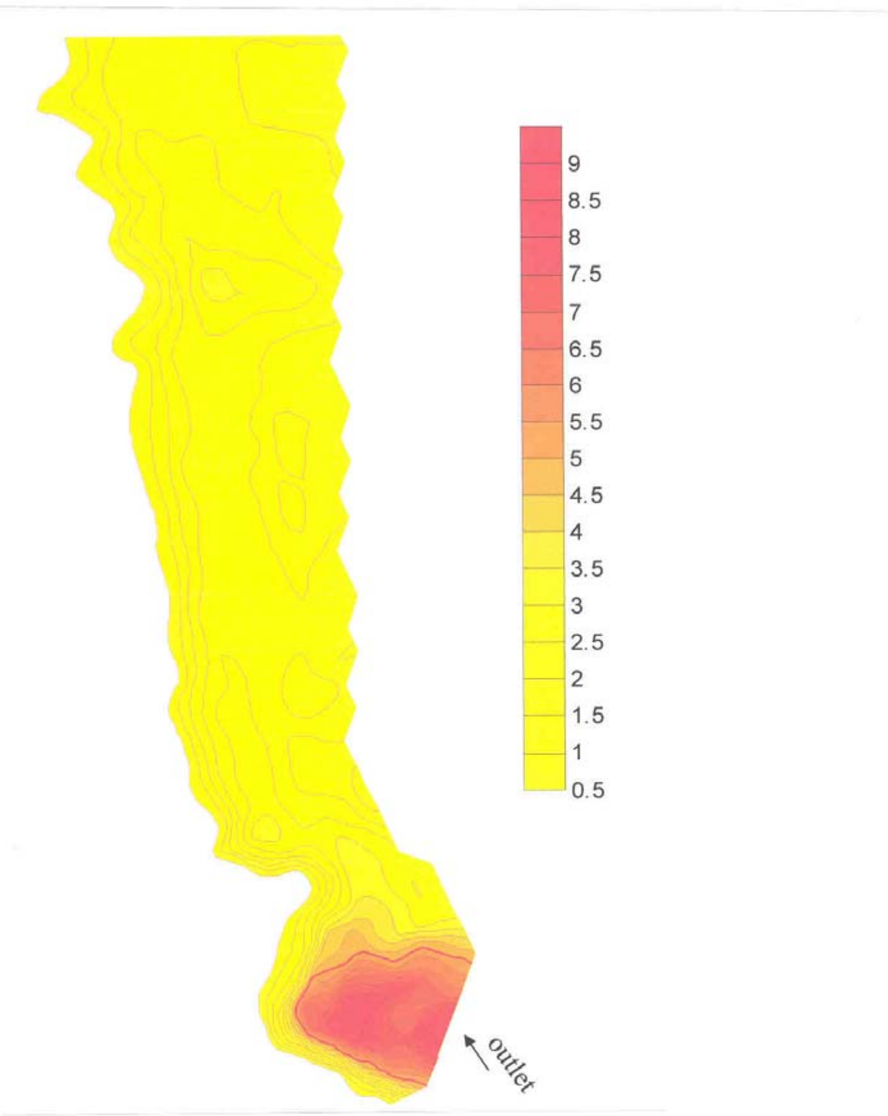


Figure 6-14

Predicted Surface Isotherms, Dominant Flow (Two Units in Operation)

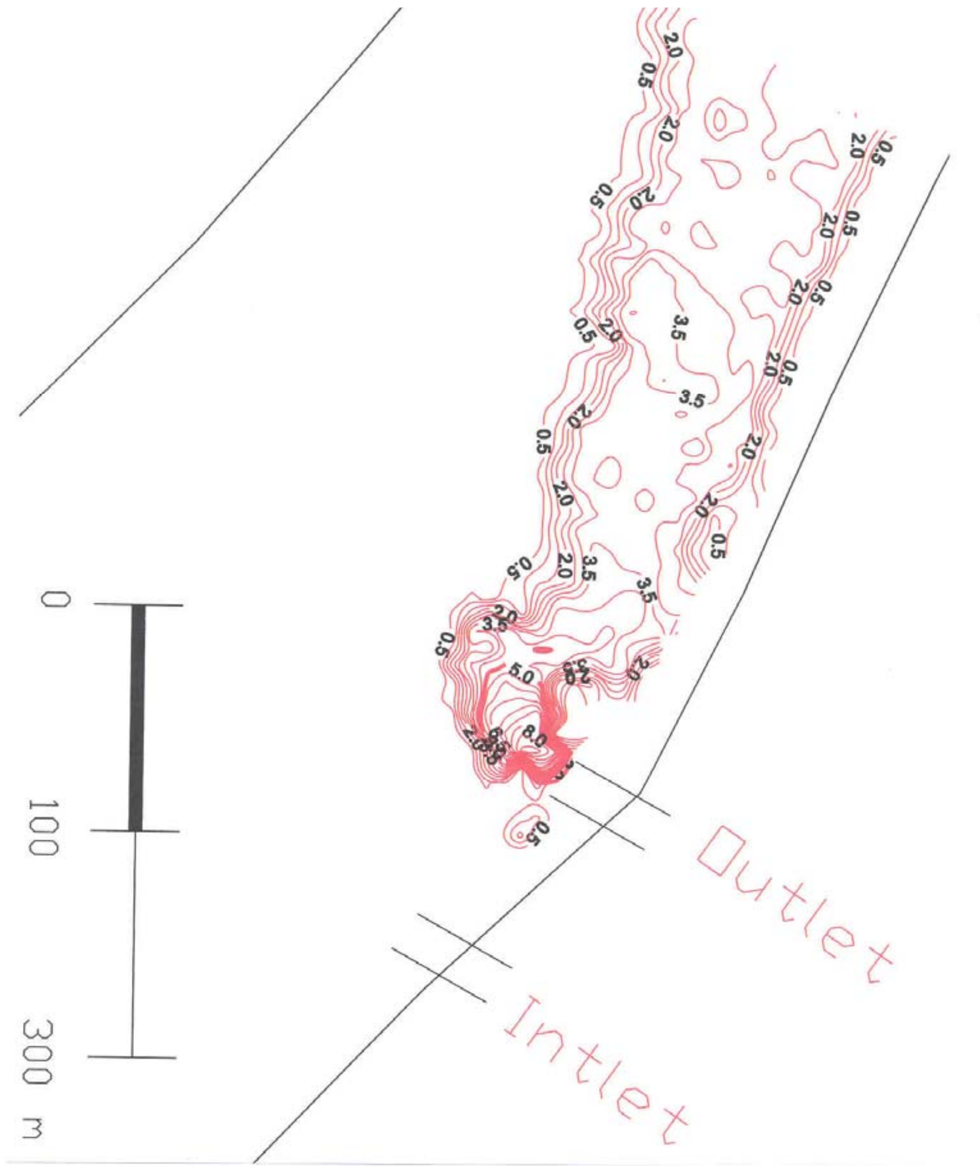


Figure 6-15

Predicted Thermal Plume (in ^{o}C), Dominant Flow (Two Units in Operation)

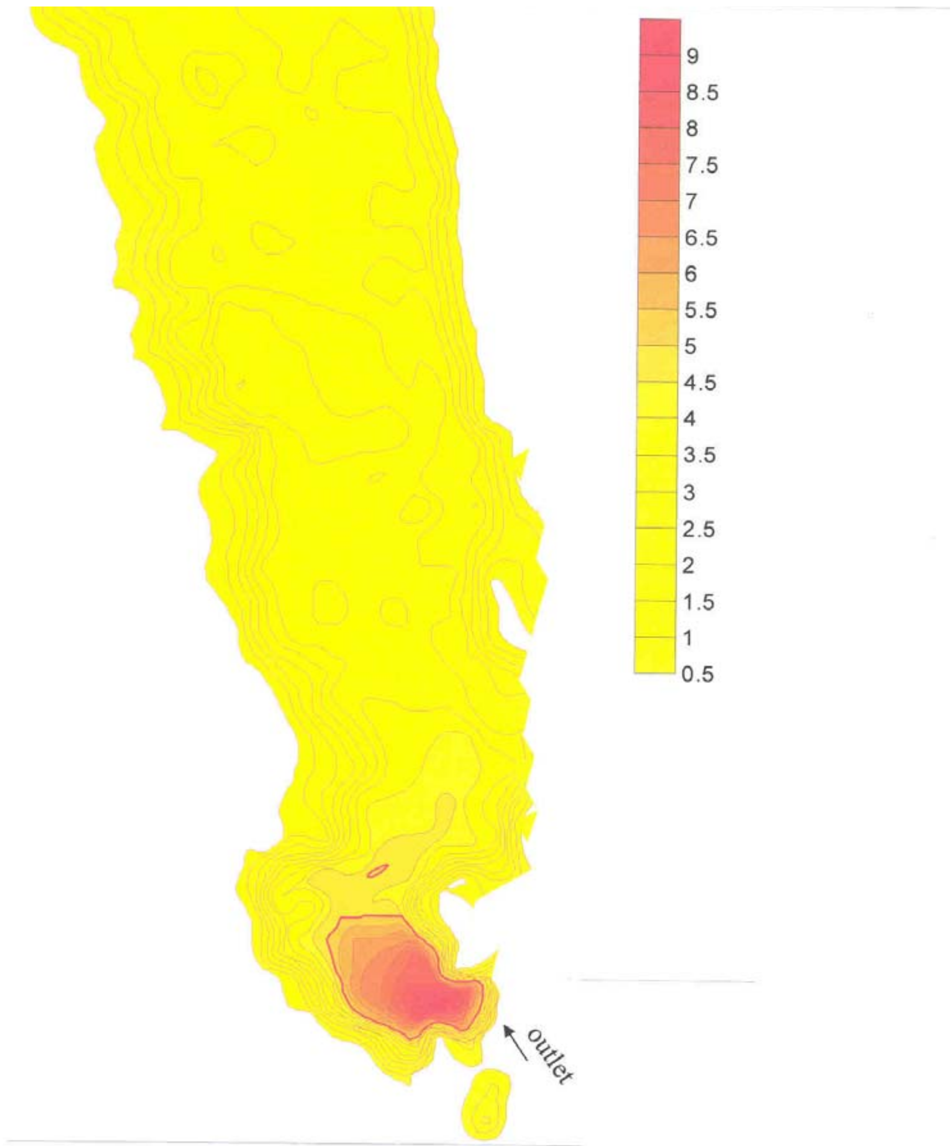


Figure 6-16

Predicted Surface Isotherms, Dominant Flow
(One Unit in Operation)

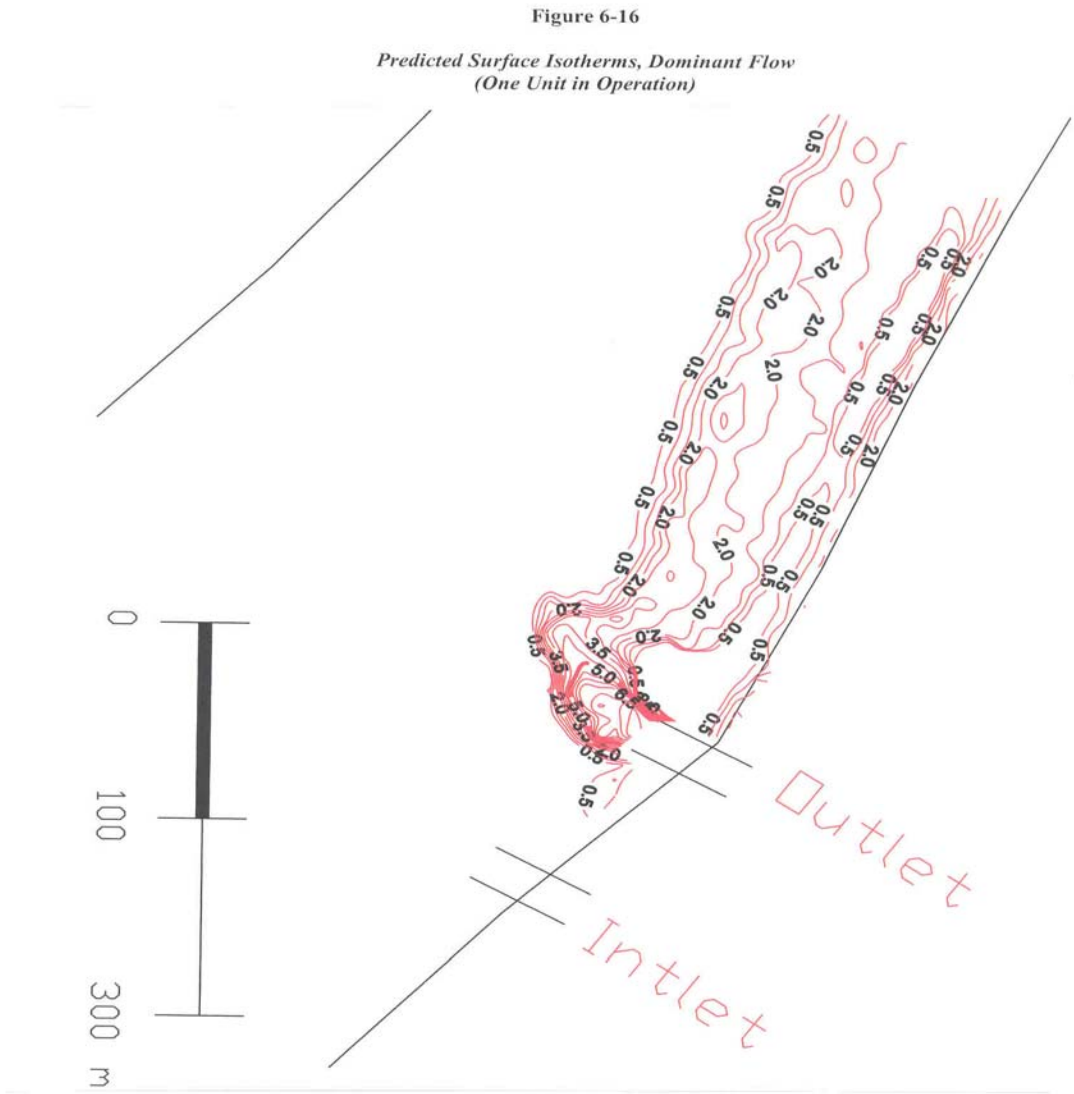


Figure 6-17

Predicted Thermal Plume (in ^{o}C), Dominant Flow
(One Unit in Operation)

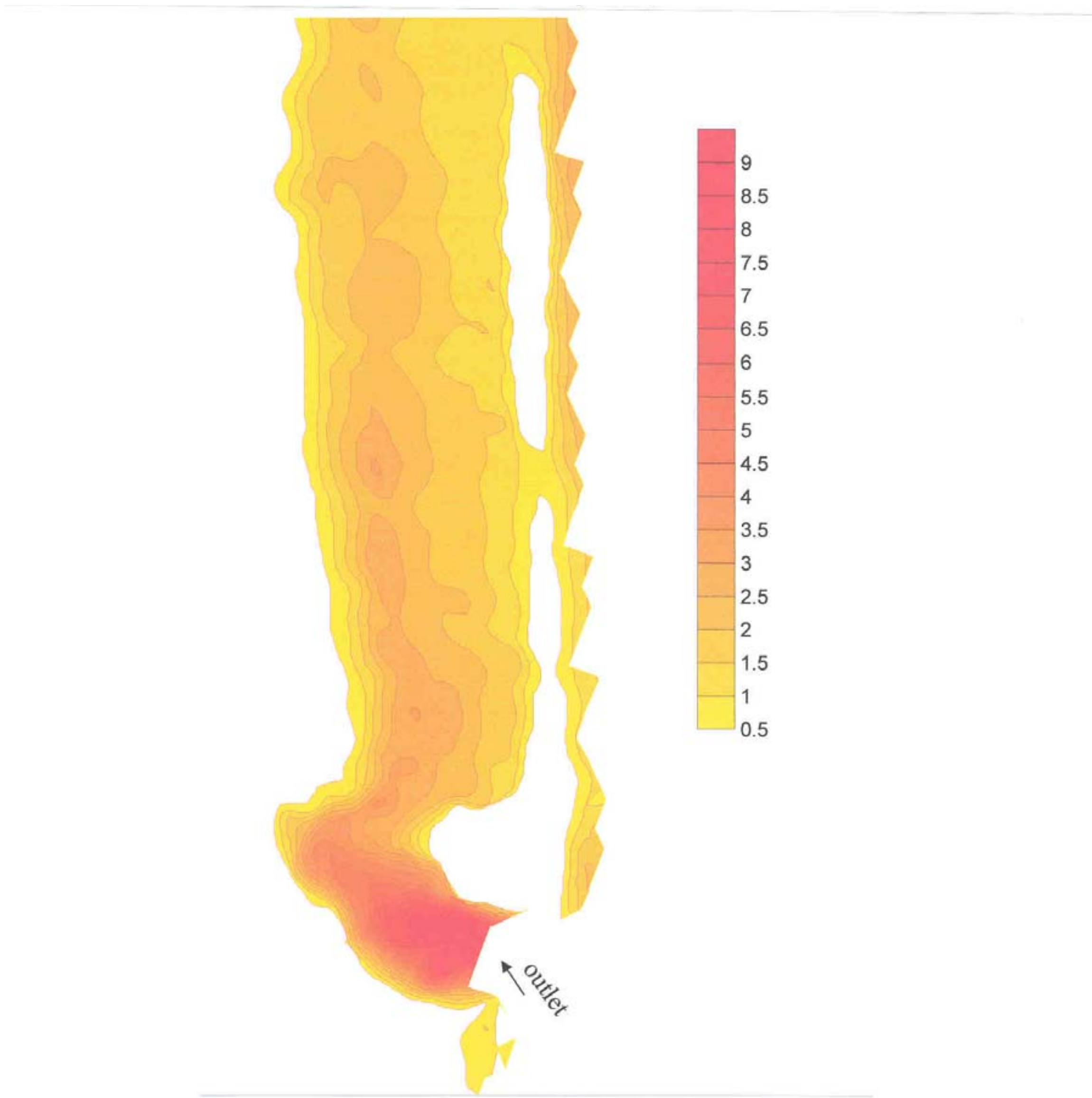


Figure 6-18

Predicted Surface Isotherms, Maximum Flow (Two Units in Operation)

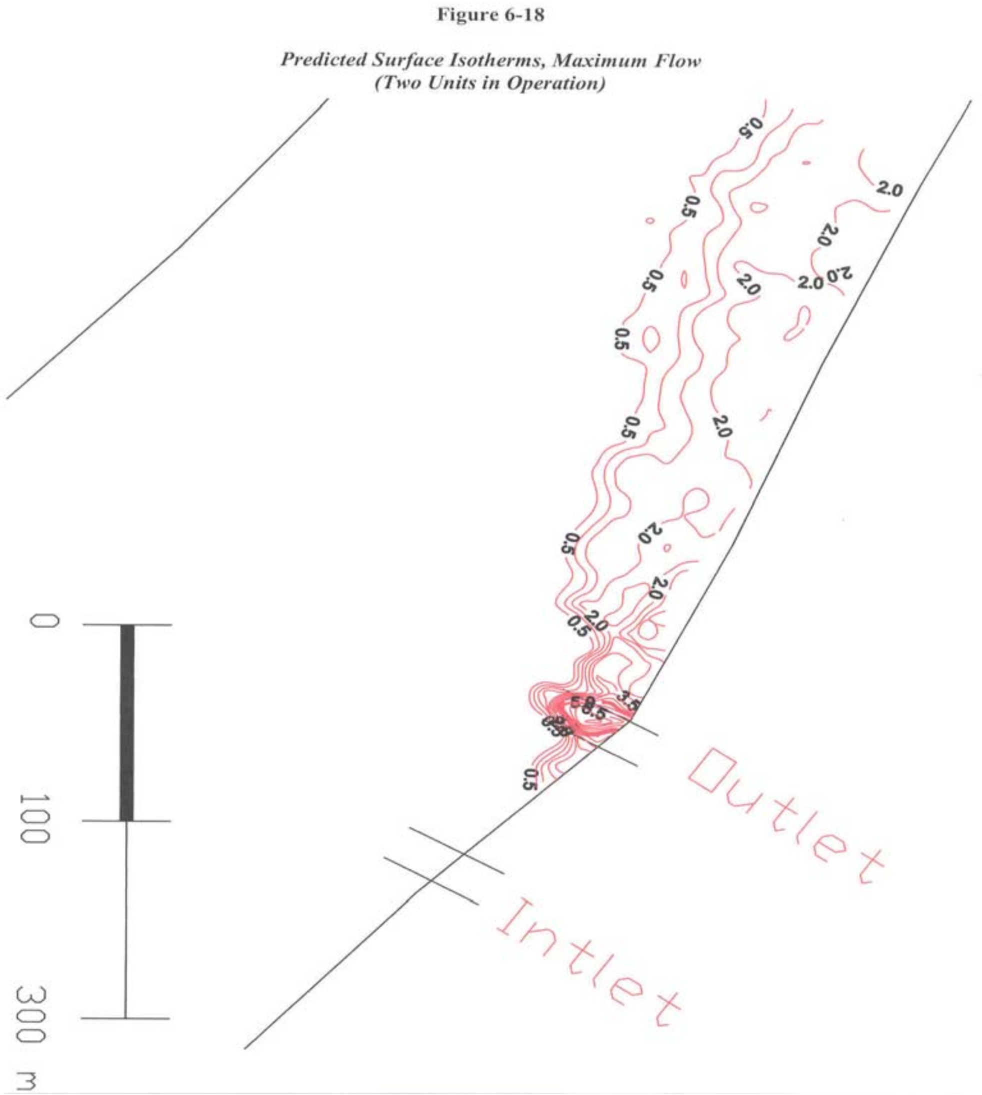


Figure 6-19

Predicted Thermal Plume (in ^{o}C), Maximum Flow (Two Units in Operation)

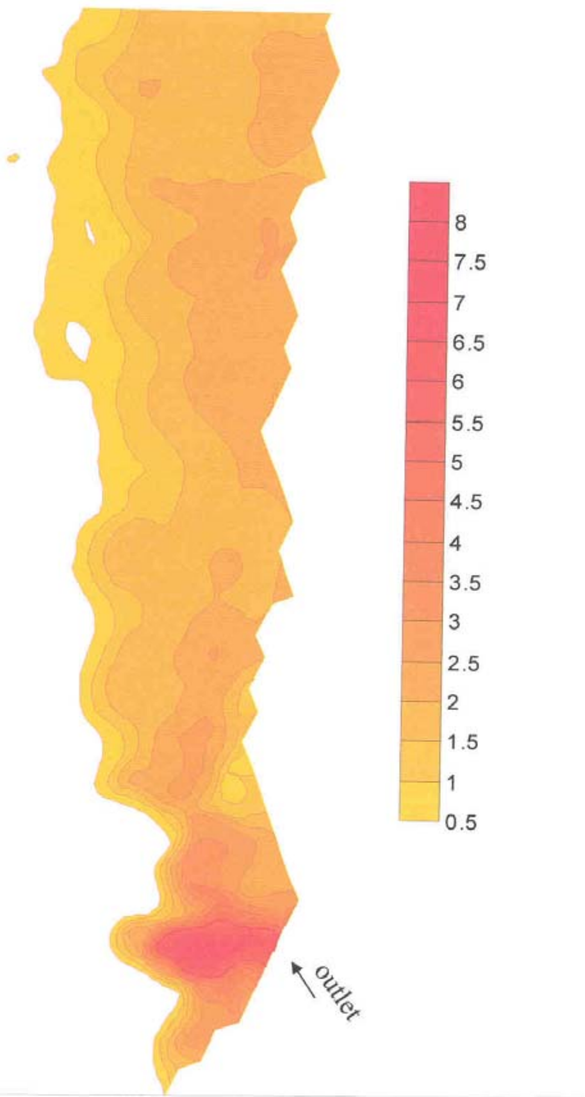


Figure 6-20

Predicted Surface Isotherms, Maximum Flow
(One Unit in Operation)

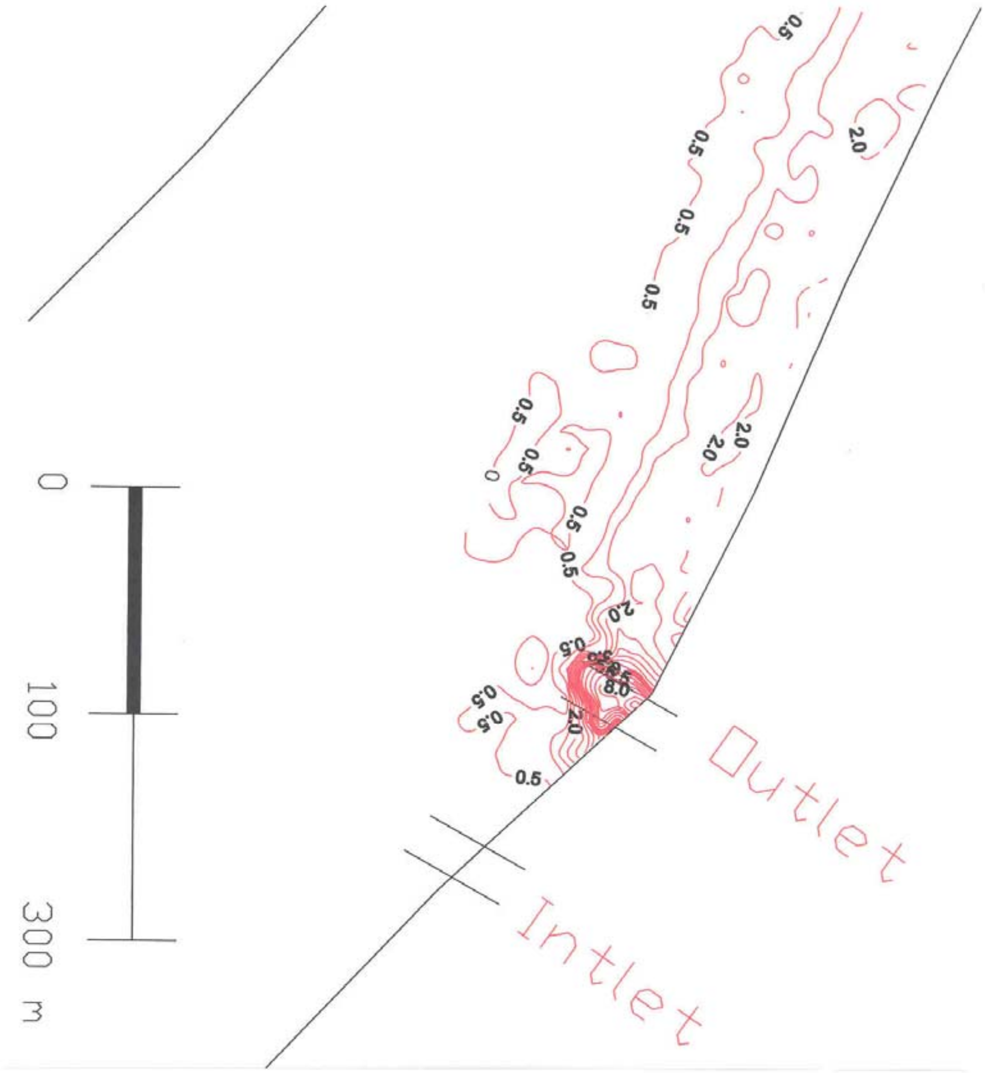


Figure 6-21

Predicted Thermal Plume (in ^{o}C), Maximum Flow (One Unit in Operation)

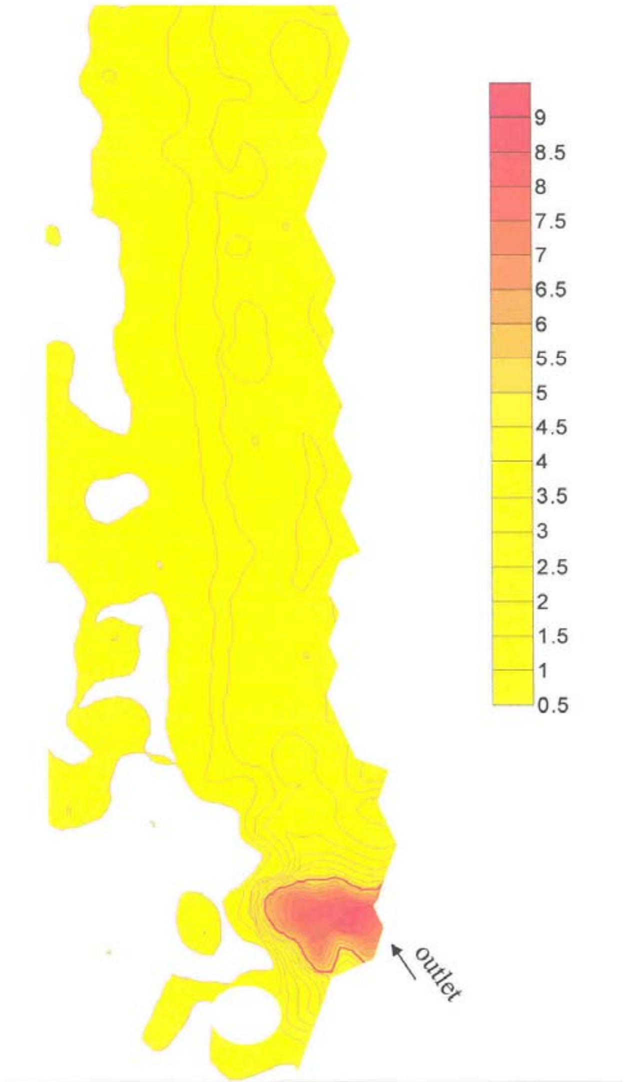


Figure 6-22

Velocity Distribution of the Dominant Flow, Intake Structure (Two Units in Operation)

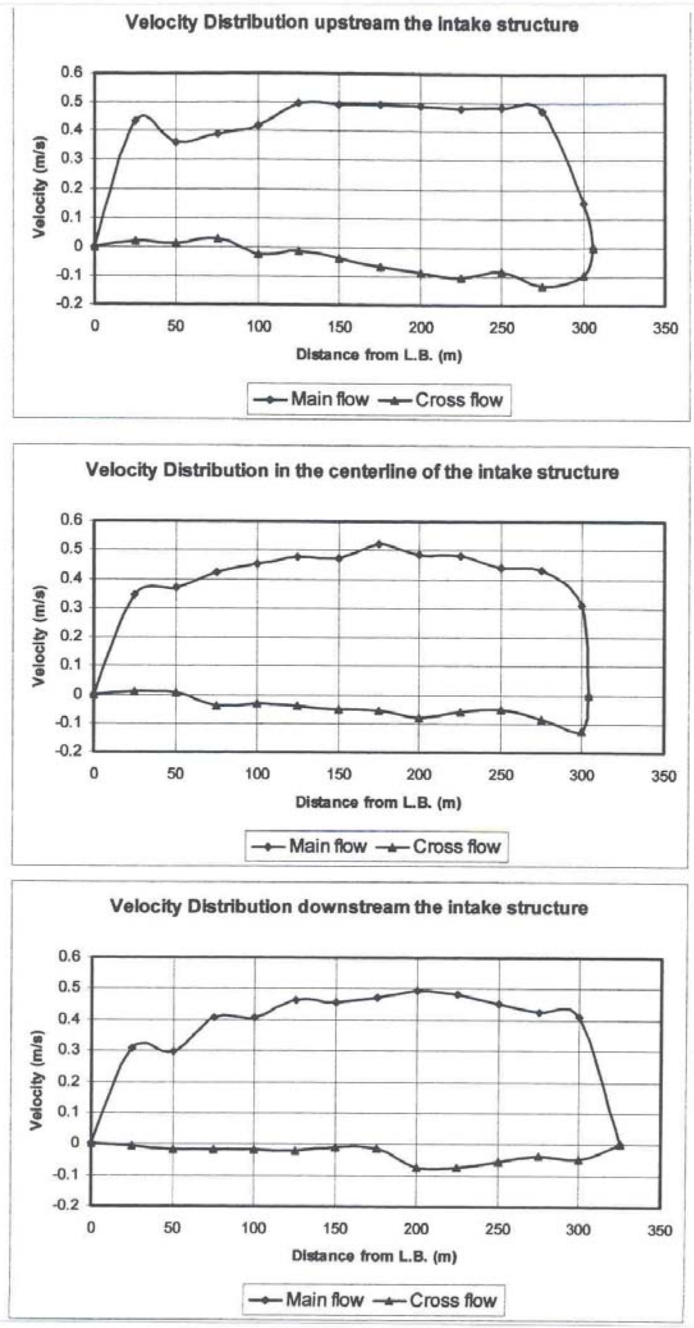


Figure 6-23

Velocity Distribution of the Dominant Flow, Outfall Structure (Two Units in Operation)

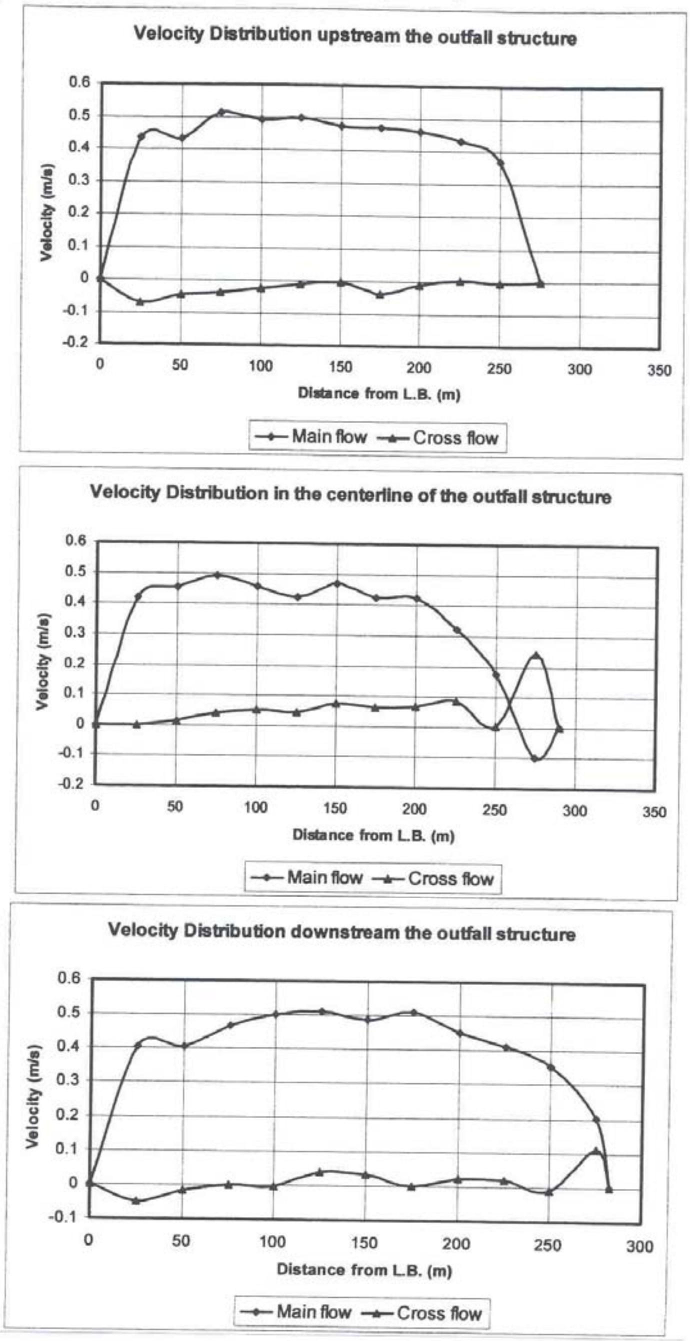


Figure 6-24

Velocity Distribution of the Dominant Flow; Intake Structure (One Unit in Operation)

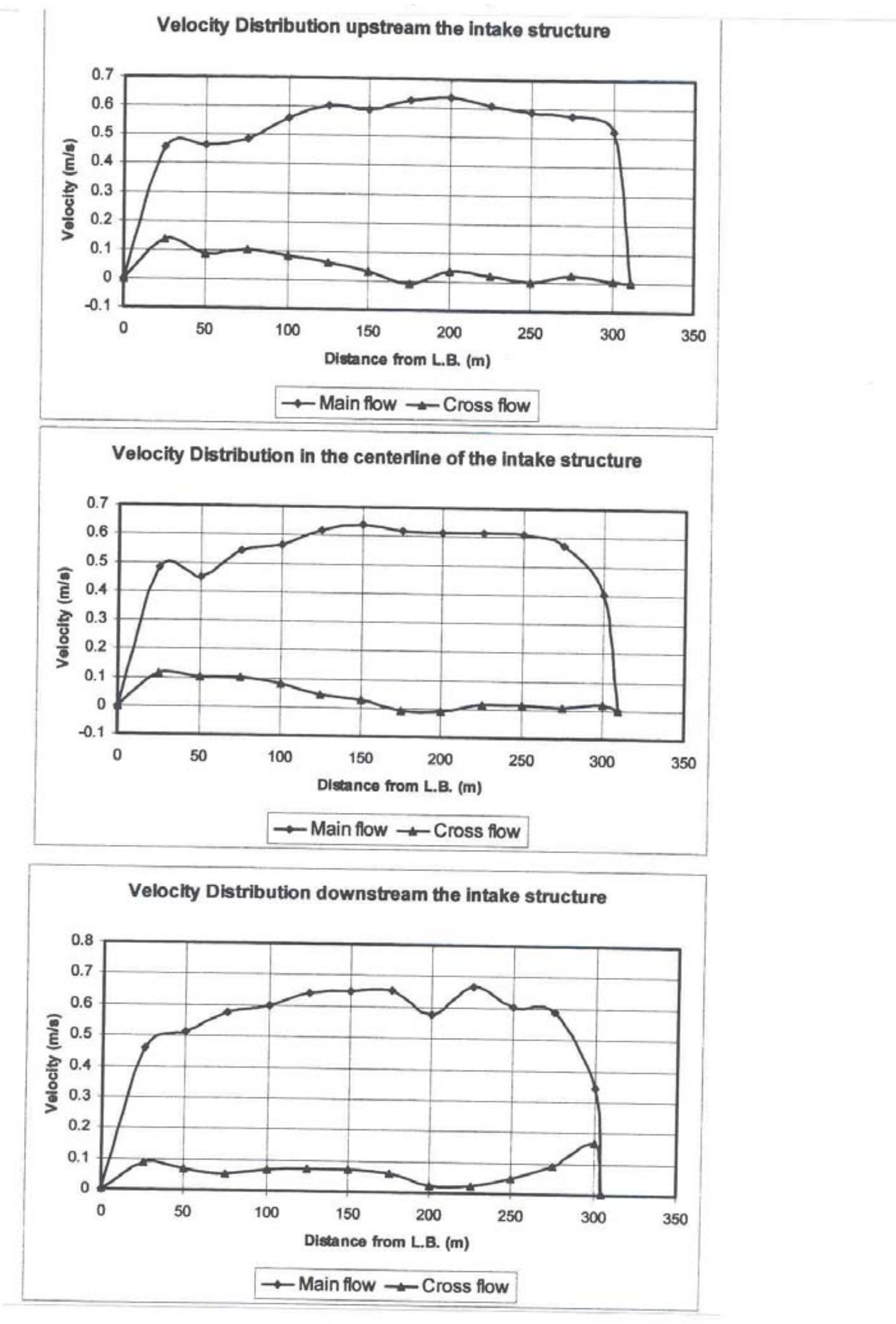
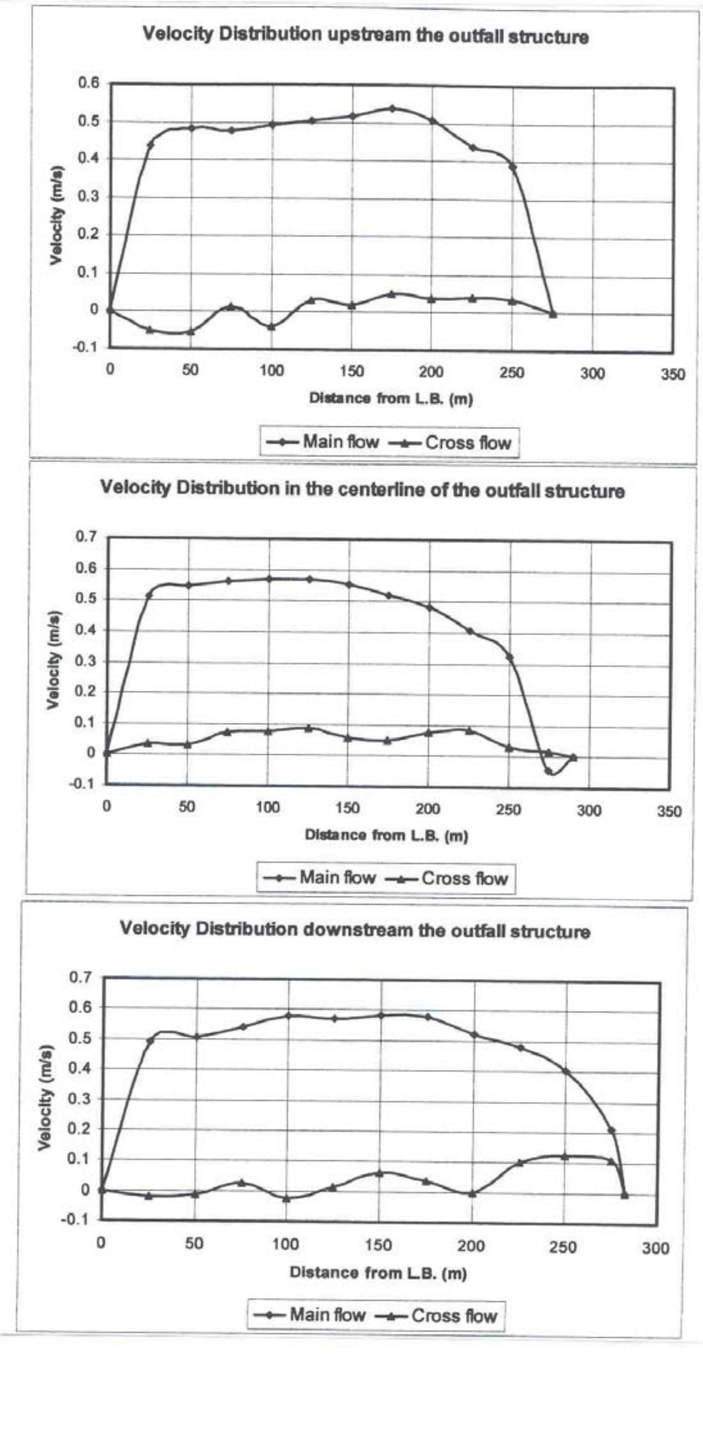


Figure 6-25

Velocity Distribution of the Dominant Flow; Outfall Structure (One Unit in Operation)



Impact of Thermal Plume on Aquatic Ecology

The effect of raised water temperature on fauna and flora could include the following:

- lethal effects due to direct temperature increases;
- effects on physiological processes such as raised metabolic and breathing rates, grouped as stress effects; and
- changes in behavior of mobile species such as avoidance or attraction to water of a higher temperature.

Lethal temperatures for aquatic animals are related to the summer maximum temperature in which they live. Temperatures over and above that maximum may result in any of the three levels of effect described above. It is anticipated that lethal effects as a result of the thermal discharge will be limited to any non-mobile benthic fauna and flora adjacent to the outfall.

There will be limited, short term and local impacts on planktonic species affected by the warm plume and this may result in changes to the observed planktonic communities as more tolerant species displace less tolerant species. This in turn may impact the fish species present by sustaining larger populations or attracting some species whilst displacing others.

Mobile species will show a similar response to the warm water with some species avoiding the warm water and some species attracted (Young bass *"Dicentrachus labrax"* migrate into warm water plumes at Kingsnorth Power Station in the UK where they achieve 30% faster growth than comparable fish in unheated water (Turnpenny et al, 1985)).

In summary, the thermal discharge is predicted to impact aquatic flora and fauna both positively and negatively. At the point of discharge where water temperatures will be around 8°C above ambient temperatures, it is unlikely that non- mobile flora or faunal species will survive, however the area is already relatively impoverished. The more marginal temperature increase experienced further from the discharge outlet, up to a distance of 50 m, however may sustain larger populations of some species or attract additional species to the area.

The intake and discharge structures will however also provide new habitats for some species. The hard structures of the submerged vanes will provide a surface for colonization which may support these communities. In turn, these species will attract planktonic and fish species into the newly created habitat.

Impact of Operational Discharges on Water Quality

During operation water will be withdrawn from the Nile river for condenser cooling and other plant uses. Most of the water will be returned to the Nile river in the form of cooling water discharge by the way of the discharge structure. The activities that are expected to generate waste water from the power plant include the following:

- cooling water;
- demineralization of water for plant uses;
- chemical cleaning of boilers and air heaters;
- oil/water interceptor effluent;
- equipment and floors cleaning; and
- recovery of rainfall runoff from oil storage areas and transformers.

Condenser cooling water, which corresponds to the most important water consumption of the power plant (~ 95%), does not need to be treated by chemicals. The water cooling condensers are designed in a type of metal alloy to avoid discharge in the Nile water of heavy metals such as copper and zinc coming from the wear of tubes of brass condensers. The power plant will be equipped with all water treatment facilities in order to keep waste water quality within the applicable regulations.

Sanitary water will be discharged to the City sewer system. Other waste water (except heated cooling water) will be collected and treated before being discharged via the water discharge system, which includes two separate pathways: City sewer system and the plantation irrigation network. The major water treatment steps include:

- neutralization of any waste water that has a pH outside the range of 6 to 9;
- oil separation of any waste water that may be contaminated with oil or grease; and
- flocculation and filtration of any waste water that may contain high concentrations of suspended solids.

The oil/water separators will operate continuously. Rain waters containing oil will be routed to the oil separator; rain waters without oil will be discharged to the City sewer system.

All the process effluent, in combination with site drainage from areas at risk of contamination (power block areas, drains and sumps) will be treated and then discharged to the water discharge system. The discharge from the power plant will comply with the Egyptian and World Bank standards for discharge to River Nile and its branches as a minimum (as per the *Law 48/1982*)(*Table 6-12*).

Table 6-12

Water Quality Guidelines and Standards Applicable to the Operation of the Plant (mg/1, unless otherwise stated)

Parameter	Egyptian Standards(1)	World Bank Guidelines	Estimated Characteristics of Discharge	Background Concentrations (where available)(2)
Biological Oxygen Demand	30	-	-	2-4
Chromium (total)	0.05	0.5	-	< 0.02
Copper (ppb)	1	0.5	< 0.5	N/A(3)
Iron	1	1.0	<1	N/A
Oil and Grease	5	10	<5	0.95-2
Suspended Solids (total)	30	50	<30	6-10
Residual Chlorine (total)	1	0.2	<0.2	N/A
Zinc (ppb)	1	1.0	<1	0.024-0.047
Temperature Increase (^{o}C) above the ambient with max absolute value of	$\leq 5^{o}$ 35^{o}	$\leq 3^{o}$ at 100 m	$8^{o}C$ at discharge point and $5^{o}C$ at 50 m	$28^{o}C$ Summer Max.
pH (unitless)	6-9	6-9	6-9	7.4-7.6

Notes:

(1) Decree No. 8-1983; The Implementary Regulations for Law 48-1982 Regarding the Protection of the River Nile and Waterways from Pollution, Chapter 6, Art 61.

(2) Results of physico-chemical measurements of water samples collected by the National Research Center on 4th June 2005 at selected sites in the Tebbin Nile segment.

(3) N/A = Not Available.

Biocides (mainly chlorine) will be added to the cooling water system to control bacterial and algal growth which otherwise would build up on various surfaces. In addition, chlorine will be used to control the growth of larger invertebrates and algae in the cooling water intake. The cooling water discharge will contain residual quantities of biocide at concentrations below the World Bank standard for free chlorine of 0.2 mg/l. Over a 24 hour period basic chlorination treatment will be at a concentration of 2 ppm. Chlorine shocking will take place when required depending on the level of algal growth at a concentration of 10 ppm. This concentration will be rapidly dispersed by the local dilution and dispersion in the Nile river.

In order to ensure compliance with Egyptian and World Bank water quality standards, an appropriate plant management system will be developed in order to monitor the quality of the discharge.

Water Quality Related Impacts on Aquatic Ecology

Impacts on aquatic ecology during plant operation will largely be due to increased water temperatures and the quality of the discharged water. The intake structure is also likely to cause entrainment of fish and other species. The impacts of the thermal plume on aquatic fauna and flora has been discussed above.

Chemicals, including chlorine, released into the discharge structure could potentially have both lethal and chronic effects on the flora and fauna surrounding the discharge point, if released in sufficient quantities. Water treatment technologies and management systems employed at the plant and described above, will however ensure that effluents released are strictly adhered to water quality standards stipulated by the *Law 48/1982* and do not threaten the Nile river habitats and ecosystems.

Entrainment of Flora and Fauna

The cooling water intake will result in the entrainment of fauna and flora. Because of the presence of grills, entrainment may result in death and/ or damage to larger organisms including fish which may escape entrainment. Once entrained the fauna are exposed to physical damage, increased temperatures and process chemicals, including chlorine at concentrations intended to be lethal to fauna an flora whilst in the cooling system.

The potential for damage is related to the escape speed of the particular animal, the intake velocity and the size of the grills over the intake. It is the younger stages of fish species that are at particular risk from entrainment and damage.

The maximum velocity in the culvert of the intake structure will be around 0.3 m/sec. This velocity is able to minimize fish entrainment into the culvert, and is at similar orders recorded at other power plants (Langford, 1983). Fish catches on the trash screens will be monitored on a weekly basis in the first year of operation to assess the impact of intake operation on the fish community. Whilst the impact of entrainment has the potential to be highly negative, it will occur over a very localized area. In addition, the velocity of water drawn into the culvert is close to the minimum required for efficient power plant operation, which will further reduce the risk of fish entrainment.

Bank Access

Once constructed, the intake and discharge structures will be buried in a pipeline across the bankline and it is expected that there will be little or no impacts on the use of the Nile bank as a result of the operation of the power plant.

Impact on Fishing and Navigation

The Nile immediately adjacent to the project site is not considered to be of significant importance as a commercial fishery. The plant is not therefore expected to have any significant impacts on fishing activities.

Given that the outfall and discharge structures extend from the bankline, the structures are not expected to present any hazard to shipping.

6.4 NOISE AND VIBRATION

6.4.1 Introduction

The assessment of the potential noise and vibration impacts considers the following issues:

- noise and vibration from demolition and construction activities on the main site; and
- noise and vibration during operation, including from the main power plant and the pumping station.

6.4.2 Noise Sensitive Receptors

More than one residential complex have been identified around the Tebbin power plant site and there are population centres within 200m of the proposed site. The nearest land uses around the site are the Tebbin plant housing colony, approximately 60m to the immediate north of the power plant fence and the Tebbin village residential complex, approximately 150m to the northwest, and other population centers within 5 km radius of the proposed site.

Due to the industrial nature of the proposed site, the area is categorized as "Industrial area" with respect to the Egyptian ambient noise standards and "Industrial and Commercial" with respect to the World Bank environmental guidelines.

6.4.3 Standards and Guidelines for Noise Assessment

In the absence of World Bank or Egyptian standards for demolition and construction noise, British Standard BS5228 has been considered to represent good international practice for assessing and controlling noise during the demolition and construction phases.

6.4.4 Evaluation of Demolition and Construction Noise and Vibration

Noise Prediction Methodology

Noise levels from demolition and construction activities have been predicted and assessed based on the methods set out in the UK codes of practice (BS5228). Calculations of the combined sound power from all demolition and construction plant, adjusted for usage time, have been used to predict the highest potential noise levels for the peak period of demolition and construction.

Traffic noise predictions have been carried out using the methodology in the UK Department of Environment (as was) Calculation of Road Traffic Noise which is the standard method of predicting noise from roads in the UK and is considered to represent good international practice.

For the assessment, the following conservative assumptions have been made:

- fixed demolition/construction plant is located close to the center of the site;

- mobile construction plant has been assumed to use a haul route that follows the perimeter of the site;

- no account has been taken of the attenuation in noise levels due to acoustically soft ground or due to screening from intervening buildings; and

- eventhough demolition phase will use lower level of fixed and mobile plants for demolition or dismantling processes, it is assumed that noise and vibration generated during this phase are similar to those of the construction phase.

The type and number of plant assumed to represent the worst case during the peak period of construction, are presented in *Table 6-13*.

Noise from the Demolition and Construction Site

Using the worst-case assumptions, the predictions of potential levels of demolition and construction noise at the nearest receptors during peak demolition and construction phases are presented in *Table 6-14*, together with applicable Egyptian noise standards. The Egyptian noise standards are applicable to long term (i.e. operational) noise levels, but are included for reference in assessing the potential magnitude of impacts from short term demolition and construction noise. Reference is also made below to construction noise criteria used in the UK. It should be noted that no demolition or construction noise limits are published in World Bank guidance.

Table 6-13

Major Construction Plant on Site During the Peak Construction Period

Equipment	Number	Utilization Factor (1)	Day (D) Night (N) (2)
Tracked cranes (cranes, elevators, hoists, etc.)	9	50%	D, N
Air compressors	4	80%	80%D, 20%N
Bulldozers (bulldozers, IT-28, .. etc.)	5	75%	D
Truck cement mixers	3	50%	50%D, 20%N
Dump trucks (including rough terrain vehicles)	(3)	-	D
Diesel generators	3	20%	D, N
Welding equipment and generators	27	40%	60%D, 40%N
Batching cement plant	1	80%	80%D, 20%N
Grader (includes motor grader)	1	40%	D
Wheeled excavator / loader trucks	(3)	-	D
Lorries	(3)	-	D, N

Notes:

(1) Utilization factor is the percentage of time equipment is engaged in productive work and may generate significant noise,

(2) 'D' indicates daytime shift (07:00-17:00 hours) and 'N' indicates night time shift (17:00-07:00 hours). Percentage indicates the level of use in each shift,

(3) Equipment has been assumed to use the haul route / on-site road adjacent to the site boundaries. An average flow of 20 vehicles per hour has been assumed.

From *Table 6-14* it can be seen that in the absence of noise mitigation measures, demolition and construction noise levels are predicted to comply with the Egyptian standards. In the UK a daytime construction noise criteria of LAeq 70 dB is generally used to assess construction noise in rural areas. This level is not predicted to be exceeded. Hence no demolition and construction noise impacts are expected.

Noise from Demolition and Construction Traffic on the Site Access Road

Assuming that a haul route will pass the residential properties around the power plant site at a distance of more than 60 m, the resulting predicted noise levels will be less than 60 dB(A). This noise level is within the Egyptian and UK standards and, hence, no significant impacts are predicted.

Noise from Demolition and Construction Traffic on the Road Network

Noise levels from traffic on local roads have been predicted for the peak demolition and construction activity, both with and without the potential construction traffic. Predicted noise levels at the roadside are shown on *Table 6-15* below.

Table 6-14

Indicative Worst-case Demolition or Construction Noise Levels at Nearest Receptors

Receptor	Distance from Power Plant Site (m)	Egyptian Standard (dB(A))		Predicted Noise Level[2] (dB(A))	
		Day-time	Night-time	Day-time	Night-time
Cairo-Es-Saff Arterial Road [1]	40	60-70	50-60	68.5	60
Tebbin Plant Residential Colony	60	60-70	50-60	65	59
Residential Complex to the Northwest	150	60-70	50-60	59	54

Notes:
(1) Categorized as Industrial Area in Egyptian Standards.
(2) Predicted and assessed based on the methods set out in the UK codes of practice (BS 5228), using calculations of the combined sound power from all demolition and construction plant adjusted for usage time.

Table 6-15

Roadside Noise Levels from Demolition and Construction Traffic $_{LA10,\ 18hour}$ [1]

Receptor	Without construction	With Construction	Increasing
Cairo-Es-Saff Arterial Road	68.5	68.8	+ 0.3

Notes:
(1) 18 hour traffic flows derived from average hourly flows.

The difference in noise levels at roadside receptors due to the demolition and construction traffic is only 0.3 dB(A). Increases in environmental noise levels of less than 2-3 dB(A) are not generally perceptible to the human ear, consequently no demolition and construction traffic noise impacts are predicted.

Vibration from Demolition and Construction Activities

Measurements of vibration from demolition and construction plant have shown that, even from the worst case activity, i.e. percussive piling equipment, levels typically fall to imperceptibility beyond approximately 100m from the vibration source. Imperceptible levels are reached at much smaller distances from other sources of vibration, such as excavators, bulldozers and heavy goods vehicles (HGVs). Hence, because there are no receptors within 100 m of the site no vibration impacts are expected.

6.4.5 Evaluation of Operational Noise and Vibration

Noise Prediction Methodology

The potential noise emissions from the power plant have been modeled using the Bruel and Kjaer “Predictor” noise model. The noise model breaks the plant down into individual point sources representing each item of equipment or structure that may produce a significant amount of noise. Sound power levels were assigned to each point source based on field measurements of similar equipment in existing power plants as well as vendors, data on noise impacts generated by each piece of machinery, providing representative emission levels without the implementation of any unusual noise controls applied. The individual noise sources included in the model are shown in *Figure 6-26* and are listed below.

- Steam Generators (Boilers), units 1 & 2 ;
- Steam Turbines, units 1 & 2.
- LCI/Generator Excitation Compartments, units 1 & 2;
- Main Transformers;
- Auxiliary Transformers;
- Demineralization Plant;
- Water Treatment Area;
- various types of Pumps and Fans; and
- Gas Reducing Station.

Table 6-16 shows noise data on the main noise sources depicted in *Figure 6-26* (see also *Figure 4-2*).

Operational Noise

The noise model has been used to predict noise contours in the area around the site. These are shown in *Figure 6-27* through *Figure 6-29*. *Table 6-17* gives the predicted noise levels at two locations relative to the site boundary.

Table 6-16

Noise Data of the Main Noise Sources in Tebbin Power Project

Source Type	Center Frequencies, Hz								LAeq	LAeq	Remarks
	63	125	250	500	1000	2000	4000	8000	dB	dB(A)	
Turbine source	100.7	93.1	82.4	75.0	84.0	80.8	85.0	77.1	101.7		Given by EEHC
A-Weighted	74.7	76.1	75.4	72.0	84.0	82.8	86.0	75.1		90.0	
Main Transformer	92.0	87.0	87.0	83.0	83.0	80.0	77.0	56.0	95.0		Measured by MB
A-Weighted	66.0	70.0	80.0	80.0	83.0	82.0	78.0	54.0		88.0	
Auxiliary Transformer	81.0	86.0	83.0	79.0	70.0	67.0	62.0	56.0	89.1		Measured by MB
A-Weighted	55.0	69.0	76.0	76.0	70.0	69.0	63.0	54.0		80.3	
Boilers	90.0	97.0	98.0	100.0	102.0	99.0	95.0	87.0	107.0		Given by EEHC
A-Weighted	64.0	80.0	91.0	97.0	102.0	101.0	96.0	85.0		105.9	
CW Pump	91.0	92.0	93.0	95.0	97.0	94.0	90.0	86.0	102.3		Given by EEHC
A-Weighted	65.0	75.0	86.0	92.0	97.0	96.0	91.0	84.0		101.0	
Fuel Heater A-Weighted	99.6	92.9	91.2	94.8	88.2	85.2	86.8	72.5		88.9	Calculated by MB
Gas Compressors	68.2	68.9	69.5	70.7	75.5	80.4	70.7	62.3	82.9		Given by EEHC
A-Weighted	42.2	51.9	62.5	67.7	75.5	82.4	71.7	60.3		83.7	

Table 6-17

Predicted Operational Noise Levels

Receptor	Egyptian Standard (dB(A))		World Bank Guideline (dB(A))(2)		Predicted Level (dB(A))
	Day-time	Night-time	Day-time	Night-time	
Fence of the Power Plant (1) at the Plant Colony (the nearest sensitive receptor)	60-70	50-60	70	70	59.1
100 m away from the Fence of the Power Plant(1)	60-70	50-60	70	70	< 55

Notes:

(1) Categorized as "Industrial area" in Egyptian standards and as "Industrial and Commercial" in World Bank guidelines.

(2) If the specified noise criterion is not met, the plant must not give rise to an increase in background levels of more than 3 dB(A) in order to comply with the guidance.

Figure 6-26

Individual Point Sources of a Significant Amount of Noise in the Power Plant

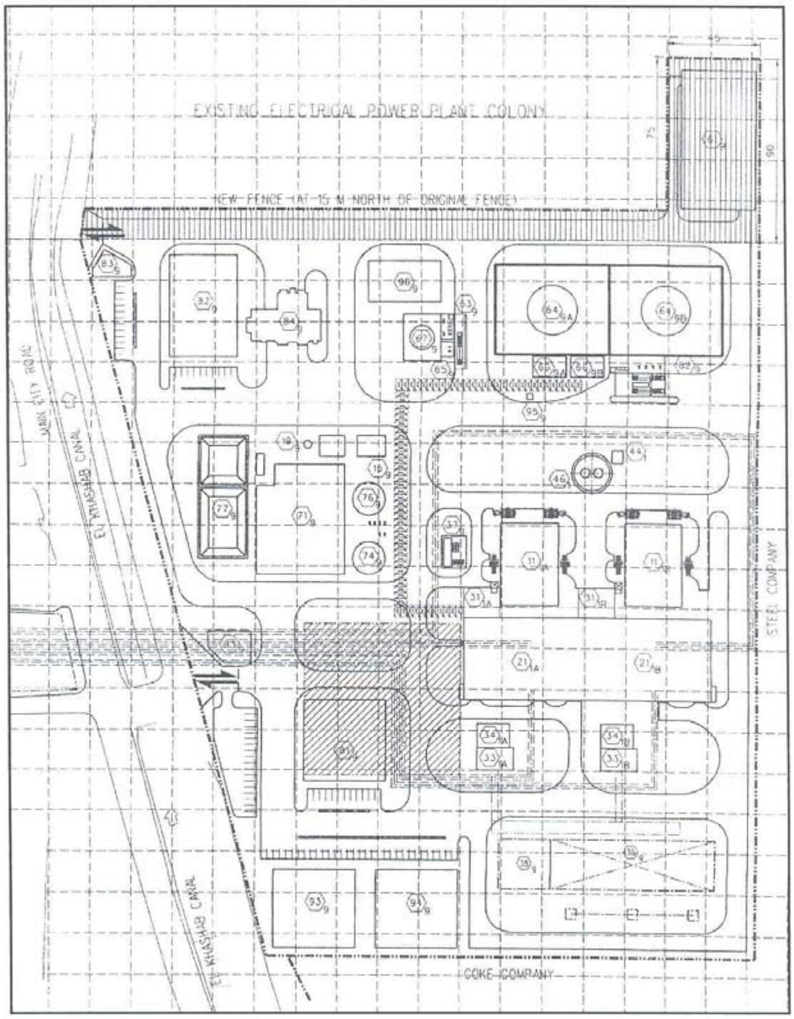


Figure 6-27

Noise Contour Area around the New Units in Lden

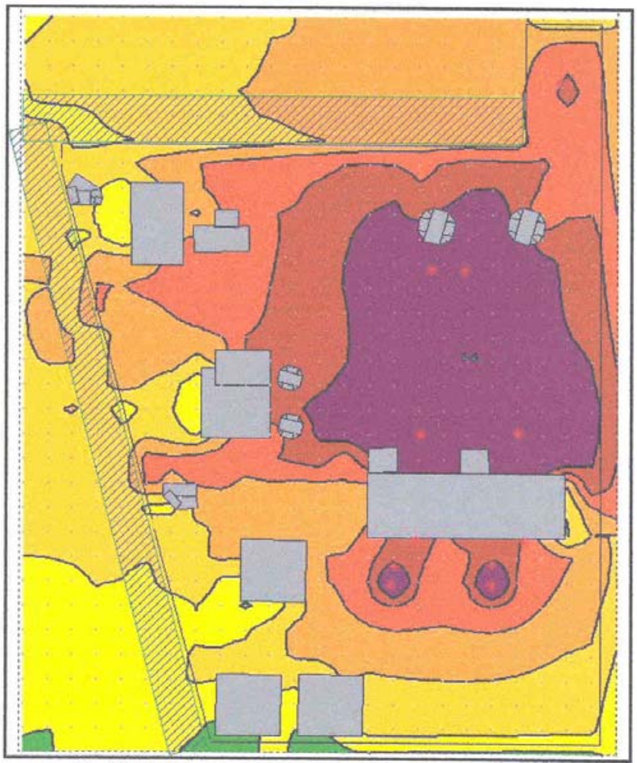


Fig.(7) Noise contour area around the new units in Lden

nr	from	to	fill color
1	0.00	50.00	
2	50.00	55.00	
3	55.00	60.00	
4	60.00	65.00	
5	65.00	70.00	
6	70.00	75.00	
7	75.00	100.00	

Figure 6-28

Noise Level Values around the New Power Units

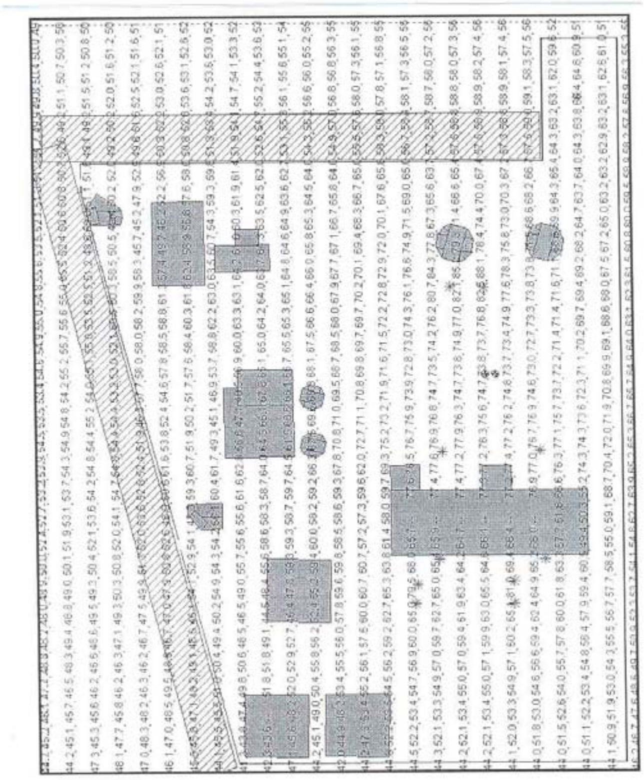
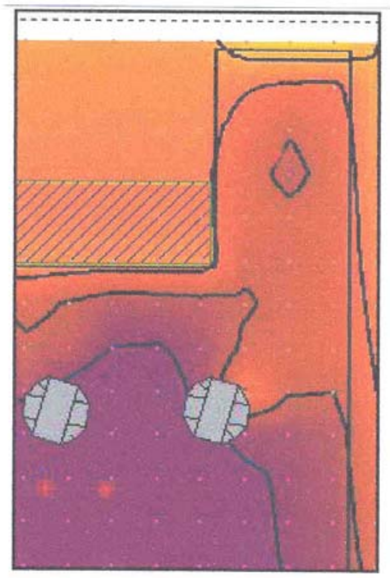
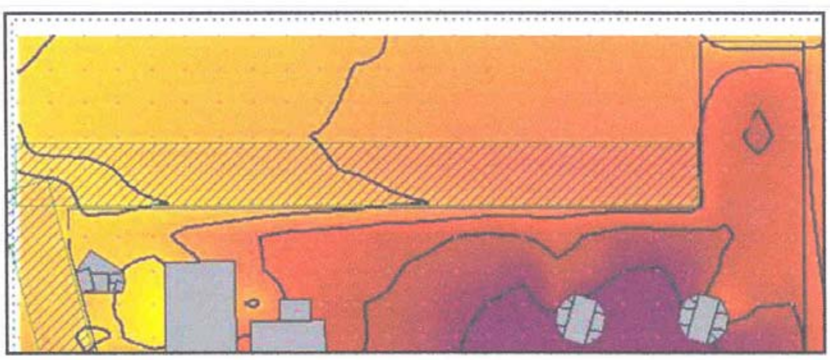


Figure 6-29

Two Zooms around the Plant



Noise Contour Area around Gas Reducing Station in L*den*



Noise Contour Area around the Northern Fence in L*den*

The predicted operational noise levels at the site boundary are below the Egyptian and World Bank Standards for daytime and night-time noise.

In addition, it should be noted that the predicted noise levels are based on conservative assumptions for noise attenuation and weather conditions. Therefore, noise from the operating plant is not expected to give rise to any significant noise impacts at receptors in the area.

However, since the nearest receptor, i.e. the plant residential colony, is some 60m to the northern side of the power plant site, and irrespective of full compliance with stipulated regulations, as modeled above, it is recommended that the fence of the plant site is elevated to a height of 5m. This will achieve a reduction of about 3-5 dB(A) (see *Figure 6-31*). This reduction will be necessary if exeedences of additional background noise are occurred.

Traffic-related Noise During Operation

The percentage increases in hourly traffic flows during the operation of the power plant are about 3% on the section of the Cairo-Es-Saff Arterial Road to the west of the power plant. These increases are not sufficient to give rise to any perceptible change in traffic noise.

Operational Vibration

The design of the power plant will ensure that all rotating machinery is correctly balanced and that reciprocating equipment is vibration isolated, to ensure that vibration will be imperceptible beyond the site boundary. Since the nearest receptor is some distance from the power compound within the site there will be no vibration impacts from the operating plant.

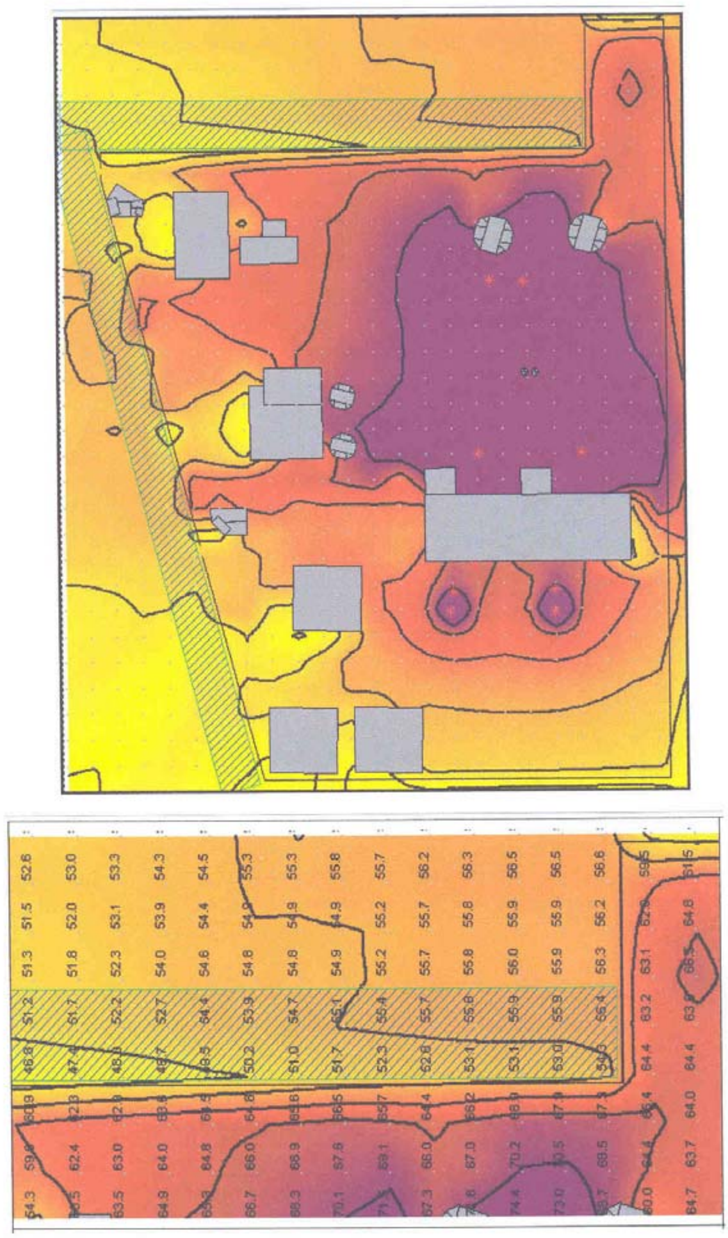
6.4.6 Conclusion

Predictions of unmitigated demolition and construction noise indicate that Egyptian and UK standards are met at all times and there will be no demolition and construction noise impacts. Neither will there be vibration impacts because the nearest receivers are some distance from the working compound within the site.

Egyptian and World Bank standards for operational noise are met at all receptors during daytime and night-time. Therefore, no significant noise impacts are expected.

Figure 6-30

Noise Contour Gradient in Lden after Modification (5m-height, northern fence)



6.5 FLORA AND FAUNA

6.5.1 Introduction

The assessment has examined the potential impacts of land take and disturbance of the proposed power plant on flora and fauna.

6.5.2 Potential Impacts

As described in Section 5.7 of this report, the project will be built on a matrix of fallow land and the area surrounding the site is sparsely vegetated with only some genetically and biologically important plant species on the northern part of the power plant site, in addition to some patches of marginal vegetation.

Although the number of plant and animal species, mainly insects, found in these patches appears large, almost all of these species are characteristic of un-managed or fallow lands and therefore they are not considered important. In addition, none of the identified species is rare or endangered, except for those plantations mentioned above.

The cultivated trees are located in the immediate outside of the area designated for development. However, as mentioned earlier in Chapter 5, two groups of plants were observed. The elimination or destruction of plants belonging to the first group inside the site would not have any significant negative environmental impacts, because of their abundance and wide geographic coverage in the Mediterranean coast and the Nile delta. It is expected that these plants will re-immerge again even if they are eliminated by the normal dissemination process. Thus even if there is a need to remove them, they could be re-cultivated in other areas with no negative impacts. The absence of vegetation means that food sources for fauna are scarce, there is minimal natural protection and there are no natural roosting areas for birds. Consequently, the area is characterized by a poor diversity of fauna, with invertebrates dominating. No fragmentation of habitat or severance of ecological corridors between isolated habitats of ecological importance exist.

However, old trees of the second group, i.e. *Bombax sp., Pinus sp., Washingtonia sp.,* and *Zizyphus sp.,* will not be removed or cut off and every effort should be paid to protect them. This could be done in two ways, firstly through preparing the master plan of the new development to avoid placing any land uses or buildings at the locations of those trees. Secondly, via keeping the location of the main building and the entrance as they are currently located, then prepare the master plan of the rest of the site.

Given the relatively small scale of the power plant development, and given that the land flats surrounding it are unlikely to be affected after construction of the plant, the impacts will be localized and should not adversely affect the number of birds using the area.

6.5.3 Effects of Demolition and Construction on the Proposed Site and Surrounding Areas

Demolition of existing structures and construction of the power plant will remove approximately 65,000 m^2 of land from the existing ecosystem. As much habitat has however already been removed from the site and the surrounding area following urbanization process during the last five decades, the impact on existing habitats is not expected to be significant. The installation of discharge and intake structures will not result in the loss of an area of landflats, however the surrounding landflat areas provide areas for birds and significant impacts are considered unlikely.

Demolition and construction works, which are likely to occur over a 37 month period, will generate increased noise, dust and movements of construction workers and equipment around the site. Any bird species and other fauna which use or are resident in the area, are likely to be displaced and will maintain a standoff distance. Areas in the immediate vicinity of the plant are considered to be similar to those on the proposed site and therefore provide an alternative habitat for displaced species. The long-term impacts are therefore not predicted to be great.

Negative impacts on flora and fauna during demolition and construction, especially with application of necessary protective measures to the existing old trees, are not therefore considered to be significant. Any disturbance during construction will be minimized through the mitigation measures described in Section 6.5.5 below.

6.5.4 Potential Impacts as a Result of Power Plant Operation

It is not anticipated that there will be any further impacts to fauna and flora as a result of the operation of the power station.

The stack measuring 152 m in height would not present an obstacle given that the area is not an area of migrating birds. However, with the inclusion of measures such as lighting, to increase the visibility of stack at night or during weather conditions with poor visibility, this impact is not expected to be significant.

6.5.5 Mitigation Measures

The potential impacts of the proposed development on any existing flora and fauna will be minimized as a result of the following mitigation measures:

- noise will be controlled during demolition, construction and operation, and will dissipate rapidly with distance from source. Any disturbance during demolition, construction and operation will therefore be localized (see

Section 6.4);

- run-off from demolition and construction activities and any movement of contaminants disturbed along the land flats, will be attenuated and disposed of in a controlled manner (as described in Section 6.3) to ensure that surrounding species/habitats are not significantly affected; and

- Proper mitigation measures will be incorporated in the design of the water intake and discharge to avoid negative impacts. Such mitigation measures are currently standardized worldwide (e.g. World Bank, 1991 & 1996).

- Plantation ecologist will work closely with the engineer and/or contractors in order to develop a detailed conservation plan for floral wealth on the site.

- Plants near the agricultural drainage banks will be kept due to its important role in accumulating pollutants especially heavy metals. This important ecological role was reported in the literature on the same genera.

- Trees growing by the fence of the power plant will be kept since they will not obstruct any constructions and due to their importance as wind shields.

Ficus elastica var decora and *Ficus nitida* will be propagated and the resulting plants will be used for decorating and landscaping the site when completing the new power plant. This is actually an economic process because one may obtain 200-300 individual plants from a single tree.

6.5.6 Conclusion

Since the site itself and surrounding areas are poorly vegetated, the significance to flora and fauna is considered to be limited. Given that the potential impacts of construction and operation of the proposed power plant are localized, there are no predicted significant effects.

6.6 LAND USE, LANDSCAPE AND VISUAL IMPACT

6.6.1 Land use

The surrounding land uses in the area constitute heavy and light industries, commercial establishments, and a mid-rise apartment buildings. To the east and south of the site are heavy industrial uses with very large, factory type facilities.

No adverse impacts to the residential centers, located to the north and northwest of the site, industrial plants or commercial facilities are anticipated. Potential impacts to the surrounding land uses include the effect of air emissions and the discharges to the aquatic environment, including any wastewater or thermal discharges. These impacts are addressed in the air quality and aquatic environment sections (Sections 6.2 and 6.3). Landscape and visual impacts are discussed below.

6.6.2 Landscape and Visual Impact

The power plant will be a substantial structure with a stack height of 152m which, within the surrounding heavy industries, will be highly visible for 5-10km along the main arterial Cairo/Es-Saff Road and few kilometers inland.

All existing views in the area will not be strongly influenced by the construction of the power plant and, although the proposed power plant will emphasize the industrial appearance and scale of the local area complex, the potential additional visua1 impact will be mitigated by the existing industrial infrastructure. The wider character of the area is also industrialized, due to the water treatment / purification station of El-Tebbin and heavily industrialized area of Iron & Steel and Coke factories such that the visual intrusion of the power plant will be reduced against this context and backdrop.

The one sensitive receptor in the area is the residential complex of the power plant and other residential settlements around the site (the Tebbin Village). From these premises the power plant will be seen in context with the existing industrial nature of the area, therefore although visible from this area the power plant is not regarded as being intrusive. In addition, the visual aspect of the residents of the inhabited complex and apartments are towards the interior directions. Views west across along the Nile river may be partially obscured by existed structures.

Thus, while the power plant will be visible, the sensitivity of the landscape is very limited. It is anticipated that the large scale of the industrial and surrounding landscape will be able to visually accommodate the structures of the power plant in an industrial context. Hence, the landscape impacts are predicted to be minor.

6.6.3 Conclusion

Due to the existing industrial infrastructure in the area, especially the heavily industrial domain of Tebbin and Helwan districts, and the lack of any sensitive landscape resources or nearby receptors, the potential landscape and visual impact of the project will be minor and not significant.

6.7 SOILS, GEOLOGY AND HYDROGEOLOGY

6.7.1 Introduction

The assessment of the impact of the proposed development on the soil, geology and hydrogeology has considered the following issues:

- physical effects of demolition and construction activities on the soil profile;
- potential contamination from demolition, construction and operation of the proposed power plant; and
- effects on groundwater resources.

The risk of seismic activity is discussed in Section 6.11.

The assessment is based on information obtained from reports prepared by National Research Institute of Astronomy & Geographics, and Enviro-Pro describing the geology and geophysical structure of the site and its surroundings.

6.7.2 Effects on Soils and Geological Features During Demolition and Construction

There are no special, sensitive or protected soil or geological features or mineral deposits within the site, hence the development of this area of land will not have any significant impacts on soil or geological features or on mineral resources.

Demolition and construction activities can potentially alter the physical make up of the soil through a number of demolition and construction processes, including:

- demolition of existing structures;
- site preparation;
- top soil removal and temporary mounding;
- excavation for foundations;
- provision of temporary drainage systems;
- excavation for laying of pipes; and
- excavation of trenching.

These activities can alter the soil's make up through evacuating and compacting the soil (e.g. reducing infiltration and aeration) and by changing the surface topography. These changes to the site may also potentially affect recharge and drainage rates to local groundwater resources. However, given that ground water recharge rates at and around the project site are minimal and groundwater is not abstracted in the vicinity of the project area, the impact of power plant construction on local water resources is considered to be insignificant.

The potential for the direct impacts on the soil mentioned above is, however, largely dependent on the management of the demolition and construction site and demolition and construction activities. A range of mitigation measures will be implemented to protect soils (and, as a result, the limited groundwater resources) from the direct impacts of demolishing the existing structures and constructing the proposed power plant. These measures include the following:

During Demolition

- demolition plan will be established so as to commit with best practices in procedures and measures of conserving soil, geology and hydrology against any potential hazard;

- spoil from demolition activities will be monitored and controlled;

- machinery and/or any other items that are suitable for reuse on other locations or sold out to a licensed contractor will be transported using safe means so as to keep the soil secured against any hazard;

- Waste materials will be disposed of by a licensed contractor and the procedures for disposal will be audited by the project engineer and CEPC;

- Hazardous wates will be disposed of by a licensed contractor, with strict adherence to the EEAA regulations and controls of the Law 4/1994. Disposal procedures will be audited by the project engineer and CEPC.

During Construction

- engineered site drainage systems will be provided to collect, balance, treat as required and control the discharge of site run-off;

- vehicles and personnel will be restricted from accessing areas not designated for construction to prevent accidental or unnecessary disturbance or compaction of the soil;

- spoil from construction activities will be monitored and controlled; waste materials which are unsuitable for reuse on-site will be disposed of by a licensed contractor and the procedures for disposal will be audited by the project engineer and CEPC.

The inclusion of the above mitigation measures means that there will be no significant direct impacts on soils or geological features from demolition and construction activities.

6.7.3 Risk of Ground Contamination

Following geotechnical investigations carried out by Enviro-Pro, according to the Dutch Guidelines (see *Table6-9*), the topsoil cover will be cleared to a depth of more than 2m and the site, accordingly is considered to be uncontaminated. However, the demolition, construction and operation of the proposed power plant has the potential to cause some contamination through spillages and leaks, especially around fuel storage areas during demolition, construction and fuel and chemical storage areas and supply lines for any hazardous substances during operation.

Potential contaminating substances which will be present on the site during demolition, construction and operation will include fuels, lubricating oils, hydraulic fluids, water treatment chemicals, plant cleaning chemicals, sanitary effluent and detergents.

The risk of land contamination will be minimized through a range of mitigation measures. These are considered below as appropriate to the demolition, construction and operation phases of the power plant.

During Demolition and Construction

Land contamination will be minimized through the following mitigation measures:

- provision of engineered site drainage systems during construction and operation to collect, balance, treat as required and control the discharge of site run-off;
- protection of the soil from accidental pollution by bunding around proposed storage areas for fuel and chemicals with the capability to store at least 110% of the volume of the storage facilities;
- provision of oil and suspended solid interceptors, such as oil/water separators for the removal of pollutant loading from the site drainage and for the retention and containment of any accidental discharges during construction and operation;
- removal of waste materials unsuitable for re-use on site during construction to appropriate licensed sanitary landfill sites;
- management of excavations during construction so as to avoid the generation of drainage pathways to underlying aquifers; and

- provision of impermeable bases in operational areas to prevent absorption of any spillage of process materials.

The potential for contaminated sediments to be excavated during construction of the cooling water discharge and inlet structures is discussed in more detail in Section 6.3.2.

During Operation

Ground contamination during operation will be minimized through implementation of the following mitigation measures:

- Bunds or sumps will be installed on-site to isolate areas of potential oil or other spillages, such as transformer bays, from the site drainage system.

- Oil and chemical storage tanks will have secondary containment structures that will hold 110% of the contents of the largest storage tank.

- Areas for unloading oil and hazardous chemical materials will be isolated by kerbs and provided with a sump, equipped with a manually operated valve.

- The transformers will be provided with pits to retain 110% of the coolant capacity of the transformers which will include fire fighting water. Alternatively, each main oil-filled transformer foundation will drain through a corner sump directly to an underground oil collection chamber sized to retain l10% of the coolant capacity of the transformers plus deluge water (for the worst single catastrophic failure). Adjacent to this collection chamber will be constructed an oil separator which will normally function to separate any oil contaminated to the storm water collected from within the transformer foundations and the clean water drained to the discharge structure. The transformers will not contain PCBs.

- Stormwater runoff from equipment slabs that may be subject to oil contamination exposure will be collected and channeled through an oil/water separator prior to discharge into the discharge structure.

With these mitigation measures in place, the construction and operation of the proposed power plant is not predicted to cause any ground contamination on-site or of the surrounding land.

6.7.4 Groundwater Quality and Recharge

The volume of water entering the aquifer from the proposed site is currently considered to be negligible. Creation of areas of impermeable hardstanding on the site will not therefore significantly affect groundwater recharge in the area.

The mitigation measures set out in Section 6.7.3 will minimize the risk of contamination of groundwater from the proposed power plant during its construction and operation. As a result, no significant impacts on groundwater resources under the site are predicted during construction or operation.

6.7.5 Conclusion

Due to the characteristics of the soils and geology of the site, in particular the lack of any sensitive features, and the mitigation measures proposed as part of the construction and operation of the power plant, no significant impacts are predicted to occur. In addition, geotechnical investigations and topsoil testing will have to be carried out so as to make sure that the site is uncontaminated.

6.8 TRAFFIC

6.8.1 Traffic Assessment Methodology

Analysis of traffic impacts during construction and operation of the power station utilized both historical and field data. The statistical analysis, undertaken on behalf of SPEEDOTRANS and reported in detail in baseline study performed by the Egyptian National Institute of Transport (ENIT) for this EIA report requirements, considered an analysis of traffic speed and growth.

The assessment considers the main roads linking the site with the surrounding road network as well as the regional roads, as indicated in Section 5.10.

There are no Egyptian standards or World Bank guidelines with respect to assessing the significance of changes in traffic flow on road networks. The analysis presented here and undertaken by ENIT compares the anticipated impacts with guidance reported in the Highway Capacity Manual (HCM) of the US Federal Highway Administration (FHWA).

6.8.2 Traffic Analysis During Construction

The schedule for construction works, the anticipated volume of traffic generated and the routes used, is discussed in detail in Section 4.7 of this report.

Three mathematical models were developed in order to estimate projected growth of the existing traffic flows to the year during which peak construction activity is likely to occur (2007) and the year of completion 2008/2009. The traffic growth rates derived from the models were used to estimate traffic volumes for 2007.

The traffic analysis is based on estimating the Level of Service (LOS) of the Cairo/Es-Saff Road. LOS is a qualitative measure that describes the operational conditions within a traffic stream and the perception by motorists and passengers. The LOS analysis was carried out by ENIT, as described by the Highway Capacity Manual (HCM), second edition, published by the US Federal Highway Administration (FHWA) in 1994 for two-way two-lane highways. In addition, speed analysis was used to estimate the average travel speed along the Cairo/Es-Saff Road and to assess the variation of the average speed.

The LOS is classified using a lettering system as set out below.
To conceive the traffic operating conditions under any of the levels C, D or E, the following descriptions are used by the HCM.

- LOS A., the best level with high operating speed and very low density.

- LOS B., occurs in the zone of stable flow, with operating speeds beginning to be restricted somewhat by traffic condition.

- LOS C; average speed is about 85 km/hr on level terrain; unrestricted passing demand exceeds passing capacity; percent time delay up to 60%; service flow rate starts from 750 up to 1200 passenger car per hour (pcph) in both directions.

- LOS D; average speed of 80 km/hr can still be maintained under ideal conditions; unstable traffic flow is approached; passing becomes extremely difficult because passing capacity approaches zero; percentage time delay approaches 75%; maximum service flow rates of 1800 (pcph) in both direction.

- LOS E; Speeds will drop below 80 km/hr under ideal conditions; passing is virtually impossible; capacity is 2800 (pcph) in both directions; percentage time delay exceeds 75%.

- LOS F; the forced flow and stop-and-go conditions at a low speeds, where volumes are above capacity.

The analysis was carried out at two levels: regional roads and surrounding roads.

Regional Roads

The general peak hour rate on the regional roads is given as 10% of the daily traffic volume. This rate is applied to all regional roads within the study area of influence, after expanding the year 2004 data to year 2005 using a nominal growth rate of 11%, where the rate of increase of the annual average daily traffic (AADT) during 1997-2004 ranges between 10% and 12% as previously detailed in Section 5.10 of this report.

Table 6-18 illustrates the volume-to-capacity ratio for regional roads during peak hour and this ratio illustrates that the level of service of Cairo/Alexandria Desert Highway is (A) and Cairo/Suez Desert Highway is (A) too, while the level of service of Cairo/Ismailia Desert Highway is (C). This is considered to be a good indication to the regional roads in relation to the level of service of Cairo/Alexandria Agricultural Highway which is classified (E).

Table 6-18

Current Peak Hour and Volume-to-Capacity Ratios (V/C) for Regional Roadway Sections that Leading to the Tebbin Site in Year 2005

Regional Road	Peak Hour Volume (Veh/hr/dir)	Volume-to-Capacity Ratio (V/C)
Cairo/Alexandria Agricultural Highway	5197	0.96
Cairo/Alexandria Desert Highway	1414	0.21
Cairo/Ismailia Desert Highway	2419	0.55
Cairo/Suez Desert Highway	851	0.19

Volume-to-Capacity calculations in the *Table 6-18* are based on lane capacity as follows:

- Cairo/Alexandria Agricultural Highway: 1800 veh/hour.
- Cairo/Alexandria Desert Highway: 2200 veh/hour.
- Cairo/Ismailia Desert Highway: 2200 veh/hour.
- Cairo/Suez Desert Highway: 2200 veh/hour.

Surrounding Roads

In general, single road capacity in regional area and districts ranges between 1000 and 1800 vehicle/hour/lane, depending on design speed, geometric characteristics (dimensions and slopes), buses and trucks percent and pavement condition. Regional highway capacity is identified in the Highway Capacity Manual (Transportation Research Board, USA, 2000), so that the level of service for regional roads was carried out using the results of survey for this road and the volume-to-capacity ratio for regional roads during peak hour which considered the critical period during the day for traffic volume on this road.

Table 6-19 illustrates the analysis results, where it can be seen that the highest of traffic flow occurring during the peak hours at Cairo/Es-Saff road at location (1) (see *Figure 5-56*) is 556 vehicle/hour, i.e. 875 pcu/hour (438 pcu/hour/lane) and the traffic volume at Es-Saff/Cairo road is 577 vehicle/hour, i.e. 908 pcu/hour (454 pcu/hour/lane) and the capacity of this road is 850 pcu/hour/lane. *Table 6-19* shows that the level of service during peak hours for Cairo/Es-Saff road is (C).

Table 6-19

Volume-to-Capacity Ratios for Related Roads

Road	Peak Hour Volume (V)(1)	Capacity (C) for One Direction (2)	Volume-to-Capacity Ratio (V/C)
Coming from Cairo to Es-Saff just before the Plant Site	438	850	0.52
Coming from Es-Saff to Cairo just before the Plant Site	454	850	0.53

Notes:
(1) Peak hour flow during morning peak in normal day for each direction (pcu/hour/lane)
(2) The capacity of Cairo/Es-Saff road (850 pcu/hour/lane)

6.8.3 Construction Traffic Assessment Conclusion

Traffic impact analysis establishes peak hour situation with the project during construction. In this case, the total traffic is estimated through combining the results of data analysis in section 5.10 of this report. Levels of service with site traffic are then estimated. A comparison of the level of service would show the amount of impact envisaged by the new power plant.

Analysis is conducted on main roads linking the site with surrounding road network as well as regional roads. Roadway or traffic operational improvement would be addressed as alternative site improvements, and would be evaluated for peak hour effectiveness. The analysis is carried out for two cases: during construction and post construction. *Table 6-20* shows the traffic volumes on Cairo/Es-Saff Road during the period 2006-2009.

In the "during construction" case, traffic associated with the plant construction will be superimposed on the existing traffic flow to produce expected traffic during construction. *Table 6-21* provides with a summary of peak construction traffic. The amount of peak hour traffic during construction is given as 92 trucks/hour. Therefore, peak hour traffic on Cairo/Es-Saff Road is expected to increase by 4%, i.e. a very slight increase is expected during the year 2006. Although most of the construction traffic is trucks, its percentage would not reduce the level of service of current roads.

Table 6-20

Traffic Volume on Cairo/Es-Saff Road with and without the Tebbin Power Plant (in (Vehicles/hr)

1. Traffic Volume 2006

	Morning Peak Hour		Evening Peak Hour	
	Without Power Plant	**During Construction**	**Without Power Plant**	**During Construction**
To Cairo	561	607	600	640
To Es-Saff	494	540	578	618

2. Traffic Volume 2007

	Morning Peak Hour		Evening Peak Hour	
	Without Power Plant	**During Construction**	**Without Power Plant**	**During Construction**
To Cairo	583	629	624	664
To Es-Saff	514	560	601	641

3. Traffic Volume 2008

	Morning Peak Hour		Evening Peak Hour	
	Without Power Plant	**During Construction**	**Without Power Plant**	**During Construction**
To Cairo	606	652	649	689
To Es-Saff	534	580	625	665

4. Traffic Volume 2009

	Morning Peak Hour		Evening Peak Hour	
	Without Power Plant	**During Operation**	**Without Power Plant**	**During Operation**
To Cairo	631	646	675	690
To Es-Saff	556	571	650	665

Table 6-21

Summary of Peak Construction Traffic

Vehicle Type	Traffic Generation			
	Day Shift		**Night Shift**	
	Peak (veh/hour)	**Total during the shift**	**Peak (veh/hour)**	**Total during the shift**
Heavy Goods Vehicles	10	100	0	0
Construction Workers Vehicles	82	164	77	88
Abnormal Loads	0	0	2	4
Total	92	264	79	92

For the "post construction" case, it is important to estimate the amount of traffic on Cairo/Es-Saff road in the year 2009. This is carried out using an annual rate of increase of 4% to the existing traffic. The power plant is expected to be operational by the year 2009. Therefore, it would be necessary to carry out the analysis exercise for the inauguration year. As such, all base year counts (i.e. year 2005 counts) should be extrapolated to cover anticipated future conditions. Next step is to add generated traffic to forecasted road traffic. Again, the amount of traffic generated of only 56 vehicles per hour is considered very small compared to the total.

The results indicate that the traffic volume at its maximum on Cairo/Es-Saff Road during construction is 689 veh/hr in direction to Cairo and 665 veh/hr in the opposite direction (to Es-Saff) in the year 2008. Therefore the V/C ratio will increase from (0.53) to (o.64) which means lesser level of service for the road from (C) level to (D) level, which is permitted in these situations.

A similar exercise was carried out for regional roads considered in the study during construction phase. It was also concluded that the total increase in daily traffic would range between 0.6% and 3% only, assuming that traffic would use only road from seaport to Cairo. This percentage of increase would have a limited effect on the existing level of service. *Table 6-22* shows the expected traffic volumes on the four regional roads in the years 2006 through 2008 in both cases: without the power plant and during construction in addition to the year 2009 without and with the power plant operational.

Table 6-22

Traffic Volumes on Related Regional Roads with and without the New Power Plant (in vehicles/hr)

Road Section	2006		2007		2008		2009	
	Without	During Const.	Without	During Const.	Without	During Const.	Without	During Operation
Cairo/Alex. Desert Highway	1570	1616	1743	1789	1935	1981	2148	2163
Cairo/Alex. Agr. Highway	5769	5815	6404	6450	7108	7154	7890	7905
Cairo/Ismailia Desert Highway	2685	2731	2980	3026	3308	3354	3672	3687
Cairo/Suez Desert Highway	945	991	1049	1095	1164	1210	1292	1307

Table 6-22 shows that the Annual Average Daily Traffic (AADT) during construction is critical for regional roads if compared with post construction. However, expected increase in traffic volume differs from highway to another. For instance, prospective incremental increase in traffic volume on Cairo/Alexandria Desert Highway and Cairo/Suez Desert Highway may lead to increase in V/C ratio from (0.22) to (0.29) and from (0.19) to (0.26) respectively after commissioning the Tebbin plant in the year 2009, i.e. this slightly increase will not change the level of service of the roads, i.e. level (A). On the other hand, for the Cairo/Ismailia Desert Highway, increase in V/C ratio from (0.55) to (0.75) will decrease level of service of the road from level (C) to level (D). On the contrary, Cairo/Alexandria Agricultural Highway, which has level of service (E), will never change its characteristics. As in all cases it is clear that the traffic volume is very small compared to Regional Roads Traffic Volume.

Traffic management system and mitigation measures

Although the effects of construction traffic are likely to be limited, a number of good management measures will be undertaken. These comprise:

- construction workers will be transported to the site by minibuses;
- prescribed routes for construction traffic will be agreed with the appropriate authorities, particularly with respect to HGV traffic and abnormal loads if required by the CAA; and
- abnormal load movements will adhere to prescribed routes to be agreed with the appropriate authorities - these will be scheduled to avoid peak hours on local roads and published in advance to minimize possible disruption if required by the CAA.

With the inclusion of the mitigation measures, the potential impacts upon the affected roads will not be significant.

6.8.4 Operational Traffic

Construction and commissioning of the power plant is expected to be complete in 2008/2009.

Operational Workers

The power plant will operate 24 hours a day, 7 days a week and will employ approximately 500-600 people. During a normal working day it is understood that 330-400 employees will access the site at the beginning and end of the working day. Peak vehicular activity of 56 movements will occur at the start and end of the normal working day, assuming that part of the workers travel to the power plant by private motor vehicle with a vehicle occupancy rate of 4 and another part of the workers travel to the power plant by van motor vehicle with a vehicle occupancy rate of 8-10. During night-time and official holidays, 60-72 employees will be on-site.

Heavy Goods Vehicles (HGVs)

All delivery of gas and heavy fuel oil will be via pipelines. Therefore, the only HGV movements arising from the operation of the power plant will be associated with the delivery of light fuel oil (sollar), process materials or maintenance equipment. Delivery of these materials is estimated to generate approximately two HGVs, or four HGVs movements, per day.

Assignment of Operational Traffic

Operational staff are likely to originate from Greater Cairo and surrounding cities and will therefore access the site via the Cairo-Es-Saff road.

A summary of generated traffic is given in *Table 6-23*.

Table 6-23

Summary of Generated Operational Traffic

Type Vehicle	Peak Period	Daily
HGV	2	4
Car/LGV	54	94
Total	**56**	**98**

6.8.5 Operational Traffic Impacts

Percentage increases in peak hour traffic flows during the operation of the power plant are about 8-9% on the Cairo-Es-Saff Road to the site of the power plant.

These small increases in road usage are insufficient to cause any noticeable impacts during peak hours on traffic conditions, cyclists or pedestrians and, therefore, no significant effects are predicted.

6.8.6 Parking Demand

Parking demand differs, in general, by land use type and density. It is also affected by the presence of public transport modes and laws imposed and the zoning ordinances. Parking demand also changes by time due to changes in car ownership, traffic management measures and changes in employment densities. International references[(1)] normally provide parking rates as a percentage of the land use area or number of employees. For instance, the parks is given as space per 100 or 200 m^2 of the gross building area.

In this study, the total employment of Tebbin power station is some 350 employees covering all jobs (executive directors, engineers, accountants, technicians, etc.). The station works three shifts over the 24 hours, each shift is 8 hours. Some 15% of the employment is resident inside the station premises, while the remaining 85% commute daily to/from the station using the company own-account buses or by other public transport modes or live near by the station. As such, the parking demand will be limited to visitors and high executive directors.

Now the consultant is performing a whole design for the station and decided the number of parking areas. From the drawing it was suggested 30 places in front the administration building, as well as 32 places for the building to be used by the contractor during construction and a parking area of 24 places near the workshop and store.

According to the low possession of private cars to workers in the station compared to International Measurements, car ownership can be calculated from similar places by 1 car for every 10 workers. As the total number are 350 workers so we need a parking area for 35 car, and 10% increase for visitors so the total becomes 39 places.

On conclusion comparing calculated parking area by design proposed, we find that the total number of places suggested near the administration building and contractor building is 62 places while the required calculated parking spots are 39 places. Looking for the fleet of the station contains 2 different vehicles (pick up, Microbus and Bus) and increasing rate 5-10% at the opening year the total places needed is 24 vehicles which is proposed in the design drawings.

6.8.7 Conclusion

The assessment of traffic and transport covers the changes in traffic conditions in terms of delay and congestion during construction and operation.

(1) Traffic Engineering Handbook, 5th edition, 1999, Washington, D.C.: Institute of Transportation Engineering.

The greatest potential for traffic impacts to occur arises during the short period of peak construction. There is some potential for increased congestion on the main roads to the power plant, however the impacts will only occur during the peak construction phase and during peak hours. The overall impact is therefore not predicted to be significant. Mitigation measures will be put in place to reduce the potential for impacts to arise.

During operation, a small number of workers and HGVs are associated with operating the power plant and no impacts are predicted to occur.

Overall, the traffic impacts associated with the construction and operation of the power plant are considered to be minor and not significant.

6.9 SOCIO-ECONOMIC EFFECTS

6.9.1 Introduction

The administrative structure within which the power plant is situated is explained in Section 5.12 of this report.

This section addresses the socio-economic impacts associated with the construction and operation of the Tebbin Power Plant. The nearest permanent settlements to the proposed plant are Tebbin District, Maraziq community and the Helwan area, all around the site. The Tebbin and Maraziq settlements are likely to experience the greatest positive and negative socio-economic impacts from the construction and operation of the plant due to its proximity to the plant.

The assessment of impacts draws upon baseline data collected and provided by SPEEDOTRANS, the Egyptian Electricity Holding Company (EEHC) and Cairo Electricity Production Company (CEPC) during preparation of their documentation for local environmental permitting requirements and preparation for this EIA report. No information on existing income levels was available from the Governorate, Tebbin and Helwan District Authorities.

6.9.2 Resettlement

As there are permanent staff settlements within the Grater Cairo Region, no resettlement or displacement of people is envisaged.

6.9.3 Re-employing Present Staff

Total staff number of the old Tebbin power plant reaches 376 employees, out of them 350 are males and the rest 26 are females. Statistics prove that 56 of this labor force are comprised of highly educated personnel, 136 are mid-level skilled workers, 156 are lower level working in varios disciplines and 11 are in long-leave.

Women employment data indicates that 10 of them are graduated from university and the rest 16 have obtained mid-level certificate in various disciplines.

The labor force of the present Tebbin facility has been categorized by age-group as follows:

- 61-65 years : 7 employees
- 56-60 years : 32 employees
- 50-55 years : 76 employees
- 40-50 years : 132 employees

- < 40 years : 103 employees

This labor force has already been granted the right to choose where it will go to work within the overall Cairo Electricity Production Facilities. In fact, out of the 376 workers at the Tebbin old plant, 235 will be retained. In other words 141 workers will start working in the overall CEPC facilities.

Besides many of these are expected to apply for unpaid leave to be able to work on the construction of the new plant where preference is given to local labor. The re-employed workers will not lose any of their previous rights (employment benefits, insurance, health care etc.).

Although a considerable number of workers will be re-employed elsewhere in the greater Cairo metropolitan area, their families/homes will remain in El-Tebbin, i.e. no resettlement or loss of income will take place as a result of the re-employment.

Till now, 36 employees have been re-employed in other power plants within the CEPC system. Their distribution is as follows:

	Employment Category			
Location of Re-employment	Engineer	Technician	Unskilled Labor	Other
Cairo North Power Plant	1	2	-	-
Cairo West Power Plant	-	5	1	-
Cairo South Power Plant	-	5	2	-
Wadi-Hof Power Plant	-	15	3	2
Total	**1**	**27**	**6**	**2**

The CEPC management has set quite fair rules for re-employing all members of the old Tebbin staff with no loss of their employment rights, including salaries, overtime, insurance, health care, and social & cultural benefits.

6.9.4 Land Acquisition

The plant is sited on land given by Ministerial Decree no. 402 of the year 1958 issued on 29 September 1958(1) to EEA (now EEHC) who have assigned the land to the Cairo Electricity Production Company (CEPC) for development of the power plant. The land is formally the whole area allocated to former Tebbin Power Plant. Historically, all land in Egypt belongs to the state and is assigned to specific owners only via Governmental authorization.

(1) Al-Wakaee Al-Masriyyah: Issue No. 80, 30 October 1958.

6.9.5 Employment Generation

A key positive socio-economic impact of the development of the power plant will be the generation of employment during its construction and operation. CEPC proposes to operate a policy of preferential employment of locally resident workers depending on skills and availability in order to maximize local employment benefits. This local workforce will be drawn from the Tebbin and Helwan Zone, Greater Cairo area and other neighboring cities to the north and south of the power plant area.

It should be noted that construction works within the Cairo Governorate is traditionally undertaken by migrant labor from Upper Egypt. Migrants are attracted to the area by the availability of manual work which is traditionally not undertaken by indigenous residents. Migrants find accommodation within Cairo and its surrounding districts and remain in the area until employment prospects elsewhere draw them away. Given the plethora of construction activity ongoing in the Greater Cairo area, the number of workers available for construction of the power plant, is likely to be high.

Available employment data described in Section 5.12 of this report suggests that unemployment in the whole Governorate of Cairo lies around 9% and in the Cairo Governorate, around 550,000 people form the active workforce. Statistics suggest that approximately 80% of this labor force is comprised of industry and commerce workers and around 60% of the District’s workforce are categorized as skilled, having been trained in various disciplines.

The estimated employment generated during construction of the plant is anticipated to be as follows:

- 80 workers provided by the Architect Engineer;
- 1200 local employees for the civil work; and
- 900 local employees for mechanical and electrical work.

Local workers will represent approximately 95% of the civil and mechanical construction work.

In addition, the Architect Engineer will provide approximately 35 persons who will manage 35 other local personnel who will in turn manage local teams. Local employees to cover management activities will represent approximately 75% of the staff.

The entire labor force will be daily commuters, thus there will be no worker housing or associated facilities to be erected on site during construction or operation. Following general practice in the area, minibuses will be provided to bring construction workers to the site from Cairo area and surrounding cities.

The contractors will be responsible for relevant temporary water/toilet facilities during operation and the need to provide appropriate services will be specified in their contracts.

Following construction of the power plant, the majority of manual jobs will become redundant, however given the large number of other construction activities in the wider area, this is not anticipated to present any negative impacts to the local workforce.

During operation of the power plant, both skilled and unskilled staff will be recruited from the local workforce. Unskilled positions will include drivers, cooks, cleaners, clerks and secretaries and security guards. Many of these jobs could be filled by women. The project company will employ people with due regard to their equal opportunities policy.

The construction and operation of the power plant is therefore anticipated to provide significant employment opportunities within the Greater Cairo area and to the workforce of Cairo, Tebbin, Helwan, 15th May, Es-Saff and Giza cities. The employment generated by the power plant will be an important positive impact of the proposed project.

6.9.6 Direct and Indirect Income Effects

Direct Income Effects

The potential direct income effects during construction and operation of the power plant include:

- income from the permanent and temporary jobs that will be provided during the construction and operation of the plant. Market rates will be paid to all workers who will, in turn, spend the money in the local economy through goods and services bought in the area;

- income from locally placed orders for goods and services during construction and operation phases including contracts for the provision of construction materials and services, maintenance repairs and equipment servicing, and the establishment of supply contracts (e.g. security, waste disposal, food, cleaning, catering, transport, laundry etc.).

The average wage of an unskilled and skilled employee is 30 and 100 Egyptian pounds per day ($7 - $23). Typically about 30% of the capital cost of the plant

is likely to be expended in the region, covering payroll, civil construction materials, erection works, local plant and equipment hire/ purchase, general construction materials etc.

The typical annual operational expenditure of the power plant will be in the region of US$ 4 million, although in years where substantial maintenance is carried out, expenditure can be expected to rise to US$ 7 million.

Approximately, 70% of this operational expenditure will be spent locally on labor, consumables, equipment and general maintenance.

Indirect Income Effects

Indirectly, the power plant is likely to raise the profile of the region, and in securing the supply of power to the region will attract additional industrial investment resulting in jobs, improved infrastructure and service provision. Whilst this could be perceived as having potential negative long-term effects on local culture, the area has a long established industrial culture associated with major industrial activities of the Tebbin and Helwan Region. In addition,, long term development plans of the Government of Egypt have designated the area for some future expansions. The power plant is therefore central to attracting this investment and the positive income-generating potential of these developments is likely to outweigh any negative impacts.

6.9.7 Public Services

A potential adverse effect of the power plant is increased demand for public services, such as water and wastewater provision, housing, education, health services, etc. An assessment of these impacts however does not suggest that any negative effects will be experienced.

Drinking water during construction will be supplied to the plant with local water supply system of El-Tebbin. During plant construction, sanitary water will be provided also via local water system. During operation, all water for sanitary purposes will be supplied by the City water system. Sewage generated at the power plant will be disposed of via Tebbin's sewer system.

As discussed in Section 5.12.3, migrant labor is traditionally attracted to the region and public services are considered by public officials to be more than adequate to absorb them. No provision of additional services is therefore considered necessary during construction or operation of the power plant.

6.9.8 Off-site Activities During Construction

All construction related activities will take place within the area belonging to the Cairo Electricity Holding Company. The total area is 276,000 square meters, out of which 100,000 square meters have designated for the new plant.

In addition to the area specifically designated for the plant, there are large empty spaces next to the power plant site. All activities related to the construction of the new plant will therefore take place within the area belonging to the Cairo Electricity Holding Company, i.e. there will be no off-site activities or associated land acquisition during construction.

Transmission lines which will evacuate power generated by the Tebbin power plant will replace existing 66kV transmission lines. Some short distance (≤ 5.5 km) 220 kV cables will connect the power plant to existing substation following existing route of 66 kV underground cables. No land take or resettlement will be associated to the power interconnecting lines.

6.9.9 Impacts on Local Fishermen

The number of fishermen on the Nile utilizing the area in question is estimated to about ten or engaged in fishing part time. Testing has shown that the impacts of the warm water from the plant are highly localized. At the point of discharge the water temperature is 8 degrees above ambient. 20-50 meters from the discharge point the temperature is 5 degrees above ambient and at 100 meters 3 degrees higher. 300 meters downstream there is no longer any difference in temperature. The fishermen generally utilize a 5km stretch, roughly 2.5km in each direction from the point of discharge.

The effects on the fisheries of warmer water returned to the Nile from similar power plants along the river are well known. Experience from about a dozen other power plants that have operated for a number of years indicates that the overall impacts on fisheries of slightly warmer water actually are positive, and consultations with the fishermen indicate that the catches in these areas have increased rather than decreased. Since this is part-time, small-scale fisheries no statistics are available, but after many years the warmer water around the various points of discharge, is clearly perceived by the fishermen to have positive effects.

In line with this recognition, discussions have already been initiated between the EEHC and the General Authority for Fishery Development with a view to jointly take advantage of this, e.g. establishing a fry collection station near the edge of the mixing zone.

6.9.10 Cultural Effects

As the larger project area (i.e. the Cairo Governorate) is already dominated by large scale heavy industrial activity, no cultural impacts are anticipated as a result of the power plant development. In addition, migrant manual labor is traditionally welcomed in the region resulting in no social or community problems.

6.9.11 Conclusion

It is clear that the demolition of the old Tebbin power facility will not result in any problem to the present workforce of the plant. It is, also, anticipated that the new power plant will provide a net positive socio-economic impact through the provision of employment opportunities and attraction of economic investment into the area.

In addition, the use of local labor wherever practicable, will maximize these positive impacts through the development of the local skill base and will also generate increased demand for local services, materials and products.

6.10 ARCHAEOLOGICAL, HISTORIC AND CULTURAL HERITAGE

6.10.1 Introduction

This section assesses impacts on archaeological, historic and cultural resources as a result of the construction and operation of the Tebbin power plant.

6.10.2 Known Archaeological, Historic and Cultural Remains

The baseline study completed before found no available information to identify any archaeological, historic or cultural remains on the site or in the surrounding area. No buildings or remains of archaeological, historic or cultural significance, are known to exist along the access road to the site or in the surrounding area. This is supported by consultation undertaken by SPEEDOTRANS with local officials and experts, during which it was stated that there are no identified archaeological remains at the proposed power plant site.

6.10.3 Conclusion

It is concluded that the construction and operation of the power plant will have no impact on any known archaeological, historic or cultural resources. Consultation undertaken with local officials and experts in Cairo verified that the site is not of archaeological interest.

In the event however, that remains being found construction will cease and the advice of the Supreme Council of Antiquities will be sought. Appropriate measures will be put in place to protect and/or excavate the remains, including the following procedures:

- where possible, remains will be protected in-situ;
- where identified remains cannot be protected, an excavation of the indicated area will be undertaken prior to the commencement of construction activities to record and remove vulnerable remains and features;
- any finds of archaeological, historic or cultural significance will be given to the Supreme Council of Antiquities; and
- preparation of a Chance Finds Procedure (see the BOX below) which lays out the steps to be taken if archaeological, historic or cultural remains or finds are discovered during construction activities. The procedures will clearly set out how the construction team will be briefed so that they are aware of what to look out for and the actions which must be taken should a potential find be uncovered.

The incorporation of these precautionary measures into the construction program will ensure that all potential remains of significance are recorded and are accorded the required protection where considered necessary.

BOX

CHANCE FINDS PROCEDURE[1]

Chance find procedures will be used as follows:

(a) Stop the construction activities in the area of the chance find;
(b) Delineate the discovered site or area;
(c) Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be present until the responsible local authorities and the equivalent take over;
(d) Notify the supervisory Engineer who in turn will notify the responsible local authorities and the General Authority of Antiquities immediately (within 24 hours or less);
(e) Responsible local authorities and the General Authority of Antiquities would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by the archeologists of the General Authority of Antiquities (within 72 hours). The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values;
(f) Decisions on how to handle the finding shall be taken by the responsible authorities and the General Authority of Antiquities. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance) conservation, preservation, restoration and salvage;
(g) Implementation for the authority decision concerning the management of the finding shall be communicated in writing by the General Authority of Antiquities; and
(h) Construction work could resume only after permission is given from the responsible local authorities and the General Authority of Antiquities concerning safeguard of the heritage.

These procedures must be referred to as standard provisions in construction contracts, when applicable, During project supervision, the Site Engineer shall monitor the above regulations relating to the treatment of any chance find encountered are observed.

Notes:
(1) Source: the World Bank.

6.11 NATURAL DISASTER RISK

6.11.1 Seismic Risk

The power plant will be designed to conform to the Uniform Building Code Zone 2 seismic criteria, according to US regulations for earthquake. These design criteria are therefore considered sufficient to withstand the level of seismic activity experienced in the Area.

The potential environmental impacts of a seismic event during power plant operation are not anticipated to be significant.

6.11.2 Flood Risk

The risk of flash flooding in the project area, as indicated in Section 5.2 of this report, is considered to be very low, hence the proposed power plant is largely located in an area classified as not representing Significant flood risk.

In order to further reduce any potential impacts of flooding during construction and operation, the following measures will be implemented:

- during the early stages of construction, a site drainage system will be built, equipped to protect the site against potential flooding;
- site drainage will be constructed in such a way so as to dissipate flood waters away from the main plant areas and to discharge clean waters to the sewer system and any potentially contaminated waters to the discharge structure via the oil interceptor;
- the access road will be culverted to allow adequate transit of flood waters.

With these provisions for controlling the impacts of the plant as a result of heavy rainfall, no significant flood risk impacts are predicted to occur.

6.12 MAJOR ACCIDENT HAZRDS

6.12.1 Introduction

A major accident is defined as a physical situation with a potential for harm to individuals, infrastructure and buildings, or for impairment and environmental damage. Major accident hazards of concern with respect to the construction and operation of the power plant are those with the potential for injury, impairment and/or damage external to the power plant perimeter.

6.12.2 Assessment of Major Accident Hazards

An assessment of major accident hazards associated with the demolition, construction and operation of the power plant should consider the following issues:

- the potential risk to third party hazardous industry, facilities or populations of the operation of the power plant; and
- the potential risk to the power plant posed by third party hazardous industry or facilities.

Given the measures incorporated into the design of the plant to minimize the risk from fire and explosion, the plant is not anticipated to pose a potential risk of any significance to any third party facilities. Furthermore, none of the third party industrial facilities and activities within 2 km of the site represent a significant risk of a major accident hazard to the power plant e.g. from fire, explosion, release of toxic gases etc.

In addition, since natural gas will be delivered to the plant by pipeline, there will be no natural gas storage facilities on site. Furthermore, no hazardous chemicals will be held on site in quantities sufficient to pose a major hazard.

Potential accidents may however occur as a result of ruptures to the gas pipeline during future development of the area. Whilst the pipeline connection is the responsibility of GASCO, the following mitigation measures are recommended to avoid damage to the pipelines:

- the minimum reinstated cover should be 1.2m above the pipeline;
- above ground markers should be installed so as to clearly indicate the routes for all pipelines; and
- valves should be located within the pipeline at regular intervals so that flow can be halted in the event of a rupture.

6.12.3 Risk of Major Accidents on the Power Plant Site

Fire risks were identified during design of the power plant and in particular with regard to the following areas of the plant:

- the gas turbines;
- the boilers;
- fuel oil storage tanks [1];
- transformers;
- turbine oil tank; and
- electrical rooms.

The power plant has been designed to be in conformance with the international code of the National Fire Protection Authority (NFPA), which requires particular specifications for fire protection[2] and compliance with local fire protection systems. A Fire Safety Plan will be developed and will be implemented prior to power plant commissioning. A permit from the Egyptian Civil Defense Authority is required prior to plant operation.

An Industrial Hazard Assessment has not been undertaken and is not considered necessary since:

- measures will be incorporated into the design of the plant to minimize the risk from fire and explosion; and

- the third party industrial facility within 2 km of the site does not represent a significant risk of a major accident hazard to the power plant e.g. from fire, explosion, release of toxic gases etc.

(1) Flash Point is 55°C: Normal storage temperature for the fuel will be 35°C.
(2) NFPA 850: Recommended Practice for Fire Protection for Electric Plants and High Voltage Direct Current Converter Stations, 1996.

6.13 SOLID AND HAZARDOUS WASTE MANAGEMENT

6.13.1 General

Recycling, storage, transportation and disposal measures are recommended to avoid or minimize potential adverse impacts. The CEPC will incorporate these recommendations into a Waste Management Plan that incorporates site specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials.

Waste management options can be categorized in term of preference from an environmental viewpoint. The options considered to be more preferable have the least impacts and are more sustainable in a long term context. Hence, the hierarchy is as follows:

- Avoidance and minimization by not generating waste;
- Reusing materials and therefore avoiding disposal;
- Recovery and recycling, avoiding disposal; and
- Treatment and disposal, according to relevant laws, guidelines and good practice.

If Asbestos is found among the demolished materials, asbestos waste that is produced shall be handled in accordance with the Code of Practice on the Packaging, Handling Transportation and Disposal of Asbestos Waste.

For unavoidable wastes, reuse, recycling and optimal disposal are most practical when segregation occurs on the demolition site, as follows:

- Public fill (inert) for disposal at public filling areas;
- Demolition & Construction waste (non-inert) for landfill;
- Chemical waste for treatment at licensed facilities; and
- General refuse for disposal at landfill.

Specifically, it is recommended that:

- Wastes should be handled and stored in a manner which ensures that they are held securely without loss or leakage thereby minimizing the potential for pollution;
- Only reputable waste collectors authorized to collect the specific category of waste concerned will be employed;
- Appropriate measures will be employed to minimize windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers;
- The necessary waste disposal permits will be obtained from the appropriate authorities, if they are required, in accordance with the Waste Disposal Regulation and the Government Land Ordinance;
- Collection of general refuse will be carried out frequently, preferably

daily;
- Waste will only be disposed of at licensed sites and site staff and the civil engineering Contractor will develop procedures to ensure that illegal disposal of wastes does not occur;
- Waste storage areas will be well maintained and cleaned regularly; and
- Records will be maintained of the quantities of wastes generated, recycled and disposed, determined by weighing each load.

Training and instruction of demolition staff will be given at the site site to increase awareness and draw attention to waste management issues and the need to minimize waste generation. Thee training requirements will be included in a site waste management plan.

6.13.2 Demolition Phase

Demolition of a thermal power plant may produce hazardous waste. The management of demolished hazardous materials and wastes will include the following measures:

- Classification, characterization and coding.
- On-site storage and handling.
- Transportation.

Management considerations involved in all these three main stages may be summarized as follows:

- ***Classification, Characterization and Coding***

The Basel Convention (Basel, 1989) established the following Hazardous Materials and Wastes characteristics:

- Explosive
- Flammable liquids
- Flammable solids
- Waste liable to spontaneous combustion
- Waste emits flammable gases by reaction with water
- Oxidizing
- Organic peroxide
- Poisonous (acute)
- Infectious
- Corrosive
- Liberates toxic gas in contact with water
- Toxic (delayed or chronic)
- Eco-toxic

According to the Egyptian classification system certain classes of chemical materials and wastes are specifically listed as being hazardous. Codes for these types of hazardous materials and waste have been defined. Wastes are known as "Listed Hazardous Wastes". Common listed wastes include:

S-Listed Wastes (Special)

- Medical waste
- Radioactive waste
- Paint waste
- Asbestos waste
- Gas cylinder or Aerosol cans waste
- Empty container waste
- Photographic chemical waste
- Oil waste
- Battery waste

F-Listed Wastes

Wastes generated during a non-specific industrial process. Solvents such as paint thinners with Xylene, Toluene or Acetone and carburetor cleaner, sludges from electroplating. Wastewater treatment sludges, leachate, spent ion exchangers and activated glass are included in this list.

K-Listed Wastes

Wastes generated from specific industrial processes such as:

- Organic chemicals processing
- Explosive processing
- Petroleum refining processing
- Petrochemical process and pyrolytic processing
- Metal surface treatment (etching, staining, polishing, galvanizing, cleaning, degreasing)
- Chlorine processing
- Natural gas processing
- Production or use of solvents
- Coating paints, lacquers, varnishes and plastics
- Glues, cements, adhesive latex and resins
- Cleaning, emptying and maintenance of tanks
- Cleaning of barrels containing chemical substances
- Water and air purification processing
- Incineration, distillation and concentration processing
- Maintenance and repair work on vehicles

P-Listed Wastes

Wastes that contain acutely hazardous (extremely toxic) off-specification materials as well as container residues and spill residues of these materials.

U-Listed Wastes

Wastes that contain unused toxic hazardous off-specification materials as well as container residues and spill residues of these materials.

- ***On-Site Storage and Handling***

Improper storage of hazardous wastes can cause serious accidents, health and safety problems, and damage to the environment.

Law 4 of 1994 is the overall legal instrument that regulates environmental pollution control in Egypt. Articles 1, 5, 29, 30 to 85, 88, 95, 99, and 101 to 104 of this Law and the Executive Regulations for Law 4, Articles 25 through 33 represent the relevant legislation for management of hazardous materials and wastes. Also, Law 12/2003 and its Executive Regulations no. 211/2003 for health and safety will apply.

For obtaining license for handling hazardous wastes, the applicant submits his application in writing containing the data identified in Article 26, of the executive regulations (included in MSDA). The license shall be valid for a maximum of 5 years and subject to renewal (Article 27).

According to Article 28 paragraph 1B of the Executive Regulations of Law 4/1994, every establishment must characterize the waste generated in terms of both quantity and quality. A new hazardous waste classification system has been put in place as indicated above.

Hazardous waste storage facilities can be either on-site, at the property where the waste is generated, or off-site, at a common hazardous waste storage (plant warehouse, laboratory, ..etc.) and disposal facility. EEAA recommends the use of three types of on-site storage facilities:

- Storage in drums, containing small quantities of liquid or solid waste (easy to handle and allows for easy segregation of incompatible wastes such as corrosive and reactive wastes).

- Storage in tanks for bulk quantities of liquids. Tanks can be constructed above ground or buried underground. EEAA does not recommend underground tanks because of their complexity and the high risk of environmental damage. Liquids should be periodically pumped to on-site treatment systems or transferred to tankers for off-site treatment and disposal.

- Storage in large containers (generally of steel from 1 to 20 tons in capacity) for bulk quantities of solids. The containers are designed to be hauled by trucks to an off-site disposal facility and returned for refilling.

Requirements for storage facility include the following:

Location

- Must be a secure site with limited admission.
- Must be located away from storage areas, particularly those for hazardous chemicals, and from drinking water sources and any residential areas.
- Must have access for loading, unloading, and responding to emergency situations.
- Must have electrical power, including emergency power supply.
- Must have a water supply for cleaning and firefighting.

Capacity

Several factors should be considered such as present and projected waste quantities, types of wastes and their incompatibility, storage time, and cost of bulk versus drum storage including transportation and disposal.

Layout

Outdoor storage is recommended for ease of accessibility, handling, safety, and cost considerations. Indoor storage is vital to protect stored waste from extreme heat or for other considerations.

Storage space should be laid out to contain all types of hazardous waste produced by the industry.

It should provide for:

- Access from at least two sides for responding to fire and other emergency situations.
- Adequate separation of incompatible wastes, safe movement of waste containers using mechanical equipment, and adequate access for inspection.
- Ignitable or reactive waste (solid or liquid) should be stored at least 15 meters from the facility's property line.

Security

The storage area should:

- Have a person responsible for the security of the storage area.
- Be controlled: only trained personnel can enter the hazardous waste storage area.
- Have a restricted area sign: a hazardous waste storage area.
- Be well lighted for security at night.
- Be designed to an accommodate temporary containment of spills and equipment to respond to spill incidences.

Design

- Drum Storage.
- Tank Storage.
- Bulk Container Storage.
- Empty Chemicals/Containers.

Operation and Management of storage facility include the following:

- Organization and Responsibilities.
- Training.
- Record-Keeping and the Hazardous Waste Register.

- ***Transportation***

Operational procedures include the following:

- Permitting for hazardous waste transportation
- Permitting requirements

Article 26 of the Executive Regulations of Law 4-1994 identifies the requirements and conditions for permitting Hazardous Wastes (HW) handling as follows:

Transporter License

To be granted the license, the transporter must complete an application from issued by the concerned authority and pay the required permitting fees. The main components of the application include the following:

- Intended means of hazardous waste transport.
- Hazardous waste description.

- Training plans/records.
- Time schedule.

A copy of the application form for the HW transporter license is included in the publication entitled, "Hazardous Waste License Requirements in the Egyptian Law 4 of 1994".

Means of Transport

Hazardous waste transportation can be carried out by road, railways or vessels. The transporter license application requires that the intended mode(s) of transportation be specified. In this respect, the means of transport used (vehicles, rail wagons or vessels) need to conform to set technical and safety specifications and equipment.
Figure 6-32 depicts HW transportation system.

Hazardous Waste Manifest

The tool used to track hazardous waste is the Manifest System. This system is composed of a set of forms and procedures designed to track the waste from the time it leaves the generator facility, to the point at which it reaches the off-site facility that will store, treat, or dispose of this waste.

The key component of this tracking system is the Hazardous Waste Manifest, which is a legal form with multiple copies. For transportation, this form is filled out with the information on the type and quantity of the waste being transported, instructions for handling, and signatures of all parties involved in the transportation process (generators delivering the waste to the transporters, the transport operators, as well as the facility receiving the waste for storage, treatment and/or disposal).

Labeling

According to Law 4/1994 and its Executive Regulations, HW means of transport must have clear signs indicating the hazardous characteristic(s) of the transported waste. Such signs, when used on means of transportation are refereed to as "placards".

Asbestos Control (if Asbestos is Found)

First investigation has demonstrated that there is no Asbestos Containing Materials (ACM) in Tebbin old power plant.

However, there is a potential for finding ACM during dismantling and demolition processes. If found, remaining ACM will require removal before the buildings and stacks are demolished but these are not currently a hazard to the pubic or staff as they are not readily accessible.

The recommended approach is that any ACM present in the stacks and superstructures shall be removed before commencement of the demolition works. Whereas this is the preferred approach, experience suggests that in practice the removal of asbestos materials in certain locations may run more smoothly if both asbestos contractors and civil demolition contractors work in tandem. In general this is due to the convenience of the main civil demolition contractor providing access (scaffolding etc.) to the ACM, for the asbestos contractor and avoiding duplication of effort.

In this project, materials around the ACM, may in some cases, be dismantled by the civil demolition contractor, leaving the ACM in-situ (undisturbed). The work actually involving the removal of ACM, that involves the handling of the ACM shall be carried out by a Specialist Asbestos Contractor. The multi-party nature of the project and the involvement of non-asbestos contractor increase the risk of accidental disturbance of ACM. The CEPC should ensure that these is a reliable supervision and co-ordination mechanism to guard against any accidental disturbance of the asbestos containing material (ACM) by non-asbestos professionals.

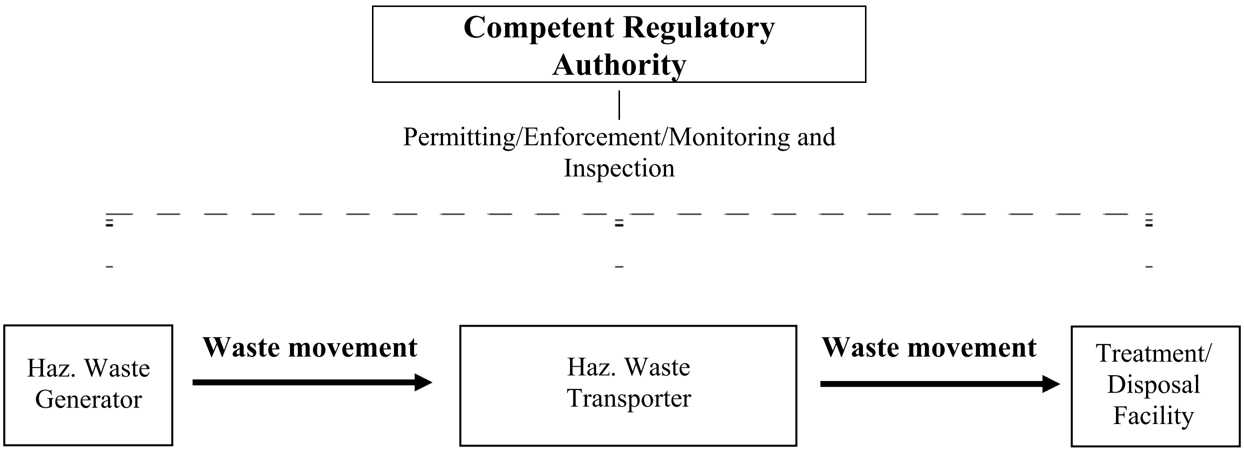
Debris Waste Removal

For regular debris waste, private sector contractor will be assigned via general bidding process and the contract will include detailed environmental procedures, according to Law 4/1994 and Governorate of Cairo regulations, for demolishing about 20,000m^3 of debris materials. The contract covers all fees required.

With these management procedures, no significant impacts from the management of hazardous wastes, particularly during demolition phase, will occur.

Figure 6-31

Hazardous Wastes Transporting System



Hazardous Waste Generator:

- Proper waste identification and classification
- Waste labeling and packaging where applicable
- Ensure that transporter and TD[(1)] facility used have the necessary HW licenses
- Use of manifest

Regulator:

- Grant permits
- Implement permit conditions
- Revoke permits in case of violation
- Enforce and monitor use of manifest
- Carry out inspection to verify that generator/transporter and TDF[(2)] carry out their responsibilities

Hazardous Waste Transporter:

- Obtain necessary permits
- Use vehicles with proper specifications and placards
- Implement necessary safety procedures and use safety equipment
- Follow the agreed-upon routing
- Carry out vehicle maintenance and cleaning
- Training of all staff
- Only accept waste properly identified and where applicable packaged and labeled
- Use of manifest

Treatment/disposal Facility:

- Only accept waste properly identified and where applicable packaged and labeled
- Use the manifest
- Ensure that transporter has a HW transportation license
- Carry out vehicle cleaning before it leaves the facility

(1) TD = Treatment and Disposal
(2) TDF = Treatment and Disposal Facility

6.13.3 Construction and Operational Phase

A natural gas power plant produces no ash and only a low quantity of other solid wastes during construction and operation. These include the following:

- *Construction waste*: contaminated spoil, oil drums etc.;
- *General plant wastes*: oily rags, broken and rusted metal and machine parts, defective or broken electrical parts, empty containers, miscellaneous refuse;
- *Raw water pre-treatment sludge*: from build-up of solid residues in the raw water pre-treatment system;
- *Tank sludge*: solid residues which build up in process chemical storage tanks;
- *Oil Interceptor sludge*: from drainage interceptors used to remove solids and oils and grease from effluent;
- *Packaging waste*: from operational consumable supplies; and
- *Commercial wastes*: from offices, canteen and staff facilities.

Wastes generated at and by the plant will be evacuated from the site by licensed contractors. Final disposal of wastes will be to waste treatment plants or local landfill sites, as agreed by the relevant Competent Administrative Authority.

To ensure that impacts from solid waste generation and disposal are successfully avoided, the following mitigation measures will be undertaken during plant construction and operation:

- all waste taken off site will be carried out by a licensed waste contractor and CEPC will audit the disposal procedure;
- all solid waste will be segregated into different waste types, collected and stored on site in designated storage facilities and areas prior to release to off-site disposal facilities;
- all relevant consignments of waste for disposal, will be recorded, indicating their type, destination and other relevant information, prior to being taken off site; and
- standards for storage area, management systems and disposal facilities will be agreed with the relevant parties.

The environmental engineer will be responsible for solid waste management at the site and will ensure that all wastes are managed to minimize any environmental risks.

With the adoption of these mitigation measures, the impacts of solid waste generated by the construction and operation of the power plant are not predicted to be significant.

6.14 PUBLIC HEALTH

6.14.1 Air Pollution

The key issue in relation to public health is the potential effects of air pollution from the plant's stack emissions. The assessment of air quality impacts presented in Section 6.2 demonstrates that ground level pollutant concentrations as a result of emissions from the power plant will not significantly affect air quality. Hence, the health risks from stack emissions are not considered to be significant.

6.14.2 Disease Vectors

The proposed power plant includes a range of mitigation which will prevent the encouragement of disease vectors, such as rodents or insects. These measures include the following:

- provision of sanitation during construction and operation;
- control and management of solid wastes;
- provision of potable and process waste supplies; and
- disposal of site drainage and effluent.

With these mitigation measures, the potential for encouragement of disease vectors is low.

6.15 OCCUPATIONAL HEALTH AND SAFETY ISSUES

6.15.1 Safety Issues

The proposed Tebbin power plant site is currently unused and occupied by the old decommissioned power plant for demolition and no environmental features or characteristics have been identified which could cause special occupational health and safety impacts. In particular, no asbestos was used for insulation or other purposes in the old plant, neither PCBs were used or stored. Also, ground cover to a depth of more than 2m will be cleared, therefore no soil contamination will be present and no special construction techniques are expected to be required to build the power plant.

In addition, there are no other activities bordering the site (industrial activities to the east and south are some distant from the fence) and therefore no safety issues associated with third-parties are anticipated.

The project company will establish and integrate policies and procedures on occupational health and safety into the operation of the power plant. Emergency and accident response procedures will also be included in the operation manual for the power plant. In particular, construction and operation activities will be carried out on the following basis:

- compliance with international standards for good construction and operational practices;

- adherence to local and international guidance and codes of practice on EHS management during construction and operation;

- management, supervision, monitoring and record-keeping as set out in the plant's operational manual;

- implementation of EHS procedures as a condition of contract with contractors and their sub-contractors;

- clear definition of the EHS roles and responsibilities of the companies involved in construction and to individual staff (including the nomination of EHS supervisors during construction and an EHS coordinator during operation);

- pre-demolition, pre-construction and operation assessment of the EHS risks and hazards associated with demolition, construction and operation, including consideration of local cultural attitudes, education level of workforce and local work practices;

- provision of appropriate training on EHS issues for all construction and operation workers, including initial induction and regular refresher training, taking into account local cultural issues;

- provision of health and safety information;
- regular inspection, review and recording of EHS performance; and
- maintenance of a high standard of housekeeping at all times.

Given the provision of this high standard of health and safety management on site, construction and operation of the power plant in accordance with good industry practice and the lack of any adverse features/characteristics of the site, the occupational health and safety risks associated with demolition, construction and operation of the power plant will be minimized.

6.16 ASSOCIATED INFRASTRUCTURE

Connections to existing gas, oil, and electrical infrastructure will be the responsibility of GASCO, EGPC, and CEPC respectively. Key potential impacts that will be considered include:

- land use; and
- existence of residential communities.

6.16.1 Gas Pipeline

An existing gas pipeline runs to the northeastern corner of the site area. EEHC has already submitted a request to GASCO for their needs for the new plant which will necessitate a bigger diameter pipeline, and which will follow the same existing pipeline. Any required modification, including any environmental impact will be identified and mitigated/managed by GASCO. *Figure 6-33* illustrates where this gas pipeline comes from.

6.16.2 Mazout Pipeline

An existing mazout oil pipeline runs to the southern part of the power plant site as shown in *Figure 6-33*. No modification will be required by the Petroleum Pipelines Company, who owns the supply facilities, as the required quantity of mazout is needed only in emergency situation when gas supplies are unavailable for any reason, and for a maximum of 170 hours all over the year.

6.16.2 Transmission Lines

The Tebbin power plant will be connected to the Egyptian Electricity Transmission Company's (EETC) (an affiliate company to the EEHC) 220 kV network via connecting transmission line. Connection methodology includes modification of the 220 kV double circuit overhead transmission line, today under construction, between Haram/Cairo South and Giza/Cairo South to become Haram/Tebbin and Giza/Tebbin using existing routing of 66kV network. EETC 220 kV substation is located to the southeast of the power plant site. Connecting 220 kV cables to this substation is already identified by approximately 5.5 km, which will replace an existing 66 kV cables following the same route. No land will be expropriated. However, the World Bank will be notified if any subsequent changes occur as it is recognized that this may have policy procedural implications. Good compensation, if any, will be paid for the right of way according to the *Law 63 of the Year 1974*. *Figure 6-34* depicts the proposed single line diagram set out by the EEHC. EETC and CEPC will submit Screening Form B to the EEAA concerning this interconnection. No significant impacts are anticipated.

Figure 6-32

Existing Fuel Supply Pipelines

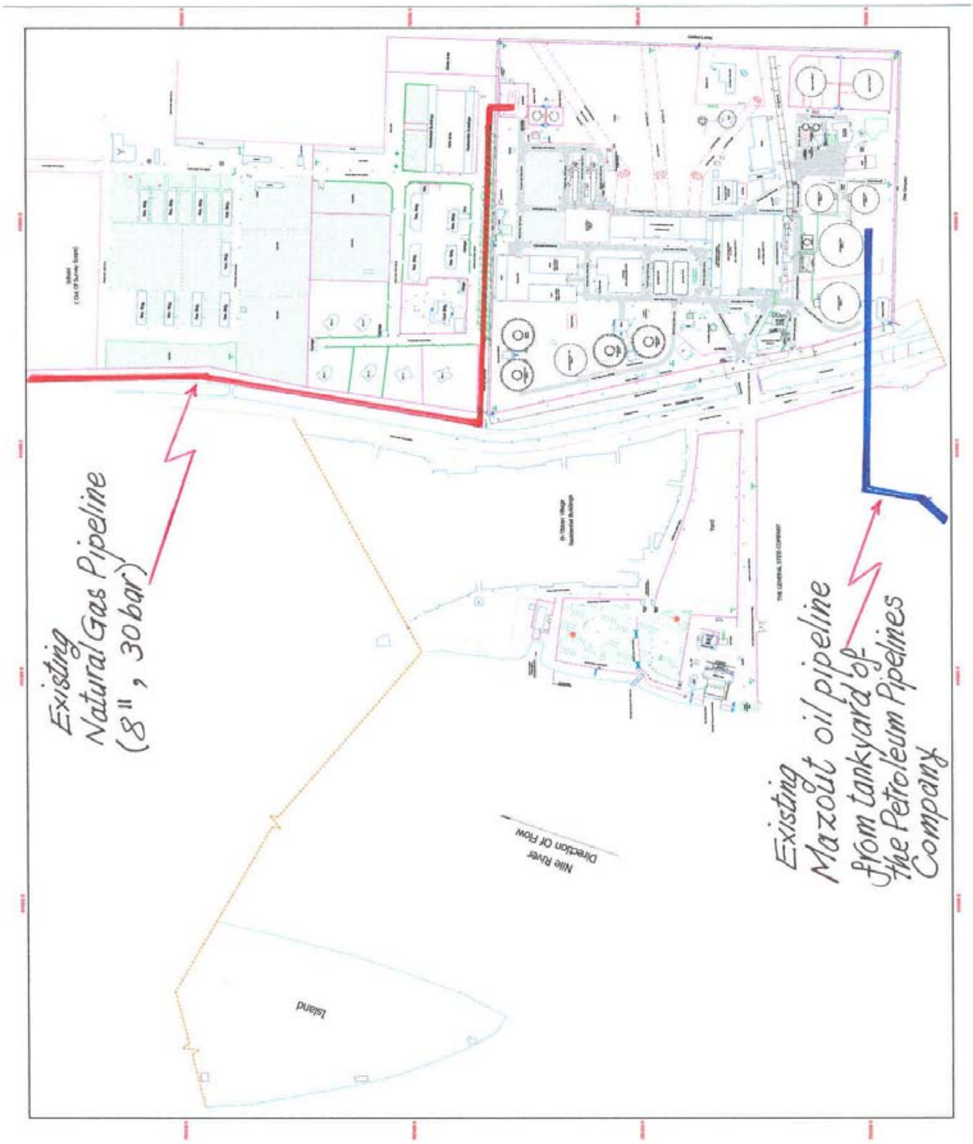
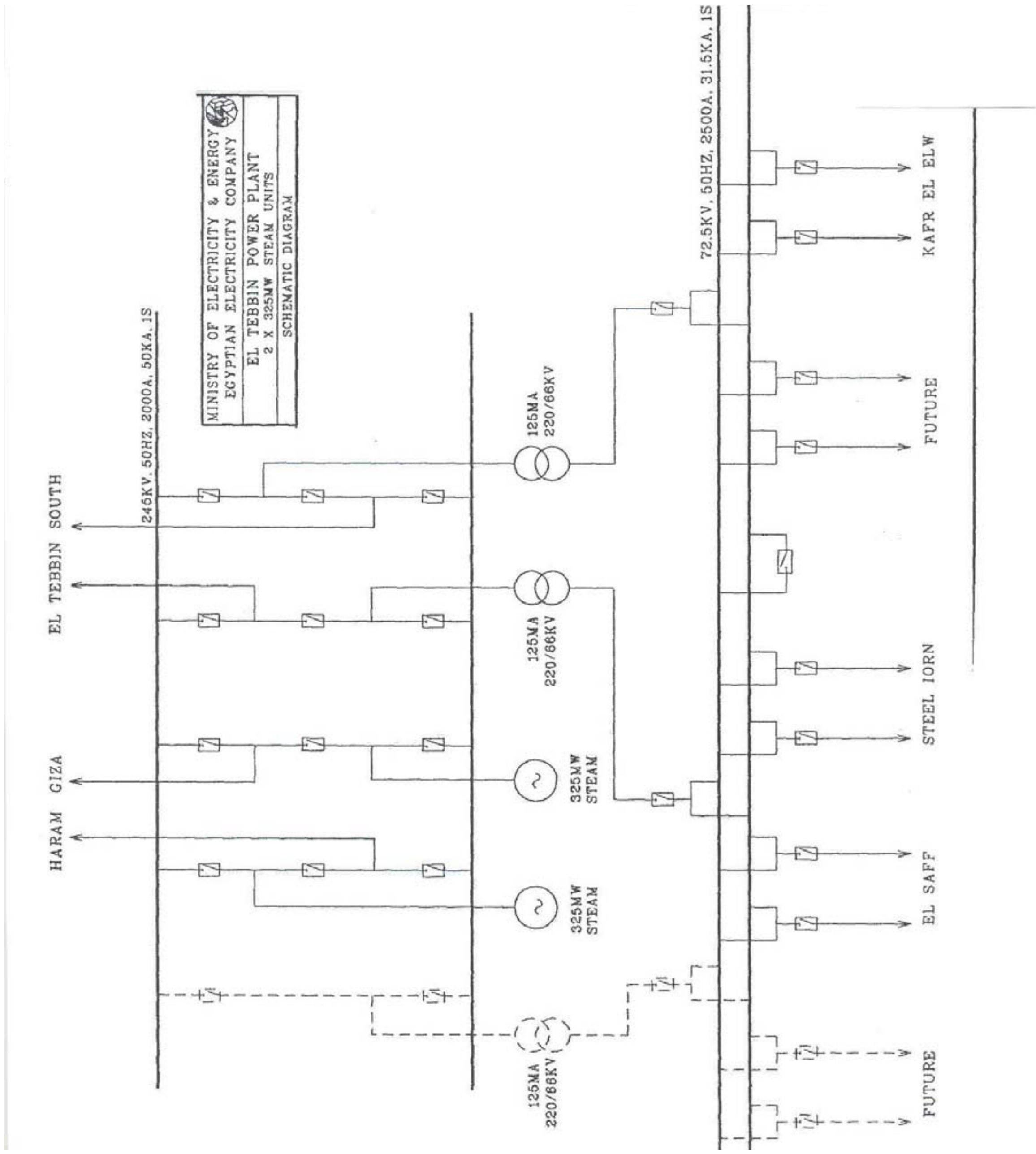


Figure 6-33

Schematic Diagram for the Electrical Interconnection of the Tebbin Power Project



7. MITIGATION OF ENVIRONMENTAL IMPACTS

7.1 INTRODUCTION

Cairo Electricity Production Company (CEPC) is committed to constructing and operating the Tebbin power plant to high environment, health and safety (EHS) standards.

This section provides a summary of mitigation measures, as well as environmental enhancement opportunities, for the key EHS impacts which have been identified through the EIA process. The mitigation measures represent a synthesis of those measures which are part of the basic power plant design and those that have been recommended in Section 6 of this report for demolition, construction and operational phases of the power plant.

The mitigation measures discussed in this section are summarized in *Tables 8-2, 8-3 and 8-4* in *Section 8*, together with respective environmental monitoring and management arrangements. It should be noted that many of the mitigation measures presented below for the demolition and construction phases, will be carried forward into plant Operation.

All the mitigation, monitoring and management measures proposed below and in Section 8 of this report (the Environmental and Social Management Plan (ESMP)), will be adopted by the Project Company and imposed as conditions of contract on the contractor and any sub-contractors employed to build or operate any part of the power plant. Since many of the mitigation measures presented are considered an essential, integrated component of the construction and operation works, it is not possible to separate the specific costs of their implementation from the overall construction costs.

7.2 MITIGATION MEASURES DURING DISMANTLING AND DEMOLITION

7.2.1 General Demolition Principles

To minimize impacts resulting from dismantling and demolition processes, certain general principles will be followed:

- Demolition of buildings and structures would generally be in the reverse order to that of construction, progressive, level by level, having regard to type of construction. Wherever possible, external non-load bearing cladding shall be removed first.

- All asbestos containing materials (ACM), if found, shall be removed prior to commencement of demolition works, wherever possible. Other ACM may need to be removed as access is gained to particular areas and as the demolition progresses.

- Debris to be removed at frequent intervals and stockpiles shall not be allowed to build up. Waste shall be removed on a daily basis as far as reasonably practicable.

- The Contractor will need to carry out works in accordance with statutory requirements and guidelines covering health and safety issues. Relevant legislation has been reviewed as part of the Site Investigation, the Contamination Assessment and the Hazardous Waste Handling & Disposal Requirements.

- The use of all mobile cranes will be strictly controlled to ensure that cranes of adequate capacity will be used for lifting under different loading conditions. The Contractor shall also arrange for retaining a competent person dedicated as EHS specialist all times at the site. This EHS specialist will inspect the scaffolding work and make any adjustments as the work proceeds, ensure its stability and safety in line with statutory requirements, particularly the Construction Site (Safety) Regulations and the Code of Practice for Scaffold Safety.

- The area beneath the stack would be cordoned off and only authorized staff involved in the demolition of the stacks would be allowed admission. Two crane shafts would be erected inside the stack up to 120-150m high. A derrick would be mounted on the top of each crane shaft for hoisting & lowering of tools and debris. A working platform would be constructed at a level 2m below the top of the stack within the concrete supporting weather shield.

- The principle of the demolition procedure for the upper portion of the stacks (10m from ground level or greater) is that the stacks will be cut into small pieces by hand held tools on the spot by operatives who would work from working platforms inside the stack. Hydraulic breakers would be used for the remaining lower portions of the stacks. The concrete supporting weather shield and the metal flues will be removed manually. The principle of the demolition procedure shall be that the stack and flues would be cut up into pieces and these pieces lowered to the ground by derrick. This method would ensure that full control of the debris and that the pieces of reinforced concrete are not left to free fall.

- An asbestos consultant will be required to be employed by the CEPC to supervise the contractor to ensure that ACM is removed in line with the requirements of the Asbestos Abatement Plan and not accidentally removed in the demolition process.

7.2.2 Air Quality during Demolition

Appropriate dust control measures will be implemented during demolition stage in accordance with the requirements in the stipulated Regulation. Dust control techniques will be considered to control dust to a level not exceeding the Air Quality Objectives (AQOs) as well as the 1-hour TSP guideline level under the Law 4/1994.

Statutory control of dust emissions from demolition works requires appropriate dust control measures to be implemented during the construction stage in accordance with the requirements in the Regulation. Using the measures and requirements in the Air Pollution Control (Construction Dust) Regulation, the dust nuisance to the surrounding air sensitive receivers can be minimised. With such mitigation, the predicted dust levels at the Air Sensitive Receivers (ASRs) will be within the established criteria, therefore excessive dust during demolition works is not expected. In addition, as a proactive measure, the Environmental Monitoring and Audit (EM&A) for dust generated during the demolition is also recommended at the site boundary at the north and west to ensure that the dust criteria will not be exceeded.

With the adoption of appropriate dust suppression measures, demolition dust is unlikely to cause significant adverse impacts on surrounding sensitive receivers. Effective and adequate dust suppression measures could be ensured during the whole demolition period by the observation of the stipulated Regulations.

7.2.3 Noise Impacts during Demolition

The likely noise impacts on the Noise Sensitive Receivers (NSRs) were modelled and the modelling results showed that whereas the extent of construction activities will be significant no noise exceedance would be expected at all NSRs. During the peak of activity months 7 to 8 the predicted noise levels will not exceed the Noise Standards for Daytime Construction Activities of 70 dB(A) for domestic premises. No night time work is anticipated.

With good site management, the predicted noise levels at the Tebbin old power plant will be within the established criteria. Therefore, noise exceedances during the demolition works is not expected and although no EM&A is recommended at this stage, it is recommended that good site practices should be adopted so as to avoid unnecessary noise generated by any construction/demolition works (such as machine idling) as far as practicable. Noise impacts will not require mitigation.

7.2.4 Water Quality during Demolition

As the majority of the site has a hard concrete covering, the area of potentially exposed soil will be minimal. Such areas and the accumulation of dust and fine waste material shall be kept to a minimum to reduce the potential for siltation, contamination of run-off, and erosion. Run-off related impacts associated with demolition work and other general activities can be all readily controlled through the use of appropriate mitigation measures which include:

- The use of sediment traps, where appropriate; and
- The adequate maintenance of drainage systems to prevent any overflow.

Critical areas within the site shall be clearly marked and provided with protective measures to control site run-off. Temporary channels shall be provided to facilitate run-off discharge into the appropriate watercourses, via a silt retention pond. Permanent drainage channels shall incorporate sediment basins or traps and baffles to enhance deposition rates.

Wheel washing facilities will be installed to ensure no earth, mud and debris is deposited on roads. Sand and silt in the wash water from such facilities shall be settled out and removed before (in line with effluent discharge standards) discharging the used water into water drains.

The above mitigation shall apply generally to all excavated stockpiled materials during the soil remediation process. In practice the consultants experience suggests that runoff from the site can be controlled even though the hard concrete covering is removed in places and the area of potentially exposed soil is greater than during the demolition. Surplus water arising from dewatering is to be collected on site for re-use.

In general, the demolition works will not significantly modify the layout and hydraulics of the existing drainage network, or substantially alter the quantity of storm flows entering it. Provided the environmental guidelines for the handling and disposal of discharges from construction sites there should be no adverse impacts from demolition on drainage. Discharges to sewers or drains from the works must comply with the standards. Discharges to coastal waters should be avoided if at all possible. Therefore, it is not expected that the Water Quality Objectives will be exceeded during the demolition works.

7.2.5 Asbestos Control (if Asbestos is Found)

There is a potential for finding Asbestos Containing Materials (ACM) during dismantling and demolition processes. If found, remaining ACM will require removal before the buildings and stacks are demolished but these are not currently a hazard to the public or staff as they are not readily accessible.

If found during dismantling and demolition process, all remaining ACM on the site is not accessible to the general public. In general, the operation of the Premises has not given existence of any residual contamination of the buildings with ACM dust or fiber. Routine sampling, undertaken around the site, to check that no ACM dust and debris has accumulated around the potential ACM components, does not indicate contamination of the site.

A Specialist Asbestos Contractor (SAC) shall be totally responsible for completing the asbestos abatement within the given time frame. It is anticipated that a minimum of 5 competent workers in various trades would be employed over the whole period. The SAC will control and monitor their work progress and make the necessary adjustment to their workforce to meet the work requirements. A full time Safety Supervisor shall be required to assist the contracting regarding safety and health of the site personnel and to keep the necessary records. The final program will be passed to Project Manager prior to the commencement of abatement works. Any subsequent amendments will also be passed to Project Manager prior to the reprogramming of abatement works so as to keep the authorities up to date with the works.

7.2.6 Land Contamination

At this stage the only opportunity for human exposure to any of the contamination on site will be if the materials are excavated. For this site and any potential redevelopment, the preferred approach with least environmental impact, is to cause minimal disturbance to the ground conditions, immobilise the contaminated soils where necessary and make provisions for the protection of workers. Where this is not appropriate the disposal of some material to landfill may be a more suitable remedial option.

It is recommended that the planned remedial actions for underground contaminants take place after the civil demolition.

Criteria for the assessment of land contamination levels and sampling protocols were agreed with CEPC prior to the preliminary soil investigations. It is recommended that site investigation, including the collection of subsurface samples should be taken at various depths and a contaminated land specialist shall present during all stages of the sampling to instruct and amend sampling strategies at the time of sampling as necessary to take account of particular site conditions. Groundwater samples will also be taken.

Samples will be tested at an accredited laboratory in accordance with standard international methods (USEPA or ASTM or equivalent) in line with best international practice. The overall sampling strategy will provide a framework for the site investigation in order to determine the overall scale, nature and extent land contamination and should be taken account of the former site activities (as far as they can be ascertained) and potential locations for contamination.

7.2.7 Waste Management during Demolition

Recycling, storage, transportation and disposal measures are recommended to avoid or minimize potential adverse impacts. The Contractor will incorporate these recommendations into a Waste Management Plan that incorporates site specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials.

In accordance with the Law 4/1994, disposal of Construction & Demolition (C&D) material can either be at a specified landfill, or at a public filling area.

If Asbestos is found among the demolished materials, asbestos waste that is produced shall be handled in accordance with the Code of Practice on the Packaging, Handling Transportation and Disposal of Asbestos Waste.

Specifically, it is recommended that:

- Wastes should be handled and stored in a manner which ensures that they are held securely without loss or leakage thereby minimising the potential for pollution;
- Only reputable waste collectors authorised to collect the specific category of waste concerned will be employed;
- Appropriate measures will be employed to minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers;
- The necessary waste disposal permits will be obtained from the appropriate authorities, if they are required, in accordance with the Waste Disposal Regulation and the Government Land Ordinance;
- Collection of general refuse will be carried out frequently, preferably daily;
- Waste will only be disposed of at licensed sites and site staff and the civil engineering Contractor will develop procedures to ensure that illegal disposal of wastes does not occur;
- Waste storage areas will be well maintained and cleaned regularly; and
- Records will be maintained of the quantities of wastes generated, recycled and disposed, determined by weighing each load.

Training and instruction of demolition staff will be given at the site to increase awareness and draw attention to waste management issues and the need to minimise waste generation. The training requirements will be included in a site waste management plan.

It is recommended that auditing of each waste stream should be carried out periodically by the Environmental Monitoring & Audit (EM&A) Team to determine if wastes are being managed in accordance with approved procedures. The audits should look at all aspects of waste management including waste generation, storage, recycling, treatment, transport, and disposal. An appropriate audit programme would be to undertake a first audit at the commencement of the demolition works, and then to audit quarterly thereafter.

Provided that the recommendations are thoroughly implemented the storage, handling, collection, transport, and disposal of wastes arising from the demolition of El-Tebbin old power plant, the plant will be in full compliance with the regulatory requirements.

7.2.8 Socio-economic Effects during Demolition

Present labor force of the existing old Tebbin power plant have already been granted the right to choose where they will go to work within the entire Cairo Electricity Production Company. CEPC management has set quite fair rules for re-employing all members of the old Tebbin Staff with no-loss of their employment rights, including salaries, overtime, insurance, health care and social & cultural benefits.

7.3 MITIGATION MEASURES DURING DESIGN AND CONSTRUCTION

7.3.1 Dust Emissions during Construction

As described in Section 6.2.2, dust generated by construction activities could be significant locally, not only in terms of air quality, but also with regard to visibility and traffic safety. To minimize dust nuisance, certain good site practices will be employed as follows:

- roads will be kept damp through use of water bowsers;
- stockpiles of friable materials will be sited and maintained appropriately (including the use of sheets) so as to minimize dust blow (such as balancing of cut and fill operations);
- drop heights for material transfer activities such as unloading of friable materials shall be minimized;
- the construction phase will begin with the construction of access roads;
- roads created during construction will be compacted and graveled if necessary;
- roads used on site will be maintained in good order;
- access into the site will be regulated;
- vehicle speed limits of less than 35 km/hr on dust roads will be enforced on site; and
- lorries and vehicles will be sheeted during transportation of friable construction materials and spoil.

In addition, to ensure that pollutant levels resulting from transport operations are kept to a minimum during construction activities, all vehicles being used on site will meet pollutant emission standards.

7.3.2 Aquatic Environment during Construction

Construction impacts on the aquatic environment are likely to arise as a result of:

- dredging;
- construction of the discharge and intake facilities;
- surface water runoff; and
- pipeline construction across the Nile river bank.

As discussed in Section 6.3, these activities are likely to result in impacts to water quality and aquatic ecology.

Given the mitigation and management measures described below, impacts will be minimized and are not expected to be significant.

For construction activities in the Nile river:

- dredged areas will be limited to the minimum area required for construction purposes; and

- dredged sediments will be disposed of at a site agreed between the CEPC developers and the relevant local authorities prior to the commencement of construction activities.

For construction activities on site:

- no effluents will be discharged into the Nile river during normal construction activities;

- a site drainage plan will be developed to ensure that if any erosion occurs during storm events, minimal amounts of sediment will result by reducing the flow velocity and sediment load before discharge;

- temporary stockpiles of soil should be protected from erosion by using a reduced slope angle where practical and by incorporating sediment traps in drainage ditches. This can be addressed by a site drainage plan as described above; and

- good site management practices will be enforced to ensure that the construction site is kept clean and tidy.

In addition, to ensure access to the Nile river bank is not restricted for public use (as decreed by Egyptian Law) and navigation activities are not jeopardized, the following measures will be implemented:

- the bank across which the intake and discharge pipes are constructed will be returned to its original state following construction; and
- navigational signs will mark the navigation route fronting the outlet and discharge structures.

All construction teams employed and contracts commissioned will incorporate these mitigation measures as part of Operational Procedure in contracts and briefs (see the ESMP Section 8).

7.3.3 Noise Emissions during Construction

Specific noise mitigation measures for the construction phase reflect standard good site management practices and include:

- enforcement of vehicle speed limits, strict controls of vehicle routing and prohibition of heavy vehicle movements during nigh;
- diesel engine vehicles and compression equipment will be equipped with effective silencers;
- activities with highest noise emissions (e.g. piling) will be undertaken only during the day shift (0700 hours - 1800 hours) and between Saturday and Thursday and not during official holidays; and
- personnel will use hearing protection when using or working in the vicinity of noisy equipment.

7.3.4 Flora and Fauna during Construction

Negative impacts on flora and fauna during power plant construction were described in Section 6.5.2 and are not considered to be significant. However, species on or close to the site may be disturbed and displaced as a result of increased noise, dust and human activity. Good site management practices as discussed elsewhere in this section, and implementation of the following mitigation measures, will ensure that any disturbance is reduced to a minimum:

- run-off from construction activities will be attenuated to ensure that surrounding species/habitats are not significantly affected;
- sediments removed during construction across the Nile bank and Nile bed which may be contaminated, will be disposed of in a controlled manner, as described in Section 6.3; and

- personnel and vehicles will be restricted to within the boundaries of the construction site, lay down areas and access roads, and will not be permitted to enter surrounding land.

7.3.5 Soils and Hydrology during Construction

The potential for direct impacts on soil and groundwater during construction, is largely dependent on the management of the construction site and construction activities. A range of mitigation measures will be implemented to protect soils (and, as a result, the limited groundwater resources) from the direct impacts of constructing the proposed power plant. These measures include the following:

- engineered site drainage systems will be provided to collect, balance, treat as required and control the discharge of site run-off;

- vehicles and personnel will be restricted from accessing areas not designated for construction to prevent accidental or unnecessary disturbance or compaction of the soil; and

- spoil from construction activities will be monitored and controlled; waste materials which are unsuitable for reuse on-site, for example for landscaping, will be disposed of at an appropriately licensed sanitary landfill site.

In addition, the potential for any transfer of existing contamination will be minimized through the following mitigation measures:

- protection of the soil from accidental pollution by bunding around proposed storage areas for fuel and chemicals with the capability to store at least 110% of the volume of the storage facilities;

- provision of oil and suspended solid interceptors, such as oil/ water separators for the removal of pollutant loading from the site drainage and for the retention and containment of any accidental discharges during construction and operation;

- removal of waste materials unsuitable for re-use on site during construction to appropriate licensed landfill sites;

- management of excavations during construction so as to avoid the generation of drainage pathways to underlying aquifers; and

- provision of impermeable bases in operational areas to prevent absorption of any spillage of process materials.

7.3.6 Traffic and Transport during Construction

Construction activities will generate additional traffic on local roads and in particular, significant volumes of heavy plant traffic and occasional abnormal loads. To minimize any inconvenience, hazards and damage caused to other road users, local people and the local road network, the following mitigation and management measures shall be implemented:

- abnormal load movements will be confirmed with the Competent Administrative Authority (CAA) and will adhere to prescribed routes. Their movement will be scheduled to avoid peak hours and notices will be published in advance to minimize disruption if required by the CAA;

- consideration will be given to staggering construction shifts to split arrival and departure times;

- scheduling of traffic will be undertaken to avoid the peak hours on the local road network wherever practicable; and

- construction workers will be transported to the site by contract bus.

7.3.7 Socio-economic Effects during Construction

The assessment of impacts showed an overall positive impact on the local society, culture and economy. Given that the use of local labor will be prioritized during construction, no mitigation measures are proposed.

7.3.8 Archaeology during Construction

Whilst careful examination of existing literature and data did not reveal any sites of archaeological or cultural heritage importance on or around the site, the existence of archaeological remains cannot be ruled out. Remains could be unearthed and damaged during construction of the power plant and ancillary buildings, pipelines, cables and the intake and discharge facilities.

Construction works will therefore be monitored to ensure that in the event of remains being found construction activities will be stopped and the Supreme Council of Antiquities will be consulted on the most appropriate measures, which could include the following:

- where possible, remains will be protected in-situ from construction activities, by relocating non-essential activities ;

- where identified remains cannot be protected, an excavation of the indicated area will be undertaken prior to the commencement of construction activities to record and remove vulnerable remains and features;

- any finds of archaeological, historic or cultural significance will be given to the appropriate CAA; and

- preparation of a Chance Finds Procedure which lays out the steps to be taken if archaeological, historical or cultural remains or finds are discovered during construction activities. The procedures will clearly set out how the construction team will be briefed so that they are aware of what to look out for and the actions which must be taken should a potential find be uncovered.

7.3.9 Flooding during Construction

The site is not likely to be affected by occasional flash flooding. However, in order to reduce any potential impacts of flooding during construction, the following measures will be implemented:

- during the early stages of construction, a site drainage system will be built, equipped to protect the site against potential flooding; and

- site drainage will be constructed in such a way as to dissipate flood waters away from the main plant areas and to discharge clean waters to the sanitary pipeline network and any potentially contaminated waters to the discharge system via the oil interceptor;

7.3.10 Solid Wastes during Construction

To ensure that impacts from solid waste generation and disposal are successfully avoided, the following mitigation measures will be undertaken during plant construction:

- all waste taken off site will be carried out by a licensed waste contractor and CEPC will audit the disposal procedure;

- all solid waste will be segregated into different waste types, collected and stored on site in designated storage facilities and areas prior to release to off-site disposal facilities;

- all relevant consignments of waste for disposal, will be recorded, indicating their type, destination and other relevant information, prior to being taken off site; and

- standards for storage area, management systems and disposal facilities will be agreed with the relevant parties.

An engineer with responsibility for environmental aspects will be responsible for solid waste management at the site and will ensure that all wastes are managed to minimize any environmental risks.

7.3.11 Occupational Health and Safety during Construction

CEPC will ensure that construction activities are undertaken in a manner which does not present hazards to workers' health and safety. In particular, the project company will establish and integrate policies and procedures on occupational health and safety into the construction and operation of the power plant. Emergency and accident response procedures will also be included in an EHS manual for the power plant.

The following measures will be carried out in both the construction and operational phases:

- compliance with international standards for good practice;
- adherence to local and international guidance and codes of practice on EHS management;
- management, supervision, monitoring and record-keeping as set out in the plants operational manual;
- implementation of EHS procedures as a condition of all contracts;
- clear definition of the EHS roles and responsibilities of the companies contracted to work on site and to all their individual staff (including the nomination of EHS supervisors and coordinator);
- pre-construction and operation assessment of the EHS risks and hazards associated with construction and operation, including consideration of local cultural attitudes, education level of workforce and local work practices;
- provision of appropriate training on EHS issues for all employees on site, including initial induction and regular refresher training, taking into account local cultural issues;
- provision of health and safety information;
- regular inspection, review and recording of EHS performance; and
- maintenance of a high standard of housekeeping at all times.

7.4 MITIGATION MEASURES DURING OPERATION

7.4.1 Introduction

Mitigation measures introduced into the design and construction phase of the power plant will be carried forward into the operational phase by the CEPC Company. Many mitigation measures, as described in Sections 4 and 6 of this report, have already been integrated into the design of the power plant in order to minimize any operational impacts on the environment. Mitigation measures such as low NOx burners, noise silencers and water discharge controls are for example considered integral to the design of the power plant.

The following section builds on the design criteria for the power plant in order to reduce to a minimal level any further potential negative impacts. Areas where positive impacts can be introduced or maximized are also considered.

7.4.2 Air Quality during Operation

Emissions Guidelines

Several specific measures have been taken to reduce stack emissions from the power plant and to comply with Egyptian and World Bank standards. The power plant will fire natural gas as its main fuel which is the least polluting fuel available, (with negligible sulfur dioxide emissions and low particulate matter emissions). Heavy fuel oil (mazout) will only be used as an emergency fuel. In order to reduce NOx emissions when firing natural gas or heavy fuel oil, low NOx burners are used on the boilers. In addition, a stack measuring 152m high has been designed to allow maximum dispersion of emissions into the surrounding atmosphere.

Stack emissions to the air from the proposed plant are therefore within the Egyptian, as well as the World Bank guidelines (1), with full compliance with SO_2 standards when firing the emergency heavy fuel oil (oil no.6/mazout). However, the IFC has indicated that its emission guidelines must be met for at least 95% of operating time. Given that CEPC is committed to burning heavy fuel oil for no more than 170 hours per year and only if natural gas is unavailable, (i.e. <2% of total operating hours), the plant will operate well within the SO_2 emission guidelines, and no further mitigation is proposed.

Air Qunlity Guide1ines

To investigate the issue of atmospheric emissions from the power plant and their impact on ambient air quality, dispersion modeling has been undertaken

and the results of the modeling were presented earlier in Section 6.2. The modeling indicates that the predicted off-site maximum annual and 24 hour mean ground levels of NO_2 and PM concentrations, do not exceed the Egyptian as well as the World Bank ambient air quality guidelines when natural gas is burned. As described above, CEPC is committed to using natural gas for more than 98% of operating time in a year.

No further requirement for mitigation of the emissions to air from the power plant is proposed.

7.4.3 Aquatic Environment during Operation

The main impacts of the power plant on the aquatic environment during power plant operation are likely to derive from:

- discharge of cooling and process water into the Nile river;
- disruption of navigational transport; and
- entrainment of fish and mobile organisms in the intake structure.

The design of the intake and discharge structures has incorporated measures to reduce impacts on the Nile environment including minimizing the area affected by the discharge plume. These design measures include:

- water cooling condensers will be designed using titanium or stainless steel to avoid discharge of heavy metals such as copper and zinc into the Nile river;

(1) World Bank Pollution Prevention and Abatement Handbook - Part III: Thermal Power - Guidelines for New Plants, July 1998.

- bunds or sumps will be installed on-site to isolate areas of potential oil or other spillages, such as transformer bays, from the site drainage system;

- oil and chemical storage tanks will have secondary containment structures that will hold 110% of the contents of the largest storage tank;

- areas for unloading oil and hazardous chemical materials will be isolated by kerbs and provided with a sump, equipped with a manually operated valve;

- transformers will be provided with pits to retain 110% of the coolant capacity of the transformers which will include fire fighting water. Alternatively, each main oil-filled transformer foundation will drain through a corner sump directly to an underground oil collection chamber sized to retain 110% of the coolant capacity of the transformers plus deluge water (for the worst single catastrophic failure). Adjacent to this collection chamber will be constructed an oil separator which will normally function to separate any oil contaminated to the storm water collected from within the transformer foundations and the clean water drained to the discharge structure. The transformers will not contain PCBs; and

- stormwater runoff from equipment slabs that may be subject to oil contamination exposure, will be collected and channeled through an oil/water separator prior to discharge into the discharge structure.

In order to minimize potential impacts to water quality, CEPC will ensure implementation of good site management practices including the following measures:

- wastewater will be collected and treated before being discharged into the discharge system, the main water treatment steps include:
  - neutralization of any wastewater that has a pH outside the range of 6 to 9;
  - oil separation of any wastewater that may be contaminated with oil or grease; and
  - flocculation and filtration of any wastewater that may contain high concentrations of suspended solids.

- no solid wastes will be discharged into the Nile river;

- drainage systems have been designed on site to prevent any contaminated surface run-off from being discharged into the discharge system without prior oil separation and neutralization of any other contamination; and

- all effluent discharges will comply with local Egyptian and World Bank standards.

7.4.4 Noise Emissions during Operation

A number of noise mitigation measures have been built into the design of the plant in order to ensure that noise levels are minimized and that all items of plant are operating to local and international standards.

Specific design mitigation measures include:

- steam turbine generators, air compressors, pumps, and the emergency diesel engines are enclosed in buildings;
- air compressors are equipped with air silencers; and

- noisy outdoor equipment have been designed to a noise limit of 85 dB(A) at one meter.

In addition, all personnel working in noisy areas will be required to wear hearing protection.

7.4.5 Flora and Fauna during Operation

The potential impacts of the proposed development on any existing flora and fauna will be minimized as a result of the following mitigation measures:

- noise will be controlled during operation, and will dissipate rapidly with distance from source. Any disturbance during construction and operation will therefore be localized (see Section 6.4); and

- personnel and vehicles will be restricted to within the boundaries of the site and access roads, and will not be permitted to enter surrounding land.

7.4.6 Visual Impact during Operation

Landscaping will include tropical shrubs (trees, grass, palm groves) around the site. All plants will be indigenous species.

7.4.7 Soils and Hydrology during Operation

During plant operation, the main potential for impacts to occur to soils and hydrology (including run-off into the discharge system), are likely to arise as a result of spillages and storage of chemicals and fuels on site. Good site management practices such as those described under Section 7.4.3 "Aquatic Environment" will minimize potential impacts.

7.4.8 Solid Waste Impacts During Operation

The mitigation and management measures during construction described in Section 7.3.10 above relate to both the construction and operation phases.

7.4.9 Health and Safety during Operation

The following mitigation and management measures will ensure that the health and safety of staff and any visitors on and to the site is not jeopardized during operation of the plant:

- development and implementation of an Operational Health and Safety Plan with appropriate training;
- provision of training in use of protection equipment and chemical handling;
- clear marking of work site hazards and training in recognition of hazard symbols;
- installation of vapor detection equipment and control systems;
- development of site emergency response plans;
- all personnel working or standing close to noisy equipment will be required to wear noise protectors; and
- drinking water will be supplied to the plant via local filtration facilities which will comply with drinking water standards published by the World Health Organization.

In addition, the operational health and safety measures during construction described in Section 7.3.11 above, will be carried forward into the operational phase of the power plant.

7.5 COMPENSATION FOR AFFECTED PARTIES

No indigenous populations or legally entitled landowners will be affected by the development of the power plant, therefore no affected parties require compensation.

8. ENVIRONMENTAL MITIGATION AND MONITORING: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

8.1 OBJECTIVES OF THE PLAN

The project company is committed to implementing an environmental and social management and monitoring plan which will ensure that the construction and the operation of the Tebbin power plant (TPP) involves full implementation of all proposed mitigation measures and complies with high environmental standards, the requirements of the environmental legislation and guidance notes as applicable in Egypt, and the procedures and guidelines of the World Bank.

Previous sections of this report have outlined the baseline environmental and socio-economic conditions in the area of the proposed development, have identified the potential impacts on these baseline conditions which could result from demolition, construction and operational activities and have proposed measures to minimize and mitigate against any negative impact identified. To complete the environmental evaluation, this section presents necessary Institutional Arrangements for El-Tebbin power project (*Table 8-2*) as well as the Environmental and Social Management Plan (ESMP) which summarizes the mitigation measures suggested and discusses initial and ongoing monitoring and management of significant impacts of the proposed plant.

The ESMP covering demolition, construction and operation of the power plant as well as transmission system impact mitigation and management is summarized in *Tables 8-3, 8-4, 8-5* and 8-6 respectively. *Table 8-7* gives a summary of implementation cost of the ESMP. For further detail on the mitigation measures to be undertaken, reference should be made to Section 7 of this report. Details of demolition and pre-construction/operations monitoring and management activities summarized in the tables are discussed in more detail below.

The ESMP includes the definition of the following measures to minimize environmental effects:

- **dismantling and demolition management,** including control of noise generated, fugitive dust emissions, demolition site run-off, land contamination and waste materials;
- **construction management,** including control of construction traffic, site drainage, construction waste and spoil etc.;
- **engineering design measures** directly incorporated into the power plant as good design practice, through the selection of appropriate plant and equipment and choice of construction materials;

- **specific mitigation measures designed to prevent or minimize releases** from the process, such as the use of low NOx burners, closed loop cooling system;

- **operational control systems,** such as the use of water treatment chemicals; and

- **operational management,** which includes staffing levels and staff training.

The effectiveness of these environmental management and mitigation measures will be monitored throughout the construction and operation of the power plant.

Monitoring will be carried out using standard techniques and equipment agreed with the Egyptian Environmental Affairs Agency (EEAA), which will be calibrated, operated and maintained in accordance with the manufacturers specifications.

Monitoring data will be analyzed and reviewed at regular intervals by CEPC/TPP and compared with the relevant standards so that any necessary corrective actions can be taken in a timely manner. Records of monitoring results will be kept in an acceptable format and reported to the responsible government authorities and relevant parties (including the WB).

8.2 ENVIRONMENTAL MANAGEMENT

8.2.1 Environmental Management Organisation

During Demolition, Design and Construction

Suitably qualified and experienced contractors will be responsible for the detailed demolition plan and the detailed design and construction of the power plant. Construction workers will be required to demonstrate appropriate skills, qualifications and/or experience prior to employment.

During demolition and construction, CEPC/TPP will ensure that all contracts with Contractors and sub-contractors stipulate all demolition and construction management measures (as given in this ESMP), operational design criteria and environment, health and safety standards which must be implemented at the project site.

Implementation of these measures will be enforced and supervised by the Assistant Plant Manager who will have direct responsibility for the Environment, Safety and Quality Assurance program on site during demolition, construction and operation. The Assistant Plant Manager is responsible for ensuring that demolition and construction works comply with the requirements of the ESMP and all environmental permits. His key roles will be to:

- assume the interface with authorities for environmental authorizations and permits;

- act as the Assistant Plant Manager for local authorities, industrial and commercial interests and any other interested parties;

- ensure that mitigation measures to reduce impacts during the demolition and construction phases are implemented;

- ensure that monitoring to be undertaken during demolition and construction is implemented;

- ensure compliance with the environmental and social management plan; and

- ensure that health and safety requirements are respected.

During Power Plant Operation

During operation, direct responsibility for environmental compliance and the implementation of the mitigation, management and monitoring measures described in this section and in Section 7 of this report, will continue to be with the Assistant Plant Manager. This position, will report directly to the Chairman/General Manager of CEPC/TPP.

The Assistant Plant Manager will be based at the site and will be responsible for recruiting, training and managing his staff. He will be responsible for implementing the mitigation and management measures described above and for monitoring and record keeping of the following:

- stack emissions;
- air quality;
- noise emissions;
- quality of water discharge; and
- waste management.

In his role, the Assistant Plant Manager will also be responsible for maintaining any pollution control equipment and for developing and implementing procedures for safe handling and storage of any hazardous materials used on site.

The Assistant Plant Manager will also have lead responsibility for maintaining a written Environmental Register with respect to environmental impacts as required under Egyptian and World Bank guidelines. The written records will identify the characteristics of discharges and emissions, details of periodic testing including results, procedures for follow-up environmental safety actions and the person in charge of this follow-up. Should any prescribed standards be breached, CEPC/TPP, through the Assistant Plant Manager, will immediately inform the EEAA and disclose the procedures being taken to rectify non-conformity.

Results of environmental monitoring as described above, shall be recorded and submitted to the EEAA, EEHC and to any other party (i.e. WB etc.) as required. The EEAA and WB are entitled to audit the project company in order to ensure conformity with environmental standards and requirements.

In addition, the project company must keep a record of any significant environmental incidents occurring at the plant including accidents and occupational illnesses, spills, fires and other emergencies. The Assistant Plant Manager will be responsible for ensuing that these records are maintained up to date and are available on site.

The Assistant Plant Manager will supervise and lead the Environmental Department (ED) and the Environmental Management Unit (EMU) directed by the ED. *Figure 8-1* depicts the organizational structure of the Tebbin power plant including the ED and *Figure 8-2* illustrates the organization of the EMU.

8.2.2 Environmental Training

The Project Company will ensure that the power plant is manned 24 hours a day, 7 days per week. All staff employed at the plant will be trained in the following:

- general operation of the power plant;
- specific job roles and procedures;
- occupational health and safety; and
- contingency plans and emergency procedures.

Training will include:
- induction training on appointment;
- specialist training (as required for their prescribed job role); and
- refresher training as required.

The training program will be designed to ensure that appropriate skilled staff are used to operate the power plant at all times. Aspects of occupational health and safety and emergency procedures are described below.

Figure 8-1

Environmental Department (ED) within the Organizational Structure of El-Tebbin Power Plant

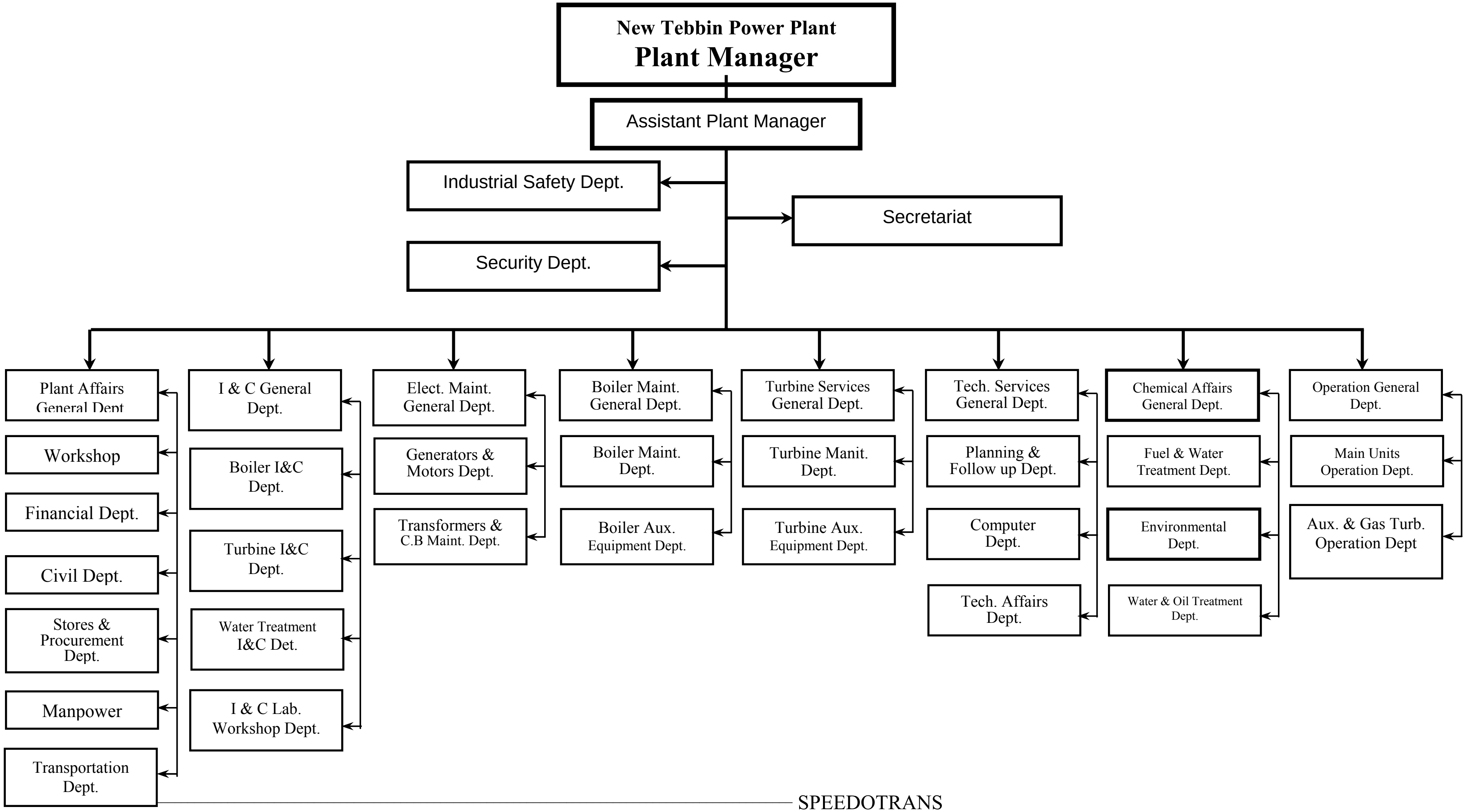
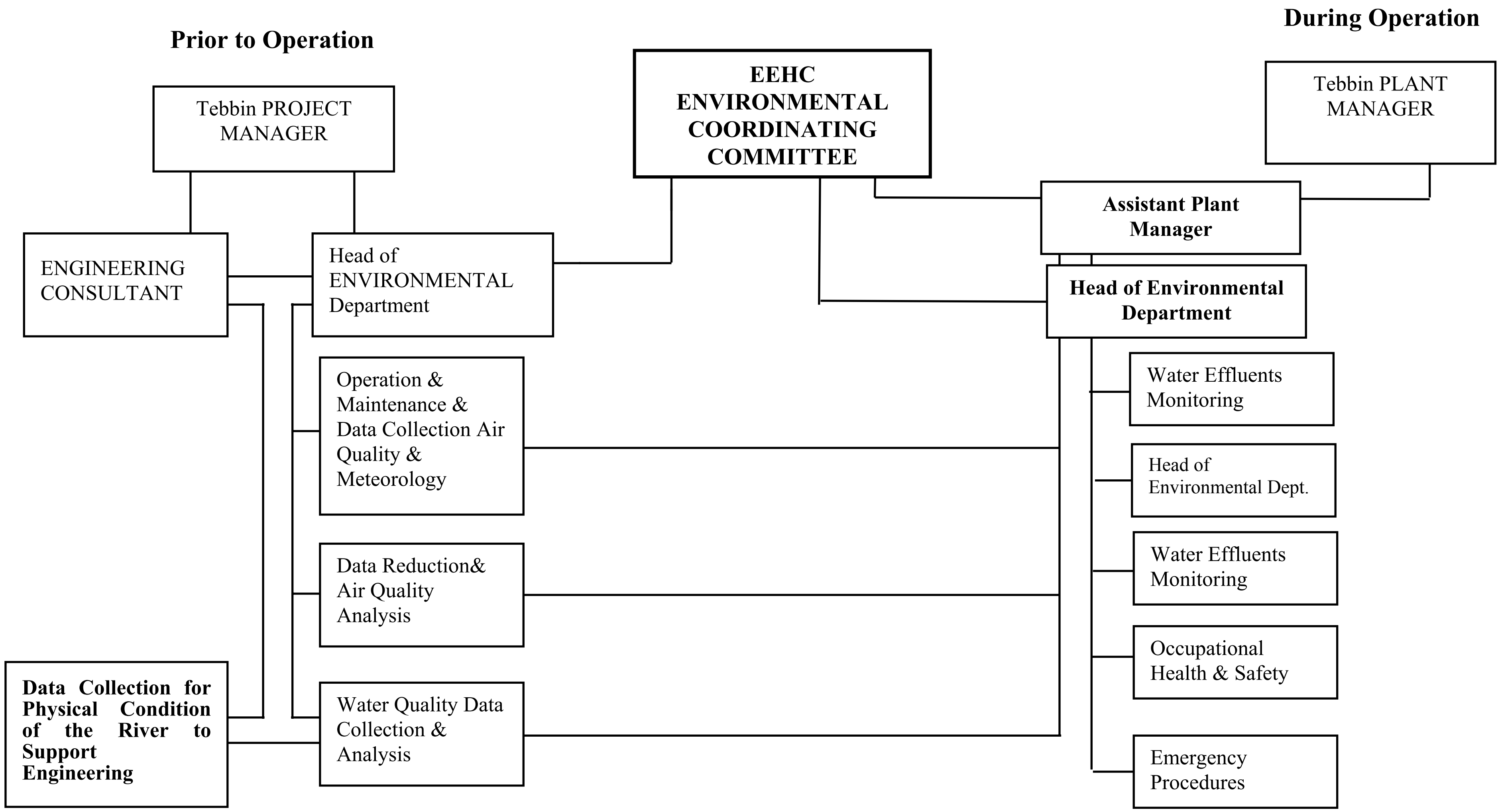


Figure 8-2

Environnemental Management Unit (EMU)



In addition to this environmental training for all staff employed at the plant, special environmental training will be given to the staff employed for the EMU. They will receive training in the following:

- day-to-day monitoring activities;
- monitoring the stack emissions;
- collection and analysis of air quality data;
- monitoring the water effluents;
- collection and analysis of water quality information;
- use of monitoring equipment, operation and maintenance;
- industrial hygiene;
- occupational health and safety; and
- emergency and contingency procedures.

8.2.3 Occupational Health and Safety

CEPC/TPP will establish and integrate policies and procedures on occupational health and safety into the operation of the power plant which meet the requirements of Egyptian and World Bank guidelines as given in Section 2 of the report. The policies and procedures will also be designed to comply with all manufacturers safety data sheets for chemical storage and usage, so as to provide a safe and healthy working environment.

Occupational health and safety programs will be supported by staff training for the power plant and the appointment of the Assistant Plant Manager. The training will include, but will not be limited to, the following:

- general area safety;
- specific job safety;
- general electrical safety;
- handling of hazardous materials;
- entry into confined spaces;
- hearing conservation;
- repetitive stress disorders;
- Code of Safe Practices;
- use of personal protective equipment; and
- first-aid.

The training will include induction courses when staff are first employed at the power plant, with specialist and refresher training as required by the job role. Training will be updated annually and occupational health and safety procedures will be included within the Operations Manual for the power plant.

The safety record at the power plant will be reviewed each month at a formal meeting, led by the Assistant Plant Manager, where the agenda items, comments and attendance will be recorded and kept on file.

In addition, periodic safety audits will be conducted to verify compliance with safe working practices, which will comprise physical inspections, review of plant records and interviews with staff. The audits will assign responsibility for any corrective action necessary to mitigate a potential hazard and allow the tracking of the completion of the corrective measure.

8.2.4 Emergency Procedures and Accident Response

Instructions on emergency measures necessary to safeguard employees and the wider environment will be prepared as part of the Operations Manual for the power plant.

Accident Response

As part of the preparation of emergency procedures and the plans for accident response arrangements, the project company will carry out the following:

- review industry-specific and Egyptian and World Bank standards and regulations;
- establish general guidelines on potential safety and accident risks;
- prepare job-specific operating instructions where appropriate;
- establish safety and security notices for hazardous materials;
- prepare specific emergency operating instructions;
- provide protective equipment (including clothing, air and ear protection etc.) as required;
- evaluate information and feedback from employees; and
- record and investigate all accidents, injuries and incidents.

Contingency plans and emergency procedures are being developed to cover events due to operational failures, natural causes and acts of third parties. The plans and procedures will cover, as a minimum, the following:

- fire;
- explosion;
- bomb alerts;
- leaks and spills of hazardous materials;
- structure or equipment failures;
- injuries and illnesses;
- risk from natural disasters (wind, sandstorm, earthquake); and
- third-party risks (potential impacts of an accident occurring at another industrial facility which may impact upon the power plant).

Oil Spill Contingency Plan

As Good practice and part of the ESMP, CEPC/TPP will prepare an Oil Spill Contingency Plan.

Light fuel oil will be delivered to the site by road and stored in:

- two 1,000 m^3 tanks for the light fuel oil (oil no. 2 / sollar).

These tanks are surrounded contained within separate retention area which is designed to contain 110% of one tank.

The plan will cover the following activities.

- delivery;
- handling;
- spills; and
- cleanup.

The plan will detail procedures, responsibilities, chains of command, information flows, monitoring and documentation.

8.3 SCHEDULE AND COSTS FOR PREPARATION AND IMPLEMENTATION OF EHS PLANS

Table 8.1 below provides a time schedule and approximate costs for the preparation and implementation of the Environment, Health and Safety Plans.

Table 8-1

Schedule and Cost Estimates for EHS Plans

Plan	Responsibility	Schedule for Submission	Schedule for Implementation	Approx. Cost (US$)
Occupational Health and Safety Plan (Demolition)	TPP Assistant Plant Manager	4th Quarter 2005	1st Quarter 2006	Within Demolition Contract
Occupational Health and Safety Plan (Construction)	TPP Assistant Plant Manager	4th Quarter 2006	2nd Quarter 2007	Within Construction Contract
Occupational Health and Safety Plan (Operation)	TPP Assistant Plant Manager	2nd Quarter 2007	3rd Quarter 2007	(a)
Emergency Procedures and Accident Response Plan	TPP Assistant Plant Manager	2nd Quarter 2006	2nd Quarter 2006	(a)
Oil Spill Contingency Plan	TPP Assistant Plant Manager	2nd Quarter 2007	3rd Quarter 2007	(a)
Chance Finds Procedure	TPP Assistant Plant Manager	3rd Quarter 2006	3rd Quarter 2006	(a)
Monitoring Plan	TPP Assistant Plant Manager	Already prepared, see Tables 8-2 , 8-3 , 8-4 & 8-5 of ESMP	Start of Demolition	(a)

Notes:

(a) The cost of the preparation of these plans will amount to around US$ 50,000. The costs of maintaining and implementing the requirements of these plans on-site cannot be determined at this stage until the contents and requirements of the plans are now known. However, the cost of air quality monitoring system may be estimated at this stage for about US$ 1,500,000.

Table 8-2

Institutional Arrangements for El-Tebbin Power Project

Issue/Impact	Mitigation Measures	Implementation Schedule	Type and Frequency of Reporting / Monitoring	Responsibility		Monitoring Indicators	Budget in US$
				Implementation	Supervision		
Demolition Phase							
Institutional capacity to address environmental and social issues	Basic training of CEPC employees responsible for supervising the demolition.	Prior to starting demolition. Ongoing training	Quarterly to EEHC & EEHC Environmental Coordinating Committee (ECC)	CEPC/TPP (EEHC training facility)	EEHC EEHC Environmental Coordinating Committee (ECC)	Training programs Compliance with ESMP	CEPC responsibility(*)
Construction Phase							
Institutional capacity to address environmental and social issues	Establishment of the Environmental Management Unit (EMU), construction phase. Basic training of persons employed to operate the monitoring activities. Basic induction training for all employees on good construction and site management practice.	Prior to starting construction. Ongoing training	Quarterly to EEHC & EEHC Environmental Coordinating Committee (ECC)	CEPC/TPP	EEHC EEHC-ECC	Training programs Compliance with ESMP	Included in air quality monitoring package CEPC responsibility
Operation Phase							
Institutional capacity to address environmental and social issues	Establishment of the Environmental Management Unit (EMU), operation phase. Basic training of persons employed to operate the monitoring activities. Induction, specific and refresher training for all employees on good operation management practice. Training methods, facilities & manuals	Prior to starting operation. Ongoing training	Quarterly to EEHC & EEHC Environmental Coordinating Committee (ECC)	CEPC/TPP	EEHC EEHC-ECC	Training programs Compliance with ESMP	Included in air quality monitoring package CEPC responsibility

Notes:
(*) CEPC responsibility: means that training and capacity building activities are included in the company organizational structure and budget.

Table 8-3
Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility: Implementation	Responsibility: Supervision	Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
Air Quality Dust emissions caused by demolition activities, demolition vehicle movements, and transport of demolished materials.	Implementation of good site practices including: • demolition method is not blasting, but is top-down deconstruction, in the reverse order to that of demolition, progressive, level by level having regard to type of demolition; • wherever possible, external non-load bearing cladding shall be removed first; • debris to be removed at frequent intervals and stockpiles shall not be allowed to build up. Waste shall be removed on a daily basis as far as reasonably practicable; • appropriate siting and maintenance of stockpiles of demolished materials so as to minimize dust blow; • minimizing drop heights for material transfer activities; • roads will be kept damp via a water bowser; • roads will be compacted and graveled if necessary; • site roads will be maintained in good order; • regulation of site access; • sheeting of lorries transporting demolished materials and spoil; • enforcement of vehicle speed limits on dust roads to <35 km/h.	During demolition contract commencing 1st Quarter 2006.	Demolition air quality monitoring of NO_2 , SO_2 , CO, TSP and PM_{10} using air quality monitors, measurements to be undertaken by the NRC(1). Measurements and analysis of these pollutants to be made on an interval basis, e.g. monthly.	CEPC/TPP/Local Consultants (NRC) Implementation of Good Site Management practices shall be the responsibility of all contractors on site.	CEPC/TPP Assistant Plant Manager EEHC Environmental Management & Studies Sector	Dust levels (TSP and PM_{10}) NO_2, SO_2, CO, levels	CEPC/TPP to check dust suppression measures daily. NRC to measure pollutants monthly. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC responsible for management of the air quality monitoring measurements. Basic training of persons employed to operate and maintain the monitoring system. CEPC to ensure the contractor and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practice.	Mitigation measures and management, Contractor responsibility (included within demolition costs). Air Quality measurements: US$ 20:40k

Notes:
NRC = National Research Center.

Table 8-3 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Water Quality Generation of demolition site run-off. Surplus groundwater during soil remediation and wastewater that may cause adverse water quality impacts on water sensitive receivers.	Mitigation activities will include the following: • no discharge of effluents into the Nile river or El-Khashab canal - all effluents shall be collected and removed off site for treatment by approved firms; • development of a site drainage plan which reduces flow velocity and sediment load; • protection of temporary stockpiles of soil from erosion by using a reduced slope angle where practical, sheeting and by incorporating sediment traps in drainage ditches; • maintenance of well kept demolition site. • proper site management to minimize surface water run-off, soil erosion, soil remediation activities and the impacts of sewage effluents; • adequate maintenance of drainage systems to prevent any overflow; • critical areas within the Site shall be clearly marked and provided with protective measures to control site run-off. • Temporary channels shall be provided to facilitate run-off discharge into the appropriate watercourses, via a silt retention pond; • drainage channels shall incorporate sediment basins or traps and baffles to enhance deposition rates;	During demolition contract commencing 1st Quarter 2006.	Continuous monitoring is required to ensure the implementation of good management practices during demolition.	Implementation of Good Site Management practices shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP.	EEHC Environmental Management & Studies Sector.	Fluid effluents within the site. Soil erosion. Surface water run-off. Sewage effluents. Earth, mud and debris depositions on roads.	Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, MWRI, WB, etc.), if required.	CEPC to ensure the contractor and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practices.	Costs for mitigation measures included within demolition costs.

Table 8-3 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
	• wheel washing facilities will be installed to ensure no earth, mud and debris is deposited on roads. Sand and silt in the wash water from such facilities shall be settled out and removed before (in line with effluent discharge standards discharging the used water into water drains; • temporary water/toilet facilities will be provided and sewage discharges on site will be connected to the existing sewer or sewage treatment facilities where possible; • the contractor shall not discharge directly or indirectly into any public sewer stormwater drain any effluent or contaminated water without the prior written consent of the site engineer in consultation with the Asistant Plant Manager.								

Table 8-3 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Noise Arising noise impacts related to operation of demolition plant and vehicles.	Implementation of good site practices including: • enforcement of vehicle speed limits; • strict controls of vehicle routing; • demolition plant equipment to be fitted with silencers; • no noisy demolition activities at night; • prohibition of heavy vehicle movements at night; • use of protective hearing equipment for workers.	During demolition contract commencing 1st Quarter 2006.	Continuous monitoring and supervision by CEPC is required to ensure the implementation of good site management practices by the contractor and subcontractors during demolition. Third party audit.	Implementation of Good Site Management practices shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP. Auditor (Noise Expert).	EEHC Environmental Management & Studies Sector.	Noise complaints register to identify concerns. Check validity using noise measuring devices already available at CEPC and operated by CEPC noise specialists.	CEPC/TPP will produce a monthly log of valid complaints and actions taken to EEHC. Quarterly audit. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure the contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practices.	Management time and costs (US$ 25K)

Table 8-3 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Flora and Fauna Site clearance-vegetation removal and habitat disturbance.	• Good site management practices will be observed to ensure that disturbance of habitats off-site are minimized. Specific mitigation measures include restricting personnel and vehicles to within demolition site boundaries, lay down areas and access roads; • Plantation ecologist will work closely with the engineer and/or contractors in order to develop a detailed conservation plan for trees at the site; • Plants near the agricultural drainage banks will be kept due to its important role in accumulating pollutants especially heavy metals. This important ecological role was reported in the literature on the same genera; • Trees growing by the fence of the power plant will be kept since they will not obstruct any demolitions and due to their importance as wind shields.	During demolition contract commencing 1st Quarter 2006.	Continuous monitoring and supervision by CEPC is required to ensure the implementation of good site management practices by the contractor and subcontractors during demolition.	Plantation Ecologist. Implementation of Good Site Management practices shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP.	EEHC Environmental Management & Studies Sector.	Good conservation of floral wealth.	Assistant Plant Manager to check status of trees and other floral species daily. No. of trees conserved or replanted.	CEPC to ensure the contractor and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practices.	Management time and costs plus ecologist specialist (between US$ 7-9K)

Table 8-3 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Land Contamination Site clearance, excavation and disposal of material, exposure of potentially contaminated soils, spillage or leakage of substances on land, movement of equipment and vehicles on site.	The potential for impacts are largely dependent on management of the demolition site and activities. The following mitigation measures will be implemented: • development of effective site drainage systems; • restriction of access only to demolition site areas; • monitoring and control of spoil; • disposal of waste materials unsuitable for reuse at appropriately licensed sites; • provision of oil and suspended solid interceptors; • management of excavations during demolition to avoid the generation of drainage pathways to underlying aquifers; • provision of impermeable bases in operational areas to prevent absorption of spillages. • machinery and/or any other items that are suitable for reuse on other locations or sold out to a licensed contractor will be transported using safe means so as to keep the soil secured against any hazard; • Hazardous wastes will be disposed of by a licensed contractor, with strict adherence to the EEAA regulations and controls of the Law 4/1994. Disposal procedures will be audited by the project engineer and CEPC.	During demolition contract commencing 1st Quarter 2006.	Site investing-ation, including the collection of subsurface samples will be taken at various depths and a contaminated land specialist shall present during all stages of the sampling to instruct and amend sampling strategies at the time of sampling as necessary to take account of particular site conditions. Groundwater samples will also be taken. Samples will be tested at an accredited laboratory in accordance with standard international methods (USEPA or ASTM or equivalent) in line with best international practice.	Implementation of Good Site Management practices shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP.	EEHC Environmental Management & Studies Sector.	• site drainage. • access only to demolition site areas. • spoils. • waste materials. • oily waters. • drainage pathways. • potential spillage in operational areas. • soil sample test, including, but not limited to, total petroleum hydrocarb-ons and heavy metals.	Continuous monitoring is required to ensure the implementation of good management practices during demolition. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure the contractor and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practices.	Costs for mitigation measures included within demolition costs with the exception of Management time. Any additional features may incur additional costs of between US$ 10-30K dependent on the measure. Subsurface sampling and analysis: approx US$75-100K.

Table 8-3 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Traffic and Transport Disruption, noise and increased air pollution due to increased traffic, heavy loads and abnormal loads.	Standard good practice measures will be implemented as follows: • adherence of abnormal load movements to prescribed routes, outside peak hours and advance publication of movements if required; • demolition shifts will be staggered; • scheduling of traffic to avoid peak hours on local roads; • transportation of demolition workers by contract bus. •	During demolition contract commencing 1st Quarter 2006.	Continuous monitoring is required to ensure the implementation of good site management practices by the contractor and subcontractors during demolition.	Implementation of Good Site Management practices shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP.	EEHC Environmental Management & Studies Sector.	Increased congestion Travel time (compared to reasonable daily commute)	Daily	CEPC to ensure the contractor and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practices.	Management time

Table 8-3 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Socio-Economic Environment Positive Impacts identified.	Present labor force of the existing old Tebbin power plant have already been granted the right to choose where they will go to work within the overall Cairo Electricity Production Facilities. Quite fair rules for re-employing all members of the old Tebbin staff with no loss of their employment rights, including salaries, overtime, insurance, health care, and social & cultural benefits. Families/homes of considerable number of workers who will be re-employed elsewhere in the greater Cairo Metropolitan area will remain in El-Tebbin, i.e. no resettlement or loss of income will take place of the re-employment. Activities related to demolition work take place on the construction site, i.e. on CEPC land. Public and Industry Relations will be maximized through open dialogue between CEPC (through the Assistant Plant Manager who has direct responsibility for EHS Liaison) and local authority, public and industry representatives.	Before demolition contract commencing 1st Quarter 2006.	Record local employment provided by the project.	CEPC/TPP	EEHC Environmental Management & Studies Sector.	Social satisfaction as measured by staff interviews and complaints submitted.	Interim and closing reports	Responsibility of CEPC.	Responsibility of CEPC.

Table 8-3 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Asbestos Control Potential health hazard due to asbestos contamination.	There is a potential for finding Asbestos Containing Materials (ACM) during dismantling and demolition processes. If found, standard good practice measures will be implemented as follows: • any ACM present in the stacks and superstructures shall be removed before commencement of the demolition works; • removal of asbestos materials in certain locations may run more smoothly if both asbestos contractors and civil demolition contractors work in tandem. This is due to the convenience of the main civil demolition contractor providing access (scaffolding etc.) to the ACM, for the asbestos contractor and avoiding duplication of effort; • work actually involving the removal of ACM, that involves the handling of the ACM shall be carried out by a Specialist Asbestos Contractor; • all remaining ACM on the site is not accessible to the general public.	During demolition contract commencing 1st Quarter 2006.	The multi-party nature of the project and the involvement of non-asbestos contractor increase the risk of accidental disturbance of ACM. The CEPC should ensure that there is a reliable supervision and co-ordination mechanism to guard against any accidental disturbance of the asbestos containing material (ACM) by non-asbestos professionals.	The CEPC will control and monitor work progress and make the necessary adjustment to their workforce to meet the work requirements.	EEHC Environmental Management & Studies Sector.	Any ACM to be found	Daily reporting to EEHC Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	An Specialist Asbestos Contractor (SAC) shall be totally responsible for completing the asbestos abatement within the given time frame. It is anticipated that a minimum of 5 competent workers in various trades would be employed over the whole period. A full time Safety Supervisor shall be required to assist the contracting regarding safety and health of the site personnel and to keep the necessary records.	Management time and costs plus ACM specialist (between US$ 10-15)

Table 8-3 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Waste Management	Recycling, storage, transportation and disposal measures are recommended to avoid or minimize potential adverse impacts. The Contractor will incorporate these recommendations into a Waste Management Plan that incorporates site specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials. Good practice measures such as the following: • wastes should be handled and stored in a manner which ensures that they are held securely without loss or leakage thereby minimising the potential for pollution; • only reputable waste collectors authorised to collect the specific category of waste concerned will be employed; • appropriate measures will be employed to minimise windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers; • necessary waste disposal permits will be obtained from the appropriate authorities, if they are required, in accordance with the Waste Disposal Regulation and the Government Land Ordinance; • collection of general refuse will be carried out frequently, preferably daily; • waste will only be disposed of at licensed sites and site staff and the civil engineering Contractor will develop procedures to ensure that illegal disposal of wastes does not occur; • waste storage areas will be well maintained and cleaned regularly; • records will be maintained of the quantities of wastes generated, recycled and disposed, determined by weighing each load.	During demolition contract commencing 1st Quarter 2006.	Continuous monitoring is required to ensure the implementation of good management practices during demolition.	Implementation of Good Site Management practices shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP.	EEHC Environmental Management & Studies Sector.	Management contract in place. Functional transfer station.	Monthly reports from management contractor to CEPC. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure the contractor and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good demolition and site management practices.	Management time and costs (<US$ 10K)

Table 8-3 (Contd.)

Demolition Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Occupational Health & Safety	Good local and international demolition/demolition practice in Environment, Health and Safety (EHS) will be applied at all times and account will be taken of local customs, practices and attitudes. Measures include: • implementation of EHS procedures as a condition of contract the contractor and subcontractors; • clear definition of the EHS roles and responsibilities of all demolition staff; • management, supervision, monitoring and record-keeping as set out in plant's operational manual; • pre- demolition assessment of the EHS risks and hazards; • completion and implementation of Fire Safety Plan prior to starting demolition to any part of the plant; • provision of appropriate training on EHS issues for all workers; • provision of health and safety information; • regular inspection, review and recording of EHS performance; • maintenance of a high standard of housekeeping at all times.	During demolition contract commencing 1st Quarter 2006.	Continuous monitoring is required to ensure the implementation of EHS Policies, plans and practices during demolition.	Implementation of Good Site Management practices and the EHS policies shall be the responsibility of the contractor and subcontractors on site under supervision of the CEPC/TPP.	EEHC Environmental Management & Studies Sector.	Management procedures in place. Workers health and safety as measured by no. of incidents.	Daily 6- monthly reporting of summary results and submitted to the EEHC and other concerned authority (e.g. EEAA, WB, etc.) if required.	CEPC to ensure the contractor and subcontractors for workers on site include reference to the requirements of the ESMP and are aware of the EHS policies and plans. All employees will be given basic induction training on EHS policies and practices. Contractor is responsible for ensuring that a Fire Safety Plan is prepared and implemented prior to starting demolition to any part of the plant under supervision of CEPC/TPP.	Mitigation measures will require management time plus costs of up to US$ 10K for preparation of Plans.

Table 8-4

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Air Quality Dust emissions caused by construction activities, construction vehicle movements, and transport of friable construction materials.	Implementation of good site practices including: • appropriate siting and maintenance of stockpiles of friable materials so as to minimize dust blow; • minimizing drop heights for material transfer activities such as unloading of friable materials; • construction phase to begin with construction of access roads; • roads will be kept damp via a water bowser; • roads will be compacted and graveled if necessary; • site roads will be maintained in good order; • regulation of site access; • sheeting of lorries transporting friable construction materials and spoil; • enforcement of vehicle speed limits on unmetalled roads to <35 km/h.	Before construction and during construction	Initiate baseline air quality survey of NO_2 , SO_2 , CO, TSP and PM_{10} using air quality monitors and continue during construction. Two analyzer stations will be electronically connected to the EEAA ambient monitoring system. Measurements and analysis of these pollutants to be made on a continuous basis by a trained staff assigned by CEPC/TPP and submitted to EEHC for reporting to any concerned authority.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Dust levels (TSP, PM_{10}) NO_2, SO_2, CO levels.	Quarterly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority. (e.g. EEAA, WB, etc.).	CEPC responsible for management of the air quality monitoring system. Submission of annual summary reports to EEHC and any other concerned authority. Basic training of persons employed to operate and maintain the monitoring system. CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice.	Mitigation Measures, Management time and costs (<included in construction costs) Baseline Air Quality Monitoring: Permanent Continuous Monitoring System-approx. US$ 1000-1500K plus management time & reporting.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting / monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Aquatic Environment Dredging and construction of the intake structure and pipe-laying for water intake and discharge pipes- increased suspended sediment and pollutant loads, permanent loss and disturbance to aquatic flora and fauna.	The following measures will be taken: • Construction Method Statement to be produced by the Contractor; • dredged areas limited to minimum area required; • disposal of dredged sediments to an agreed site; • all works will be made clearly visible using flags, beacons and/or signals; • bank area will be reinstated following construction.	During construction of intake and discharge structures	Nile survey undertaken April 2005 along 5 profiles fronting the site. Report to be maintained for later monitoring and evaluation during operation. Water quality will be measured monthly (monitoring of temperature, pH, COD, BOD, TOC, DO, TSS, oil & grease, residual chlorine, heavy metals and other pollutants).	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Bank line Dredged areas & dredging waste material.	Daily (for bankline and dredged areas) Monthly (for water quality).	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice. These mitigation measures must be a condition of any construction contracts commissioned.	Mitigation Measures: Management time and costs (included in construction cost). Water quality measurement costs (between US$ 10-15K)

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting / monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Contamination of the aquatic environment as a result of construction activities on land e.g. spillages, disposal of liquid wastes; surface run-off, exposure of contaminated soils (see also under "Soils and Hydrology").	Mitigation activities will include the following: • no discharge of effluents into the Nile river - all effluents shall be collected and removed off site for treatment by approved firms; • development of a site drainage plan which reduces flow velocity and sediment load; • protection of temporary stockpiles of soil from erosion by using a reduced slope angle where practical, sheeting and by incorporating sediment traps in drainage ditches; • maintenance of well kept construction site.	During construction	Continuous monitoring is required to ensure the implementation of good management practices during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Fluid effluents within the site. Soil erosion. Surface water run-off. Sewage effluents. Earth, mud and debris depositions on roads.	Daily Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time and costs (included in construction cost).

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Noise Increased noise in the project area as a result of the use of noisy machinery and increased vehicle movements.	Implementation of good site practices including: • enforcement of vehicle speed limits; • strict controls of vehicle routing; • diesel engine construction plant equipment to be fitted with silencers; • limited noisy construction activities at night; • prohibition of heavy vehicle movements at night; • use of protective hearing equipment for workers.	During construction	Continuous monitoring and supervision by CEPC is required to ensure the implementation of good site management practices by all contractors during construction. Third party audit.	Implementation of Good Site Management practices shall be the responsibility of all contra-ctors on site under supervision of the Assistant Plant Manager. Auditor (Noise Expert)	EEHC Environmental Management & Studies Sector. 6-monthly audit.	Noise complaints register to identify concerns. Check validity using noise measuring devices already available at CEPC and operated by CEPC noise specialist.	CEPC/TPP will produce a monthly log of valid complaints and actions taken to EEHC. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time and costs (US$ 50K)
Flora and Fauna Site Clearance-Vegetation removal and habitat disturbance.	• Good site management practices will be observed to ensure that disturbance of habitats off-site are minimized. • Specific mitigation measures include restricting personnel and vehicles to within construction site boundaries, lay down areas and access roads. • CEPC to hire a specialist ecologist to conserve and maintain old valuable trees and vegetation on site during construction phase.	During construction.	Continuous monitoring and supervision by CEPC is required to ensure the implementation of good site management practices by all contractors during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Good conservation of floral wealth. Assistant Plant Manager to check the status of trees and other floral species daily.	Weekly No. of trees conserved or replanted.	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time and costs plus ecologist specialist (between US$ 20-25K)

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Soils and Hydrology Site clearance, excavation and disposal of material, exposure of potentially contaminated soils, spillage or leakage of substances on land, movement of equipment and vehicles on site.	The potential for impacts are largely dependent on management of the construction site and activities. The following mitigation measures will be implemented: • development of effective site drainage systems; • restriction of access only to construction site areas; • monitoring and control of spoil; • disposal of waste materials unsuitable for reuse on-site, (e.g. for landscaping) at appropriately licensed sites; • provision of oil and suspended solid interceptors; • management of excavations during construction to avoid the generation of drainage pathways to underlying aquifers; • provision of impermeable bases in operational areas to prevent absorption of spillages.	During construction.	Continuous monitoring is required to ensure the implementation of good management practices during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	• site drainage. • access only to construction site areas. • spoils. • waste materials. • oily waters. • drainage pathways. • potential spillage in operational areas. • soil sample test. • ground water sample test.	Continuous monitoring is required to ensure the implementation of good management practices during demolition. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Costs for mitigation measures and management time included within construction costs. Any additional features (e.g. bunding, interceptors etc.) may incur additional costs of between US$ 20-30K dependent on the measure.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Traffic and Transport Disruption, noise and increased air pollution due to increased traffic, heavy loads and abnormal loads.	Standard good practice measures will be implemented as follows: • adherence of abnormal load movements to prescribed routes, outside peak hours and advance publication of movements if required; • construction shifts will be staggered; • scheduling of traffic to avoid peak hours on local roads; • transportation of construction workers by contract bus.	During construction.	Continuous monitoring is required to ensure the implementation of good site management practices by all contractors during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Increased congestion Travel time (compared to reasonable daily commute)	Daily	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Socio-Economic Environment Positive impacts identified.	All activities related to the construction of the new plant will take place within the area belonging to CEPC, i.e. there will be no off-site activities or associated land acquisition during construction. The entire labor force will be daily commuters, thus no worker housing or associated facilities will be erected on site during construction. The contractors will be responsible for relevant temporary water / toilet facilities during construction and the need to provide appropriate services will be specified in their constracts. Public and Industry Relations will be maximized through open dialogue between CEPC (through the Assistant Plant Manager who has direct responsibility for EHS Liaison) and local authority, public and industry representatives.	During construction.	Record local employment provided by the project.	CEPC/TPP Assistant Plant Manager	EEHC Environmental Management & Studies Sector.	Workers satisfaction as measured by staff interviews and complaints submitted.	Editing a special report	Responsibility of CEPC.	Responsibility of CEPC.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Archaeology Potential chance finds of archaeological remains during construction.	The project site does not lie on, or in the immediate vicinity of any known archaeological areas of interest. If remains are found CEPC is committed to: • cease activities and consult Antiquities authority; • protection in situ if possible; • excavation of areas where protection not feasible; • preparation of a Chance Finds Procedure and Method Statement.	During construction.	Supervision of construction activities.	Construction contractors CEPC will allocate responsibilities in accordance with the Chance Finds Procedure.	EEHC Environmental Management & Studies Sector.	Chance finds (see annex II)	Daily	CEPC to ensure that all workers on site are aware of the importance of archaeological remains and must report any potential finds immediately. Immediate liaison with Competent Administrative Authority should a potential find be uncovered.	Mitigation measures require management time. Should chance finds occur, protection & excavation could add significantly to the cost.
Natural Disasters Flash flooding.	Good engineering design will incorporate the following mitigation measures: • drainage system designed to direct flood water from main plant areas into the City sewer system and direct potentially contaminated waters through the oil interceptor.	During construction.	No monitoring measures are envisaged.	CEPC/TPP Assistant Plant Manager	EEHC Environmental Management & Studies Sector.			CEPC to ensure that all workers on site receive training in emergency preparedness and response procedures.	Relevant costs are included within the construction costs

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Solid Waste Management	Good practice measures such as the following: • all waste taken off-site will be undertaken by a licensed contractor and CEPC will audit disposal procedure; • collection and segregation of wastes and safe storage; • recording of consignments for disposal; • prior agreement of standards for storage, management and disposal with relevant authorities.	During construction.	Continuous monitoring is required to ensure the implementation of good management practices during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Management contract in place Functional transfer station.	Monthly reports from management contractor to CEPC and then to EEHC. These reports are to be submitted to any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time plus costs (< US$ 10K)

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility: Implementation	Responsibility: Supervision	Monitoring Indicators	Type and Frequency of Reporting / monitoring	Management and Training	Indicative Cost Estimate (US$)
Occupational Health & Safety									
	Good local and international construction practice in Environment, Health and Safety (EHS) will be applied at all times and account will be taken of local customs, practices and attitudes. Measures include: • implementation of EHS procedures as a condition of contract all contractors and sub-contractors; • clear definition of the EHS roles and responsibilities of all construction companies and staff; • management, supervision, monitoring and record-keeping as set out in plant's operational manual; • pre-construction and operation assessment of the EHS risks and hazards; • completion and implementation of Fire Safety Plan prior to commissioning any part of the plant; • provision of appropriate training on EHS issues for all workers; • provision of health and safety information; • regular inspection, review and recording of EHS performance; and • maintenance of a high standard of housekeeping at all times.	During construction.	Continuous monitoring is required to ensure the implementation of EHS Policies, plans and practices during construction.	Implementation of Good Site Management practices and the EHS policies shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Management procedures in place. Workers health and safety as measured by no. of incidents.	Daily Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC to ensure all contractors and sub-contractors for workers on site include reference to the requirements of the ESMP and are aware of the EHS policies and plants. All employees will be given basic induction training on EHS policies and practices. Contractors are responsible for ensuring that a Fire Safety Plan, which conforms to NFPA 850, is prepared and implemented prior to commissioning of any part of the plant under supervision of CEPC/TPP.	Mitigation measures will require management time plus costs of up to US$ 50K for preparation of EHS Plans.

Table 8-5

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility: Implementation	Responsibility: Supervision	Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
Air Quality Emissions from stack are not expected to exceed standards.	Mitigation measures have already been included in the design of the plant and, given CEPC/TPP's strict commitment to use mazout fuel oil for <2% of operating time, no further mitigation measures are proposed. CEPC/TPP will however demonstrate the validity of the conclusions drawn in the ESIA report.	During first three years of operation.	**Automatic monitoring** of stack emissions for NOx, SO_2, particulate matter and carbon monoxide (CO) via test ports installed in the main stack.	The analyzer stations will be owned and operated by CEPC/TPP. Assistant Plant Manager	EEHC Environmental Management & Studies Sector. Report introduced to EEAA as requested. Third party inspection.	Stack emissions (at least PM_{10}, NOx, SOx and CO).	Continuous Hourly data acquisition. Quarterly reporting to EEHC. Reports are to be available to any of the concerning authorities (EEAA, WB, etc.).	Records must be kept and summary data (including any deviations from Egyptian and World bank standards) will be submitted to the Government and WB on annual basis (or more frequently if required).	Automtic stack monitors: included in included in the project cost. Management time for compilation of reports and performance monitoring: included in operation cost.
Ambient air quality affected by emissions from the power plant.	CEPC/TPP will demonstrate the validity of the conclusions drawn in the ESIA report. If ground level concentrations are found to be above local and World Bank standards options for further mitigation will be discussed.		**Install two continuous** NOx, SO_2, CO, PM_{10} & TSP **monitoring stations** to monitor short-term concentrations in the area predicted to have the highest impacts on humans (as there are no other sensitive environments). The analyzer station near or within the site boundaries will include a **continuous monitor** of meteorological conditions (temperature, wind speed, wind direction and mixing heights). The analyzer stations will be electronically connected to the EEAA ambient monitoring system.			Ambient air pollutants concentrations (at least TSP, PM_{10}, NOx, SOx and CO).		Annual reporting by CEPC/TPP to Government and WB etc. (or more frequently if required) highlighting key features and comparing results with air quality standards and prediction in ESIA report	Purchase of Continuous Monitors (see construction management table). Annual servicing, calibration & running costs: included in operation cost.

Table 8-5 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Aquatic Environment Discharge of process and cooling water.	The design of the intake and cooling water structures have already incorporated measures to reduce impacts. In addition, good site management practices including the following will be implemented: • neutralization, oil separation, flocculation and filtration of any contaminated water before discharge to either city sewer or the plantation irrigation network; • no disposal of solid wastes or waste water into the discharge structure; • regular maintenance of site drainage system to ensure efficient operation; • all discharges will comply with local Egyptian and World Bank guidelines. In addition, CEPC/TPP will demonstrate the validity of the conclusions drawn in the ESIA report. If pollutant concentrations in the discharge or impacts to the surrounding aquatic environment are found to be above local and World Bank standards or unacceptable, options for further mitigation will be discussed.	Lifetime of the plant	Prepare regular water quality monitoring program including: • quality of all water prior to discharge (**continuous monitoring** of all discharged water for temperature and pH, daily monitoring of process water for COD, TSS, oil & grease and residual chlorine and **monthly monitoring** of heavy metals and other pollutants) • ambient water quality in the area affected by the discharge plume (**3-monthly monitoring** of temperature, pH, COD, BOD, TOC, DO, TSS, oil & grease, residual chlorine, heavy metals and other pollutants. **Annual monitoring** of benthic environment within a 2 km radius of the discharge point (**over a 3 year period**) **Weekly monitoring** of fish catches on intake screens inclu-ding species, num-bers and size (**over a 1 year period**).	CEPC/TPP Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Basic parameters as per the Law the 48/1982 and Law 93/1962	Monthly reports from CEPC/TPP to EEHC Continuous monitoring of water quality etc. Monthly monitoring of heavy metals and other pollutants. 3-monthly monitoring of the plume. Annual monitoring of benthic environment (over a 3 year period). Weekly monitoring of Fish Catches on intake screens (over a 1 year period. Reports are to be available to any of the concerning authorities (EEAA, WB, etc.).	Records will be kept and compared on regular basis against Egyptian and World Bank standards and impacts predicted in ESIA. Summary reports (with any exceptions identified) will be submitted to the Government and WB etc. on annual review basis (or more frequently if required). CEPC/TPP to ensure that all employees are given basic induction training on the requirements of the ESMP, good site management practices and H&S procedures. The Assistant Plant Manager will ensure implementation of procedures.	Management time for implementation of site management practices. (included in operation cost) All costs are included in operation cost.

Table 8-5 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Noise	Although noise levels at northern fence of the plant (where residential colony is located beyond it) are complying with law 4/1994, northern fence will be elevated to a height of 5 m for gaining a reduction 3-5 dB(A) in noise levels. Specific design mitigation measures to minimize noise impacts include: • steam turbine generators; air compressors, pumps and emergency diesel engines are enclosed in buildings; • air compressors are equipped with silencers; • noisy outdoor equipment are designed to a noise limit of 85 dB (A) at 1 m. In addition, plant workers will be provided with protective wear in plant areas with high noise levels. The plant will operate in accordance with internationally accepted health and safety measures.	During first year of operation.	Given that sensitive receptors are located in the immediate vicinity of the plant, noise monitoring is envisaged. When the plant is fully operational, noise audit measurements are to be carried out at noise sources and at the fence of the power plant as well as at noise receptors around the plant.	CEPC/TPP Third party audit supervised by Assistant Plant Manager	EEHC Environmental Management & Studies Sector.	Power plant compliance with ESMP.	Quarterly to CEPC and EEHC. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	Should any complaints be received regarding noise, these will be logged and the Assistant Plant Manager will investigate problem. CEPC/TPP to ensure that all employees are given basic induction training on the requirements of the ESMP, good site management practices and H&S procedures. The Assistant Plant Manager will ensure implementation of procedures.	Costs for raising the height of the northern fence included within construction costs. Minimal costs (up to US$ 5K per annum) required for provision of protective wear- included in operation cost. No further mitigation or monitoring costs envisaged with the exception of management time. Noise audit US$ 20-24K

Table 8-5 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Flora and Fauna Disturbance to habitats as a result of noise, vehicle and personnel movements.	The following mitigation measures will be implemented: • restrict personnel and vehicle movements to access roads and within boundaries of site only; and • control of noise during operation.	Lifetime of the plant.	No monitoring is envisaged.	CEPC/TPP Assistant Plant Manager	EEHC Environmental Management & Studies Sector.	Good plantation	Yearly	CEPC/TPP to ensure that all employees are given basic induction training on the requirements of the ESMP, good site management practices and H&S procedures. The Assistant Plant Manager will ensure implementation of procedures.	Management time
Visual Impact Visual image of power plant from surrounding areas.	The visual effect of the power plant will be improved through: • creation of landscaped boundary along the fence of the power plant. • *Ficus elastica var decora* and *Ficus nitida* will be propagated and the resulting plants will be used for decorating and landscaping the site when completing the new power plant. One may obtain 200-300 individual plants from a single tree.	Lifetime of the plant.	No monitoring is envisaged.	CEPC/TPP Assistant Plant Manager	EEHC Environmental Management & Studies Sector.	Improved visual image		Considered management of landscaped areas to maximize visual image and habitat creation. CEPC/TPP to contract a suitable firm to manage landscaped areas.	Approx. US$ 10-25K for landscaping measures (included in operation cost)

Table 8-5 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Soil and Hydrology Spillage of oils, chemicals or fuels on site.	Good site management measures as **described under Aquatic Environment** will minimize any potential risks. As part of this, regular checks of bunds and drainage systems will be undertaken to ensure containment and efficient operation.	Lifetime of the plant	The Assistant Plant Manager will continuously monitor application of ESMP and good site management practices and take corrective action if required.	CEPC/TPP Assistant Plant Manager	EEHC Environmental Management & Studies Sector.	Quality of bunds and drainage systems. Efficiency of operation.	6-monthly reports from management to EEHC. Annual reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC/TPP, through the Assistant Plant Manager, will implement a Spills Response Plan and all employees will receive corresponding training.	Management time
Solid Waste	Good practice measures **undertaken during the construction phase** will be continued into the operation phase (see Table 6).	Lifetime of the plant	Continuous monitoring is required to ensure the implementation of good management practices during operation.	CEPC/TPP Implementation of Good Site Management practices shall be conducted under supervision of the Assistant Plant Manager.	EEHC Environmental Management & Studies Sector.	Management contract in place. Functional transfer station.	3-monthly reports from management to EEHC. Annual reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC/TPP to ensure all employees are given basic induction training on good operation and site management practices.	Management time and costs (<US$ 5K per annum) (included in operation cost)

Table 8-5 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Occupational Health and Safety, Risks and Hazards	Standard international practice on EHS issues shall be employed on site. The mitigation measures summarized in construction management Table apply. In addition, the following measures will be undertaken: • Provision of training in use of protection equipment and chemical handling. • Use of protective equipment. • Clear marking of work site hazards and training in recognition of hazard symbols. • Installation of vapour detection equipment and control systems. • Development of site emergency response plans.	Lifetime of the plant	Regular on-site training. Regular staff checks, system checks and field tests of emergency procedures by on-site management.	CEPC/TPP Assistant Plant Manager	EEHC Environmental Management & Studies Sector.	Management procedures in place. Workers health and safety measured by incidents, injuries and illnesses.	Monthly reports from management to EEHC Annual reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	CEPC/TPP to ensure that all employees are given basic induction training on H&S policies and procedures, Emergency Preparedness and Response Plan and a Spills Response Plan. The Assistant Plant Manager is to ensure implementation of procedures. CEPC/TPP is responsible for ensuring that the site emergency response plan is complete and implemented prior to commissioning any part of the power plant.	Management time and costs (< US$ 10K per annum) (included in operation cost)

Table 8-5 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Socio-Economic Environment Positive impacts identified	Fish Catch: based upon experience with similar plants elsewhere along the Nile and the opinions of the fishermen, impacts are very likely to be positive.	First year of operation. (possibly 2 other years)	In collaboration with the Fishery Authorities, monitor any changes to the fish catch	CEPC/TPP Assistant Plant Manager Fishery Authorities	EEHC Environmental Management & Studies Sector.	Fish catch no. & quality	Monthly reports from management to EEHC		Included in operation costs.

Table 8-6

Transmission System Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Direct									
Vegetation damage, habitat loss, and invasion by exotic species along the ROW and access roads and around substation sites. Habitat fragmentation or disturbance. Increased access to sensitive lands.	• Utilize appropriate clearing techniques, (e.g., hand clearing versus mechanized clearing). • Maintain native ground cover beneath lines. • Replant disturbed sites. • Manage ROWs to maximize wildlife benefits. • Select ROW to avoid important natural areas such as sensitive habitats. • Maintain habitat (i.e., native vegetation) beneath lines. • Make provisions to avoid interfering with natural fire regimes. • Select ROW to a avoid sensitive lands. • Develop protection and management plans for these areas. • Use discontinuous maintenance roads.	During Construction and Operation	Visual inspections of the materials being used, the construction practices and mitigation measures. Short-term monitoring to assure that negative land use and/or ecological impacts are avoided and proper mitigation measures are employed. Occurs along the line as it is constructed. Monitoring of ROW maintenance activities to assure proper control methods.	Egyptian Electricity Transmission Company (EETC) CEPC/TPP	EEHC management EEHC Environmental Management and Studies Sector	Effects on environmental and human resources involved (negative land uses, ecological damage) Degree to which they are affected.	Weekly (during construction). Maintenance time (during operation)	Environmental training and management will be warranted for ROW maintenance techniques, including the proper use of chemical and mechanical clearing methods. Training will be conducted by EETC and CEPC with assistance from environmental consultant. Staff workers should have an understanding of the rational for the recommended mitigation and monitoring that they may be implementing.	Included in construction and operation cost.

Table 8-6 (Contd.)

Transmission System Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Runoff and sedimentation from grading for access roads, tower pads, and substation facilities, and alteration of hydrological patterns due to maintenance roads.	• Select ROW to avoid impacts to water bodies, floodplains, and wetlands. • Install sediment traps or screens to control runoff and sedimentation. • Minimize use of fill dirt. • Use ample culverts. • Design drainage ditches to avoid affecting nearby lands.								
Loss of land use and population relocation due to placement of towers and substations.	• Select ROW to avoid important social, agricultural, and cultural resources. • Utilize alternative tower designs to reduce ROW width requirements and minimize land use impacts. • Adjust the length of the span to avoid site-specific tower pad impacts. • Manage resettlement in accordance with World Bank procedures.								
Chemical contamination from chemical maintenance techniques.	• Utilize mechanical clearing techniques, grazing and/or selective chemical applications. • Select herbicides with minimal undesired effects. • Do not apply herbicides with broadcast aerial spraying. • Maintain naturally low-growing vegetation along ROW.								

Table 8-6 (Contd.)

Transmission System Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Avian hazards from transmission lines and towers.	• Select ROW to avoid important bird habitats and flight routes. • Install towers and lines to minimize risk for avian hazards. • Install deflectors on lines in areas with potential for bird collisions.								
Aircraft hazards from transmission lines and towers.	• Select ROW to avoid airport flight paths. • Install markers to minimize risk of low-flying aircraft.								
Induced effects from electromagnetic fields.	• Select ROW to avoid areas of human activity.								
Impaired cultural or aesthetic resources because of visual impacts.	• Select ROW to avoid sensitive areas, including tourist sites and vistas. • Construct visual buffers. • Select appropriate support structure design, materials, and finishes. • Use lower voltage, DC system, or underground cable to reduce or eliminate visual impacts of lines, structures, and ROWs.								

Table 8-6 (Contd.)

Transmission System Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Indirect Induced secondary development during construction in the surrounding area. Increased access to sensitive lands.	• Provide comprehensive plans for handling induced development. • Construct facilities to reduce demand. • Provide technical assistance in land use planning and control to local governments. • Route ROW away from sensitive lands. • Provide access control.								

Table 8-7

Summary of Implementation Cost of the ESMP

No.	Phase of Implementation	Cost in US$	
		Measures	**Monitoring**
1	Demolition Phase	174K	65K
2	Construction Phase	115K	1565K
3	Operation Phase	-	24
	Sub. Total	**289K**	**1654K**
	Total	**1943K**	

Table 8-7 shows that the total implementation cost of the environmental and Social Management Plan is about US$ 1.87 million, which amounts to about 0.74% of the total project cost.

8.4 BASELINE MONITORING OF THE PRE-CONSTRUCTION ENVIRONMENT

8.4.1 Baseline Air Quality Survey Using Air Quality Monitoring System

Objectives

Monitoring of air quality parameters such as NO_2 and SO_2 offers an appropriate method of obtaining hourly, daily, monthly and annual mean pollutant concentrations over a wide spatial area. A continuous monitoring program continued over an extended period, enables measured 1 hr, 24 hr and annual mean pollutant concentrations to be compared with relevant Egyptian and World Bank guidelines. It provides a baseline against which to evaluate short-term impacts measured using continuous NO_2 , SO_2, CO and TSP analyzers.

The main objective of the proposed air quality monitoring program is to determine the effect of effluent emissions from the El-Tebbin Station. Prior to the commencement of a monitoring program, the number and location of monitors that are required to provide adequate aerial coverage need to be determined. Consideration should be given to the effects of existing sources, nearby terrain, meteorological conditions, and the pollutant to be monitored as well as their associated averaging times.

Natural gas will be used as the primary fuel, and no. 6 fuel oil will be used for emergency purpose only with a total firing period not to exceed 7 days per year. For the siting study, only the normal gas-fired scenario was analyzed.

Methodology

Based on the U.S. Environmental Protection Agency guidance (EPA, 1987), air dispersion modeling should first be performed to determine the general locations(s) of maximum air pollutant concentrations from the proposed source.

To determine the magnitude and locations of maximum background air quality impacts, the French-approved Atmospheric Dispersion Modeling System (ADMS3) was used for the study. The (ADMS3) was also used for a stack height determination analysis conducted for the Tebbin Project (see Section 6.2).

In addition, as indicated in Section 5.4, there were the EEAA existing background air quality monitors located within the Tebbin Area including plant site. These EEAA monitors have collected sufficient ambient records to form a good base of representative background data (The Egyptian Environmental Affairs Agency, 2004).

In general, air quality monitors should be placed at (a) the expected area of the maximum concentration from the new source, and (b) the maximum combined impact area(s).

Generally, two to three sites would be sufficient for most situations in multi-source areas. In areas where there are no significant existing sources, one or two sites would be sufficient.

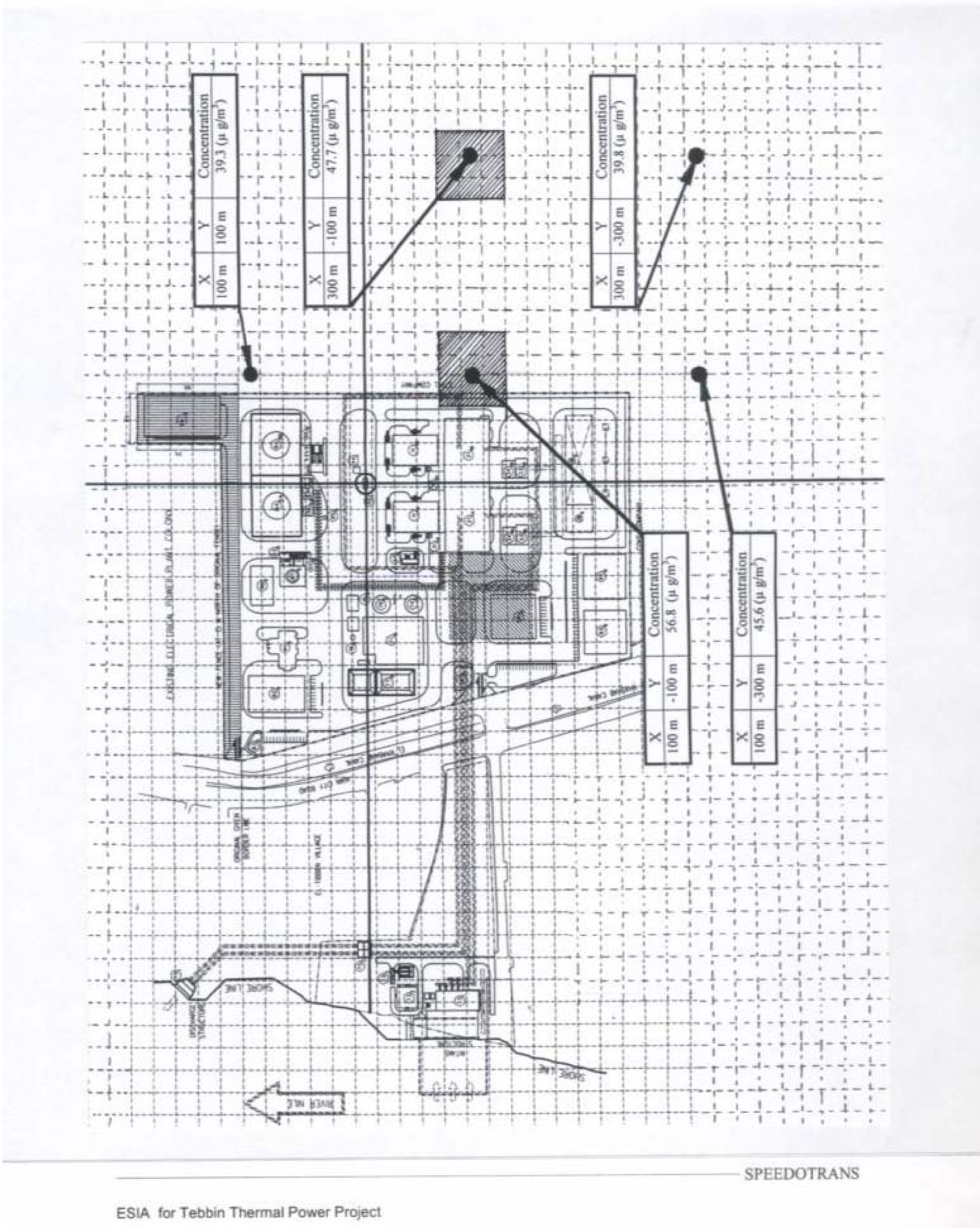
For convenience, the maximum impact locations derived in Section 6.2 are presented by the polar coordinate and the conventional x-y coordinate. Both coordinates use the same origin as shown in *Figure 8-3*.

1-hour, 24-hour and annual maximum impact areas were considered in the design of the monitoring network.

The highest concentrations for each of the averaging periods under consideration (annual, daily, hourly) are found to the south-east of the site. This is because the winds are overwhelmingly from the north and northwest for most of the time. Maximum annual concentration of NOx emissions in the ambient atmosphere due to operation of the Tebbin power plant will not exceed 10 µg/m3 (highest annual maximum is 9.6 µg/m3 at the location [300m, -300m]) and the maximum daily reaches 56.8 µg/m3 at a distance of 141 m southeast the powerhouse. Also, Maximum “One-hour Average” concentration of NOx emissions in the ambient atmosphere reaches 96.3µg/m3 at the location [130m, 95m]. Figure 6-7 depicts the locations of the First Five Maximums of daily average of NOx concentrations. The suggested monitoring locations are presented in Figure 8-3. Areas, instead of the precise points, are suggested because in some cases, it is simply not practical to place monitors at the

Figure 8-3

El-Tebbin Air Quality Monitoring Locations



indicated modeled locations. However, it is recommended that an air quality monitoring system composed of 2 or 3 monitoring stations will be utilized. The monitoring station equipped with meteorological monitoring system will be located near to, or within, the Tebbin power plant site, the other one or two stations will be located one down wind within the designated area and the other (if any) upwind.

Reporting

Reports will be prepared by CEPC/TPP on a quarterly basis, and be prepared as continuous monitoring concentration summaries.

8.4.2 Aquatic Environment

At the request of the EEHC/SPEEDOTRANS a field survey was undertaken by Hydraulics Research Institute representatives and by National Research Center staff of the Tebbin Nile segment area fronting the power station site. The results of this survey shall be retained as a baseline comparison for Nile monitoring during power plant operation.

In addition, site management practices and site drainage systems will be continuously monitored by the site Assistant Plant Manager to ensure that no pollutants reach the aquatic resources.

8.4.3 Floral Wealth

Throughout demolition and construction, plantation ecologist will work closely with the engineer and/or contractors in order to develop a detailed conservation plan for floral wealth on the site.

8.4.4 Archaeology and Cultural Heritage

Throughout construction, activities will be closely supervised by personnel trained to recognize potential archaeological finds. Should a potential find be uncovered, the mitigation measures described in Section 7.2.8 will be employed.

8.5 MONITORING OF IMPACTS DURING POWER PLANT OPERATION

8.5.1 Stack Emissions

Stack emissions will be monitored continuously during plant operation at a representative point in the stack. Operational monitoring of stack emissions shall comprise monitoring the levels of:

- Oxides of Nitrogen;
- Sulfur Dioxide;
- Carbon Monoxide; and
- Total Suspended Particles and PM_{10}.

The automatic monitoring system used will be linked to an alarm to warn when emission limits (as stated in Section 2) for each pollutant are being approached.

Concentrations will be recorded as hourly rolling averages and reports on stack emissions monitoring will compare recorded emissions against predicted levels and Egyptian and WB guidelines (as given in Section 2). Reports will be submitted to the EEAA, the WB and any other concerned authority on an annual basis (or as required).

8.5.2 Ambient Air Quality - Validation of Modeling Predictions Using Continuous NOx, SO_2 and TSP Analyzer

Objectives

The use of a continuous NOx, SO_2, CO and TSP analyzer allows for baseline air quality monitoring on a continuous basis. The provision of two continuous monitors (or three: one at the site, one upwind and the third downwind) will provide the basis for "validating" the predictions made in the ESIA. The monitors will also include a weather station providing data on air temperature, wind speed, wind direction and mixing heights on a continuous basis. These monitors shall, also, be connected electronically to the EEAA ambient monitoring system.

Methodology

The monitors will be purchased and installed as far in advance of plant start-up as possible so that baseline data can be collected for the two (or three) sites, using equipment capable of measuring short-term averages.

Training will be provided to the nominated operatives in relation to use, maintenance and troubleshooting for the equipment. The equipment will be monitored on a daily basis by CEPC/TPP to ensure that it is working correctly. Daily maintenance monitoring can be undertaken remotely by downloading the recorded results from the analyzers at upwind and downwind locations to the shelter at the project site (i.e. the analyzers do not need to be physically checked daily). The results will be checked by CEPC/TPP to ensure they are realistic and also to check against anomalies. Daily down-loading of data will also ensure that continuous records are maintained in the event of equipment failure or power shortage.

The demolition, construction and operational monitoring of air quality around the Tebbin power project will include the parameters summarized in *Table 8-8.*

A report detailing the air quality monitoring program is provided in Annex F.

Reporting

The equipment measures air quality on a continuous basis and is capable of calculating and reporting on short-term averages. Twenty-four hour and 1-hour averages would be appropriate measurements to record.

Table 8-8

Monitoring Program for Ambient Air Quality, Noise and Vibration

Item	Monitoring Parameters	Sampling Frequency	Monitoring Locations	Indicative Cost Estimate (US$)
Demolition and Construction Phases				
Air Quality Dust emissions caused by demolition and construction activities, demolition and construction vehicle movements, and transport of demolition debris and friable construction materials.	NO_2 , SO_2 , CO, TSP and PM_{10}.	Monthly during demolition. Continuous monitoring during construction.	2 locations minimum: at nearest residence and site boundary during demolition. 2 locations minimum: at nearest residence and site boundary during construction.	Permanent Continuous Monitoring System- approx. US$ 1000-1500K
Noise	Decibels (dB) A	Monthly	6 locations minimum: at nearest residences	Management time and costs (US$ 10k)
Operation Phase				
Air Quality Emissions from stack are not expected to exceed standards. Ambient air quality affected by emissions from the power plant.	**Automatic monitoring** of stack emissions for NOx, SO_2, particulate matter and carbon monoxide (CO) via test ports installed in the main stack. In addition, conduct surrogate **performance monitoring**. **Install (at least) two continuous** NOx, SO_2, CO, PM_{10} & TSP **monitoring stations** to monitor short-term concentrations in the area predicted to have the highest impacts on humans (as there are sensitive environments). The analyzer station near or within the site boundaries will include a **continuous monitor** of meteorological conditions (temperature, wind speed, wind direction and mixing heights).	Continuous and/or 24 hour average Continuous and/or passive samples every 2/4 weeks The analyzer stations will be electronically connected to the EEAA ambient monitoring system.	2 locations minimum: at maximum predicted pollution concentration and downwind. Third location, if any, will be 1 km upwind.	Included in the plant operation
Noise		Bi-annually to annually	6-10 sites at nearest residences and fence around the plant	Noise audit US$ 10-15K

Annual reports will be provided to the EEAA and to the WB or any other concerned authority (via CEPC/TPP) (or more frequently if required), highlighting key features and comparing the results with air quality standards (as presented in Section 2), with the predictions in the ESIA report, with respect to gas supply failure and subsequent emergency use of heavy fuel oil (mazout), baseline air quality and worst case air quality predictions, once the plant is operational.

8.5.3 Aquatic Environment

Monitoring of impacts of the power plant on the aquatic environment will include monitoring of the quality of the discharge water, river bank and benthic sediments, ambient water quality and the impact on aquatic flora and fauna. The survey techniques and areas will be comparable to the survey undertaken by both of the Hydraulics Research Institute and the National Research Center during April-June 2005. The survey will include the area affected by the thermal plume (i.e. 100m from the discharge point).

The operational monitoring of cooling water and effluent discharge will include the parameters summarized in *Table 8-9* below.

Monitoring data will be analyzed and reviewed at regular intervals and compared with Egyptian and World Bank guidelines (as given in Section 2). Records of monitoring results will be kept in a suitable format and will be reported (in summary format with any exceptions identified) to the responsible government authorities and the WB or any other concerned authority as required. As a result, the project company, in discussion with the EEAA, EEHC and the WB or any other concerned authority, will review the need to implement any additional mitigation features, such as provision of further water treatment facilities on site and also on the need to continue monitoring.

8.5.4 Waste Monitoring

Wastes generated on site and collected for disposal by skilled firms will be referenced, weighed and recorded. Environmental audits will be undertaken which will assess the quality and suitability of on- and off-site waste management procedures.

Table 8-9

Monitoring of the Aquatic Environment During Operation

Issue	Parameter	Method	Frequency of measurements
Water Quality	Temperature & pH of all discharged water COD, TSS, Oil & Grease, residual chlorine of effluent Heavy metals & other pollutants of effluent	Continuous automatic monitor in discharge structure Sample taken from water in discharge structure and submitted for lab. Analysis As above	Continuous Daily Monthly
Ambient Water Quality	Temperature, pH, COD, BOD, TOC, DO, TSS, oil & grease, residual chlorine, heavy metals & other pollutants	Grab sampling and analysis within the area predicted to be affected by the discharge plume	3-monthly
Flora & Fauna (1)	Benthic flora & fauna	Transect sampling (following same method as in baseline monitoring) within a 2 km radius of the discharge point	Annual
Entrainment (2)	Fish entrainment on screens	Removal and analysis of any debris caught in intake screens	Weekly

Notes:
(3) To be undertaken for the first 3 years of plant operation.
(4) To be undertaken for the first year of plant operation.

Abbreviations:
COD: Chemical Oxygen Demand
BOD: Biological Oxygen Demand
TOC: Total Organic Carbon
DO: Dissolved Oxygen
TSS: Total Suspended Solids

9. CONSULTATION AND DISCLOSURE

9.1 INTRODUCTION AND GENERAL APPROACH

In order to ensure that the views and interests of all project stakeholders are taken into accounts, public consultation has been carried out according to the World Bank guidelines and EEAA requirements which require coordination with other government agencies involved in the EIA, obtaining views of local people and affected groups. This consultation has been undertaken as part of the Environmental Impact Assessment process. The process of this consultation is also implemented in accordance with World Bank requirements for Phase I consultations.

This section summarizes the activities which have been undertaken in Phase I, the results of consultation and a summary of the activities which have been undertaken as a complementary procedure (Phase II). It, also, summarizes the activities which may be undertaken, under this condition, during the construction and operation of the power plant.

9.1.1 Public Consultation Regulations and Requirements

In accordance with World Bank requirements, namely the Bank's Operational Policy (OP) 4.01 Environmental Assessment and other key documents, affected groups and NGOs must be consulted as part of the environmental assessment of projects. The primary purpose of this provision is to protect the interests of affected communities. Therefore, the EIA process should include consultation and disclosure of information to key stakeholders involved in and/or affected by the Tebbin power plant project.

The objectives of consultation and disclosure are to ensure that all stakeholders and interested parties, are fully informed of the proposed project, have the opportunity to voice their concerns and that any issues resulting from this process are addressed in the EIA and incorporated into the design and implementation of the project.

Egyptian Law number 4 of 1994, which addresses the environment, does not stipulate or refer directly to public consultation within the EIA process. However, its importance may be inferred from the inclusion of representatives of environmental non-governmental organizations on the Board of Directors of the EEAA. Furthermore, the EEAA “Guidelines for the Basis and Procedures of Environmental Impact Assessment (EEA) – Sector Guidelines” suggest discussions with local stakeholders and interested parties during scoping and preparation of the EIA.

9.2 CONSULTATION METHODOLOGY

The adopted methodology for the public consultation comprises two phases, including four elements, namely:

Phase I

- discussions with local stakeholders and interested parties during preparation of the environmental documents for local permitting requirements;

- discussions with local stakeholders during scoping and preparation of this ESIA-Report;

Phase II

- the organization of a Public Meeting in the Cairo Governorate, and

- on-going consultation through an "open-door" policy during construction and operation of the power plant.

As far as public disclosure is concerned, major initiatives to inform the public and interested parties about the Tebbin Power project include the following:

- press advertisement describing the project and inviting interested parties to attend the public meeting and review the Draft Final ESIA Report;

- distribution of an invitation and copy of the Non Technical Summary (in Arabic) describing the context of the power plant, the technology employed, the impact on the environment, the mitigation measures and the ESMP; and

- disclosure of the Draft Final ESIA Report, including the Executive Summary, locally and via the World Bank Infoshop.

A Public Consultation and Disclosure Activities (PCDA) are designed and implemented in accordance with World Bank guidelines. The purpose of the Activities is to establish the process by which CEPC/TPP will consult and involve stakeholders in the planning, development, construction and operation of the power plant.

9.2.1 Stakeholders

During the ESIA process, stakeholders for the project have been identified and include the following:

- Local Council and District Authorities;

- Government Regulatory Agencies;
- local business and commercial interests;
- local people including population representatives;
- environmental research organizations; and
- NGOs and other environmental interests.

A full list of primary stakeholders is presented in *Table 9-1* (a full list of primary and secondary stakeholders is presented in Annex A).

Table 9-1

Primary Stakeholder Organizations

Organization
• Cairo Governorate
• District of Tebbin Zone (Haie El-Tebbin)
• Egyptian Electricity Holding Company (EEHC)
• Local Electricity Authority (Cairo Electricity Production Company “CEPC”)
• Egyptian Environmental Affairs Agency (EEAA)
• Ministry of Water Resources and Irrigation
• Cairo South population representatives (Helwan – Tebbin – 15th May)
• Ministry of Transport
• Cairo Transport Department
• Egyptian General Petroleum Corporation (EGPC)
• Egyptian Natural Gas Holding Company (EGAS)
• Egyptian Natural Gas Company (GASCO)
• Egyptian General Authority for Shore Protection
• National Research Center, State Ministry of Scientific Research and Technology
• General Authority for Fishery Development, Ministry of Agriculture
• Egyptian General Authority for Meteorology

9.2.2 Management and Participation

Public consultation and disclosure is managed and undertaken by Environmental Consultant SPEEDOTRANS and CEPC with participation from EEHC. Phase II of the consultation and disclosure process, which includes local disclosure of the Draft Final ESIA-Report and a public meeting, is undertaken in close collaboration with the local authorities, namely the Cairo Governorate. Concerned stakeholders including local industry, economic representatives and local people, have been, and will continue to be, requested to actively participate in this process.

It was not anticipated that any further notification will be required, for example, the posting of notices locally, since local communities or settlements near the power station site were notified by the CEPC/TPP. Further, it was very evident from the scoping mission that the attendance of the CEPC's Chairman and Tebbin Council's President at the public meeting will ensure media coverage.

9.3 PHASE 1 CONSULTATION

9.3.1 Consultation undertaken by SPEEDOTRANS, EEHC and CEPC

During the preparation of an ESIA-Report for local permitting requirements, SPEEDOTRANS, EEHC and CEPC undertook consultations with a variety of organizations to assist them in the identification of environmental and social concerns and the overall development of the project. These stakeholders included the Egyptian Electricity Holding Company (EEHC), Cairo Electricity Production Company (CEPC), Egyptian Environmental Affairs Agency (EEAA), the Cairo Governorate and the District Council of EL-Tebbin Zone, Egyptian General Authority for Shore Protection, Hydraulics Research Institute and local population leaders.

The purpose of these consultations was primarily to provide information regarding the project, identify published and non-published sources of relevant data and information relating to the site and surrounding area, obtain views on the scope of the project, and open channels for ongoing discussions.

The key environmental issues raised during this consultation process are summarized in *Table 9-2* and these issues were subsequently taken into account in the preparation of ESIA documentation both for local permitting requirements and this ESIA report.

Table 9-2

Key Environmental Issues Associated with the Development of the Proposed Power Plant Identified During Local ESIA Consultation

Subject	Description of the Key Issue
Air Quality	• Level of stack emissions from the power plant and the resulting compliance with air quality standards during normal operation and emergency periods, i.e. if the gas supply is interrupted. • Potential for cumulative air quality impacts due to the simultaneous operation of El-Tebbin Industrial Complex and the proposed power plant.
Aquatic Ecology	• Vulnerability of aqua-culture from liquid effluents and the cooling water.
Floral Diversity	• Vulnerability of long-living trees in the northern part of the site and the residential colony.
Noise	• Levels of noise which will be experienced at local receptors.
Hazardous Waste	• Vulnerability of human health from asbestos containing materials, if found, during demolition.
Traffic	• Traffic generation, especially during construction, and the potential for congestion on local roads.
Socio-economic	• Present workforce in El-Tebbin old plant. • Employment. • Demand for Local Service.

9.3.2 Consultation during the ESIA Process

A scoping session for this ESIA undertaken by SPEEDOTRANS in collaboration with the EEHC and CEPC, took place on Tuesday, 7 June 2005 during which a wide selection of personnel from different orientations contributed actively to its activities.

The key objectives of this consultation were to identify primary and secondary stakeholders, ensure that they had received sufficient information about the project during earlier consultation activities and to identify their immediate concerns.

The session was organized to include the following activities:

- Presentation of the ESIA scope as per the TOR;
- Breakdown of the activities to highlight the issues that the attendees might comment on;
- Explain the environmental issues and invite the participants to raise their concerns about possible negative impacts; and
- Conduct the discussions and invite the owner, local authorities and agencies to participate in the discussions.

The full documentation for the scoping meeting is presented in Annex B.

The issues raised during the scoping session are summarized in *Table 9-3* below.

9.3.3 Mini-meetings with Affected Stakeholders

In addition to the scoping meeting, several mini-meetings were held with some particular affected stakeholders for taking their viewpoints into consideration.

The purpose of taking these viewpoints into account was to improve project viability. The World Bank (1991) has found that where such views are seriously considered and incorporated in the EA process, projects are likely to be more successful. The Bank provides some useful guidance regarding the extent and level of stakeholder involvement in the EA process in its Sourcebooks (World Bank, 1991-Chapter 7).

Mini-meetings were held with fishermen on the Nile segment fronting the power plant site, the Tabbin Institute for Metallurgical Studies (TIMS), Tebbin District Administration, Tebbin power project staff, General Authority for Fishery Development and two active NGOs in Tebbin zone, namely El-Ataa Association for Environmental Protection, Haie El-Tebbin El-Bahari and Local Community Development Association, El-Tebbin, Marazique.

These mini-meetings were seen important for:

- informing interested groups and individuals about the proposed development, its potential impacts, and measures which will lessen impacts and protect the environment;

Table 9-3

Key Issues Raised During ESIA Scoping

Key issue discussed	Comments
Overall Project	All parties consulted expressed their overall approval for the project. Local Stakeholders commented that the power plant will be central to securing power supply for the industrial and commercial activities in the area and will benefit the local economy through labor opportunities.
Social and Economic Impact	Local stakeholders and council leaders considered the social and economic impact of the plant to be wholly positive.
Waste water discharge and the aquatic environment	All local stakeholders expressed concern about the quality of water in the Tebbin Nile segment and the quality of water which will be discharged from the power plant. It was however acknowledged that there are no significant aquatic ecosystems close to the power plant. The suggestion was made that treated wastewater could be used for irrigation of landscaped areas.
Air Quality	There was big concern over the following issues: • compliance with air quality standards and the effect that non-compliance and subsequent plant closure could have on security of employment in the area; • accumulated effects of the relatively degraded air quality in the Tebbin atmosphere and the impact of the power project; • back-up heavy fuel oil is prohibited in residential areas, but Tebbin, as identified in several urban planning schemes for Greater Cairo Region since 1950's, belongs to an industrial setting.
Ecology of the Site	There was significant attention to keeping a landscape area inside the power plant fence for preserving the old trees already existing within the site.
Hazardous Waste	Some parties expressed their fears of finding asbestos containing materials during demolition.
Environmental Compliance	An underlying concern expressed by all local stakeholders was compliance with environmental regulations. Assurances from CEPC are sought to the effect that CEPC will guarantee implementation of the environmental compliance measures which will be stated in the Environmental and Social Management Plan.

- providing opportunities for timely feedback;

- identifying problems, needs and values;

- minimizing misunderstandings about the scope and impacts of the project and increase public confidence in the proposed development; and

- contributing to an increased awareness and understanding of project plans and activities.

Memorandums of Mini-meetings that were held with some affected groups are given in Annex C.

9.3.4 Conclusions from Phase 1 Consultations

The main results of Phase I consultation was to successfully raise the level of local awareness about the plant, to identify the immediate local concerns and to seek stakeholder involvement in the implementation of the project.

The four issues of key concern to the stakeholders consulted were the potential health impacts of hazardous waste during demolition, the impact of the plant on pollutant loads in the Cairo South Zone, compliance with environmental standards particularly with regard to air and wastewater discharge quality and the potential economic impacts on the local community. These concerns have been addressed within the ESIA process and measures to ensure compliance are incorporated into the Environmental and Social Management Plan (ESMP). The ESMP will be implemented by CEPC/TPP as a condition of compliance with the EEAA regulations and of financing from the World Bank.

9.4 PHASE II CONSULTATION AND DISCLOSURE

Phase II of the public consultation and disclosure process included the disclosure of information about the project (advertisement, invitation including a copy of the Non-Technical Summary (in Arabic) and public access to the Draft Final ESIA Report) and organization of a public meeting.

The Draft Final ESIA report, together with the Non-Technical Summary in Arabic, was disclosed locally for 30 days at the offices of the Tebbin power plant, EEHC offices and at the offices of the local environmental consultant in Cairo.

In order to make people aware of the disclosure of the Draft Final ESIA Report, an advertisement was placed in the national newspaper Al Ahram in

Arabic. The advertisement also drew readers attention to the date and venue of the proposed public meeting.

Finally, a public meeting was held in the Cairo Governorate on 4th September 2005. The aim of the meeting was to present and explain the results of the Draft Final ESIA Report to local stakeholders, to provide them with the opportunity to raise any further or additional concerns and to ensure that all issues are taken into account in the Final ESIA Report and corresponding ESMP. Further concerns raised during Public Consultation Meeting are summarized in *Table 9-4* below.

Phase II Consultation and Disclosure activities and the Public Consultation Meeting Report are reported in Annex D.

9.5 ONGOING FACILITY FOR PUBLIC CONSULTATION AND DISCLOSURE

The World Bank also requires that the consultation process is ongoing during the construction and operation phases of the project. To this effect, CEPC/TPP has stated its commitment to maintaining long term and mutually beneficial open dialogue with local authorities, industrial and commercial interests and local people, through its Safety and Environment Officer during construction and Assistant Plant Manager during operation. A key role of this post consultation will be to ensure that local stakeholders have an opportunity to raise questions, comments or concerns and that all issues raised are answered promptly and accurately.

The site of the power plant is relatively remote from areas of dense population, being situated in the area of the El-Tebbin, an area designated for industrial use. The nearest populations during the operational life would be the residential colony and the Tebbin village, 60 m to the north and 150 m to the north west. It is not considered necessary therefore, to recommend any further public consultation measures over and above those committed to above.

Disclosure of information will also continue throughout project construction and operation. The primary emphasis here will be to assure stakeholders that the environmental mitigation, monitoring and management practices established in the ESIA and its ESMP are being implemented and the environmental standards and guidelines dictated by the Egyptian government and the World Bank are being met through a comprehensive monitoring and reporting process. CEPC/TPP is required under Egyptian law, to maintain an Environment Register of written records with respect to environmental impacts from the power plant. In addition, an annual report containing technical data relating to the monitoring program will be prepared by the CEPC/TPP and submitted to the EEHC, EEAA and the WB.

Table 9-4

Further Concerns Raised During ESIA Public Consultation Meeting

Key issue discussed	Comments
Demolition Phase	There was need for clarifications on procedures set out for demolishing the existing old Tebbin power plant and for waste disposal.
Cooling Water	EEAA representative raised the issue of algae suppression at the intake structure using chlorine instead of using sodium hypochlorite to avoid salt production. There was scientific discussion on the technical reasons for choice of once-through system instead of using closed-circuit cooling system.
Air Quality	connection of the plant monitoring system automatically with EEAA ambient air quality system.
Noise	EEAA representative gave concern about intermittent high noise impact during commissioning period and got clarification on abatement plans.

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