Pyramids Plateau Groundwater Lowering Activity

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Environmental Assessment Report

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Acronyms and abbreviations

AECOM	Architecture, Engineering, Consulting, Operations & Management Technology Corporation
AMBRIC	American and British Consortium
ARCE	American Research Centre
CAPMAS	Central Agency for Public Mobilization and Statistics
CAPW	Organization of Cairo and Alexandria Water & Sewage
CDA	Community Development Association
CMRI	Channel Maintenance Research Institute
CU	Cairo University
ECG	Engineering Consultants Group
EDG	Environment & Development Group
ESMP	Environmental and Social Management Plan
DRI	Drainage Research Institute
EA	Environmental Assessment
ED/CM	Engineering Design and Construction Management
EEAA	Egyptian Environmental Affairs Agency
EIS	Environmental Impact Statement
EHCW	Egyptian Higher Committee for Water
EIA	Environmental Impact Assessment
ESMP	Environmental and Social Monitoring Plan
GCR	Greater Cairo Region
GoE	Government of Egypt
GOPP	General Organization for Physical Planning
GOGCWS	General Organization for Greater Cairo Water Supply
GPS	Global Positioning System
IUCN	International Union for the Conservation of Nature
LMT	Local Monitoring Team
MoHP	Ministry of Health and Population
MHINC	Ministry of Housing, Utilities and New Communities
MALR	Ministry of Agriculture and Land Reclamation
MSEA	Ministry of State for Environmental Affairs
MWRI	Ministry of Water Resources and Irrigation
NGO	Non-Governmental Organization
NOPWASD	National Organization for Potable Water and Sanitary Drainage
NRI	Nile Research Institute
NWRC	National Water Research Centre
OSH	Occupational Safety and Health
RIGW	Research Institute for Groundwater
UNESCO	United Nations Scientific and Cultural Organization
SCA	Supreme Council for Antiquities
SWRI	Soil, Water and Environment Research Institute
USAID	United States Agency for International Development
USEPA	US Environmental Protection Agency
WCHS	World Conservation Heritage Site
WHO	World Health Organization

Weights and measures

µg/l	Micrograms per liter
µg/ m^3	Micrograms per cubic meter
Acre	A unit of area equal to 4,047m^2
asl	Above sea level
dB	Decibel
dB L_{eq} (A)	A-weighted average sound level
BOD5	5-day biochemical oxygen demand
COD	Chemical Oxygen Demand
ºC	Temperature in degrees Celsius
Feddan	A unit of area equal to 4,200m^2
hr or hrs	Hour or hours
km	Kilometer
LE	Egyptian Pounds
l	Liter
m	Meter
m asl	Meters above sea level
mm	Millimeter
m^2	Meter squared
m^3/day	Meter cubed per day
m^3/hr	Cubic meters per hour
mg/l	Milligrams per liter
mgO_2/l	Milligrams of Oxygen per liter
ml	Milliliters
mg/m^3	Milligrams per cubic meter
mm	Millimeters
m/s	Meter per second
MNP/ml	Mononuclear phagocytes per milliliter
NTU	Normal Turbidity Units
pH	Power of Hydrogen (acidity/alkalinity)
PM	Respirable particles
ppm	Parts per million
$	United States Dollars
TDS	Total Dissolved Solids
TSP	Total Suspended Particles
TSS	Total Suspended Solids

TABLE OF CONTENT

1. SUMMARY 6

2. PURPOSE 9

3. AFFECTED ENVIRONMENT 13

3.1 THE PHYSICAL SETTING 13
3.1.1 GEOGRAPHICAL SCOPE 13
3.1.2 GEOLOGY AND GEOMORPHOLOGY 13
3.1.3 HYDROGEOLOGY 17
3.1.4 SURFACE WATER 18
3.1.5 AIR QUALITY 24
3.1.6 NOISE LEVELS 26
3.1.7 CLIMATE 28
3.2 THE CULTURAL HERITAGE SETTING 33
3.2.1 THE GIZA NECROPOLIS 33
3.3 THE BIOLOGICAL SETTING 39
3.3.1 VEGETATION 39
3.3.2 REPTILES AND AMPHIBIANS 40
3.3.3 BIRDS 40
3.3.4 MAMMALS 41
3.3.5 INVERTEBRATES 41
3.3.6 FRESHWATER FISH 41
3.4 SOCIAL SETTING 42
3.4.1 METHODOLOGY OF SOCIOLOGICAL INVESTIGATION 42
3.4.2 EXISTING SOCIAL AND ECONOMIC CONDITIONS 43

4. ALTERNATIVES INCLUDING THE PROPOSED ACTION 49

4.1 GROUNDWATER LEVELS AND DEWATERING TARGET 49
4.1.1 PRE-DEWATERING CONDITIONS 49
4.1.2 GROUNDWATER CONDITIONS FOLLOWING THE INTERVENTION OF SCA/CU 50
4.2 ALTERNATIVE APPROACHES TO GROUNDWATER LOWERING 53
4.2.1 GROUND WATER SOURCE CURTAILMENT 54
4.2.2 THE VERTICAL WELLS 54
4.2.3 EXCESS WATER DISCHARGE 55

5. ENVIRONMENTAL CONSEQUENCES 60

5.1 IMPACT IDENTIFICATION 60
5.1.1 IMPACT SCOPING 60
5.1.2 PROJECT COMPONENTS AND ACTIVITIES 62
5.2 IMPACT PREDICTION AND INTERPRETATION 68

5.2.1 Potential impacts of the construction phase 68
5.2.2 Potential impacts of the operation phase 69
5.3 Analysis of alternatives 73
5.3.1 Dewatering scheme and the no-action alternative 73
5.3.2 Discharge alternatives 73
5.3.3 Discharge force-main and station alternatives 73

6. MITIGATION MEASURES AND MONITORING PLAN 76

6.1 Mitigation measures and Environmental and social management plan (ESMP) 76
6.1.1 Mitigation of construction impacts 76
6.2 monitoring plan 83
6.2.1 Monitoring construction activities 83
6.2.2 Monitoring during operation 83
6.3 Conclusion 86

LIST OF PREPARERS 87

ANNEX 88

Annex 1 Policy, legal and administrative framework 88
Annex 2 Noise measurements 100
Annex 3 List of plant and animal species recorded in the study area 102
annex 4 participants in focus group scoping meetings and interviews 108
Annex 5 Public meeting advertisement, agenda, and project facts sheet 113
Annex 6 List of stakeholders invited to public consultation session 116
Annex 7 transcription of public scoping meeting discusstion 119
References 123

TABLE OF TABLES

Table 1 Groundwater quality from mixed samples of three dewatering wells in the Pyramids Plateau and Water quality at 8 sites along the Mansoureya Canal 20
Table 2. Permissible exposure times to different sound intensities 27
Table 3. Number of permissible intermittent impacts during the daily working hours. 27
Table 4 Maximum allowable noise intensity in different areas (Law 4/94) 27
Table 5 SCA/CU dewatering well flows 51
Table 6 summarizes the advantages and disadvantages of the various alternatives. 53
Table 7 Impact areas 63
Table 8 Construction activities and components 64
Table 9 Operation activities 67
Table 10 Impact prediction matrix: construction and operation phases 70
Table 11 Analysis of alternatives 75
Table 12 Potential adverse impacts and proposed measures for their mitigation. 80
Table 13 Environmental monitoring plan 85

TABLE OF FIGURES

Figure 1 Water logging near the Valley Temple, the Giza Pyramids Plateau..... 9
Figure 2 Water logging near the Pyramid Builders City, Giza Pyramids Plateau..... 10
Figure 3 Capillary water rise at the base of the wall of the crow..... 11
Figure 4 Capillary water rise at base of the wall of the crow..... 11
Figure 5 Location of the Giza Plateau and the EA study area, southwest of the GCR. 14
Figure 6 Agricultural fields southeast of the Giza Pyramids Plateau. 15
Figure 7 Topographical map of the Pyramids Plateau 16
Figure 8 Cross section of the Pyramids' Plateau from West to East..... 17
Figure 9 Hydrogeological map of the Nile Valley in the vicinity of Giza..... 19
Figure 10 Surface water sampling sites along the Mansoureya Canal 21
Figure 11 TDS of Mansoureya Canal water samples in comparison to maximum allowable levels for water discharge into the Nile River and its irrigation network according to Law 28/1982. 22
Figure 12 COD and BODS of Mansoureya Canal water samples in comparison to maximum allowable levels for water discharge into the Nile River and its irrigation network according to Law 28/1982. 22
Figure 13 Solid waste in the Mansoureya Canal, southern stream 23
Figure 14 Air quality and noise monitoring sites..... 24
Figure 15 NOX values VS time, Ref. Law No.4/94..... 25
Figure 16 SO2 values VS time, Ref. Law No.4/94 25
Figure 17 CO values VS time, Ref. Law No.4/94 26
Figure 18 PM-10 values VS time, Ref. Law No.4/94 26
Figure 19 Mean monthly temperatures in Giza 28
Figure 20 Mean monthly precipitation in Giza..... 29
Figure 21 Relative humidity in Giza 29
Figure 22 Mean monthly evaporation in Giza..... 30
Figure 23 Monthly wind direction in Giza (in degrees) 31
Figure 24 General area of the Pyramids Field from Giza to Dahshur. 33
Figure 25 The Great Sphinx and the pyramid of Khafre in the background. 34
Figure 26 The Giza Necropolis..... 35
Figure 27 Giza Plateau south-eastern escarpment, main wadi, and the city of the pyramid builders south of Nazlet el Samman. 36
Figure 28 The Great sphinx. 37
Figure 29 Wall of the Crow 38
Figure 30 Nazlet El Samman, with visiting tourist buses. 44
Figure 31 Nazlet El Samman, stables, horses and camels. 45
Figure 32 Inhabited area (Nazlet el Samman) east of the Khafre Valley Temple and Sphinx. 47
Figure 33 Inhabited area (Nazlet el Samman) east of the Khufu Pyramid. 48
Figure 34 Pre-dewatering groundwater levels..... 50
Figure 35 Locations of SCA/CU dewatering wells and piezometers 51
Figure 36 Groundwater levels since implementation of SCA/CU dewatering scheme 52
Figure 37 Location of Ahram Well Fields and Mena House Golf Course..... 56
Figure 38 The proposed vertical wells dewatering system. 57
Figure 39 Preferred layout of wells and force main along Abu Fayed Street..... 59
Figure 40 The public scoping meeting, 11 April, 2010. 60
Figure 41 Force main sections..... 66

1. SUMMARY

This report presents findings of the Environmental Assessment (EA) that was carried out for the Pyramids' Plateau Groundwater Lowering Activity. The project is undertaken for the Government of Egypt (GoE) through its implementing agency, the Construction Authority for Potable Water and Wastewater (CAPW), and is financed by the United States Agency for International Development (USAID). The Supreme Council of Antiquities (SCA) is the beneficiary agency. SCA is the legal entity responsible for the project. The EA is carried out in accordance with the Egyptian Law 4/1994 and its executive regulations, Egyptian Environmental Affairs Agency (EEAA) ESIA Guideline and Operational Requirements, and the USAID procedures 22 CFR 216 for environmental assessment.

Purpose of the project

Many of Egypt's ancient monuments in the Nile Valley have recently been subjected to the erosive effect of rising groundwater, which is absorbed by the porous stone that serves as their base material. The problem of rising groundwater has appeared in the Egyptian Nile Valley, including the Greater Cairo area over the past few decades. In Giza, where many of the world famous ancient monuments of the Egyptian Old Kingdom are found, groundwater has surfaced in many low-lying areas posing a direct threat to some of these monuments, particularly those of the Giza Necropolis. The archaeological sites in the low lying areas of the Necropolis, mainly at the bottom of the southeastern corner of the Pyramids' Plateau, are the most impacted by rising groundwater. The objective of the "Pyramids' Plateau Groundwater Lowering Activity" is therefore to develop means to lower the groundwater to target levels approved by the SCA in the affected antiquity areas at the Pyramids Plateau to protect significant antiquities from further deterioration. Based on the capillary rise related field investigations and groundwater modeling conducted within the framework of this Project, this would require a groundwater extraction rate estimated at 1,300 m^3/hr.

The Giza Pyramids Plateau is located in the Giza Governorate, which occupies the southwestern sector of the Greater Cairo Region (GCR). The Plateau is situated at the eastern edge of the Egyptian Western Desert, and overlooks a densely populated area of the Nile Valley in the main Giza urban agglomeration, which extend eastward for about 10 km to the Nile River and northward for about 12 km to the Cairo city centre. The plateau is the home of the Giza pyramids, the Great Sphinx, several temples and numerous shaft tombs. The geographical scope of this EA covers the Pyramids Plateau proper, which includes the archaeological site of the Giza Necropolis; some empty desert land southwest of the plateau; and part of the urban and cultivated areas of Giza, particularly the village of Nazlet el Samman, which is situated immediately to the east and northeast of the plateau.

Project Description

In July 2008 SCA implemented a groundwater lowering scheme designed by Cairo University (CU) as an emergency solution for the water that started to surface at low spots around the Sphinx and other low-lying areas of the necropolis. The vertical wells that were drilled in the area for pumping groundwater were effective in lowering the groundwater level by about 0.9 m in their immediate area around the Sphinx. Groundwater continued to reach the monuments by capillary rise and to pose a major threat to unexcavated monuments in the

area. The present project is designed to implement a long-term groundwater system selected by the SCA which is one of the alternative systems designed under this project.

Three alternatives to achieve the desired groundwater lowering were proposed:

1. Source curtailment
2. Vertical wells
3. Drains in trenches

All of the three proposed dewatering structures will be located within the walled Giza Plateau Archaeological Zone, which is under the jurisdiction of the SCA.

Extracted water (Alternatives 2 and 3) will be discharged to the Mansoureya Canal via a force main running from the Giza Necropolis to the canal. For Alternative 2 each well is equipped with its own pump. In Alternatives 3, extracted groundwater will passively flow towards a main pumping station, which will be located on SCA property (Giza Necropolis Archeological Zone) at the western end of Abu Fayed Street. The pumping station or vertical well individual pumps will then pump the water at a rate of 1,300 m^3/hr into a force main, which will discharge the water into the Mansoureya Canal. The discharge force main will be installed under and along either Abol Hol Street or Abu Fayed Street, from the archaeological enclosure to the Canal.

Scoping and environmental consequences

The scoping activities (interviews, focus groups, transect walks, etc…as described in the Scoping Statement), technical judgment of the EA team and engineering consultant, and the public scoping session showed that only minor impacts are expected to temporarily occur during construction. If appropriate precautions are taken, these impacts will be negligible. Such impacts would be in the form of minor dust and noise generation, traffic congestion and road blockage, which will be localized and will only occur during the actual construction process. In addition, issues related to site planning and the subsequent operation of the dewatering system should also be addressed to ensure that no adverse impacts would affect the area or the community.

Scoping also showed that impact on biodiversity is not likely to be of significance for this particular project and can be safely dropped from further analysis. This highly urbanized and densely populated area supports no significant natural habitats and only a low diversity of organisms that are normally associated with human habitations. No threatened habitats or species of animals and plants occur in the area or depend for their survival on its resources.

Very few elements of the project site's socio-environment are expected to be affected by the operation of the dewatering system. The analysis of the groundwater quality that will be discharged into the canal indicates that the water is of relatively good quality, and meets all permissible limits for discharge into canals set by Law 48/1982. Water exceeding these limits cannot be discharged into the irrigation network.

Environmental and Social Management Plan

The project's potential socio-environmental impacts identified are localized. No irreversible or widespread negative impacts were identified. In order to eliminate, offset or reduce the adverse impacts to acceptable levels, it is necessary to integrate environmental and social management into the project's engineering, construction, operation and maintenance

processes. Environmental management procedures should therefore be applied and followed at all stages of development. These procedures are described in an Environmental and Social Management Plan (ESMP), which presents a set of mitigation, monitoring, and institutional measures to be taken during both construction and operational phases of the project.

SCA's Final decision

Out of the alternative groundwater lowering systems presented to the SCA, SCA selected the vertical pumping wells alternative in which the existing CU wells will be utilized. The SCA has also taken the decision to install the discharge force main along Abu Fayed Street, rather than the more easily accessible Abol Hol street, as many of the stakeholders involved in the consultation process expressed concern over the blockage of such an economically significant street for several months. However, for the sake of transparency and for a full analysis of the alternatives considered initially, all the alternatives, including no action, are evaluated in this report.

Conclusion

If no action is taken, the groundwater in the study area will likely continue to rise. The deterioration of the foundations of the antiquities in the low-lying areas of the Giza Necropolis will damage their integrity, leading to enormous cultural and economic losses. The no-action alternative is, therefore, not considered to be a viable solution.

The cumulative impact of the project will be therefore the preservation of the antiquities of the Giza Necropolis, which are a substantial source of income not only for the community of Nazlet el Samman, but for the country as a whole. A lower ground water table in the plateau area should also be beneficial to monuments still buried.

This environmental assessment showed that the proposed project is not expected to result in any irreversible, adverse impacts on the physical, biological or socio-economic elements of the environment. Minor, temporary impacts during construction activities can be mitigated through proper site management practices. The study did not predict any adverse environmental or socio-economic impact as a result of the operation of the proposed dewatering system. The construction and operation of the dewatering system will create employment opportunities and will increase the demand for some goods and services which, in turn will enhance the local economy.

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2. PURPOSE

Many of Egypt's ancient monuments in the Nile Valley have recently been subjected to the erosive effect of rising groundwater, which is absorbed by the porous stone that serves as their building material. The cause for this rising water is undetermined, but thought to be linked to the Nile's hydrological regime following the construction of the Aswan High Dam, which have altered the recharge of underlying aquifers...

The problem of rising groundwater has appeared in the lower Nile Valley including the Greater Cairo area over the past few decades. In Giza, groundwater has surfaced in the low-lying areas of the Giza Necropolis, in the vicinity of the Sphinx and the recently discovered City of the Pyramids' Builders. The effects of rising groundwater and its capillary action are known to deteriorate the limestone bedrock over time.

Figure 1 Water logging near the Valley Temple, the Giza Pyramids Plateau.

The objective of the project is therefore to develop means to counter groundwater rise in the vicinity of the Pyramids' Plateau, since Giza's monuments are not only extremely valuable in terms of architecture, archaeology, and history, they are also important contributors to the local economy. It is clear that an engineering solution will be required to actively lower the groundwater level around the Sphinx and other affected areas of the Giza Necropolis.

Figure 2 Water logging near the Pyramid Builders City, Giza Pyramids Plateau.

The Government of Egypt (GoE), represented by implementing agency, Construction Authority for Potable Water and Wastewater (CAPW), is collaborating with the United States Agency for International Development (USAID), consulting firms AECOM, ECG, and EDG, in order to design and implement a dewatering system for the Giza Necropolis area. USAID is the funding agency, while AECOM is investigating the causes of groundwater rise, and effects to antiquities. ECG and EDG are the engineering and environmental consultants, respectively.

Three dewatering alternatives have been proposed by the project's engineering consultant, based on geotechnical investigations, capillary rise measurements, and groundwater flow modeling. These alternatives consist of mostly below ground systems, to preserve the aesthetic integrity of the archaeological sites. The complexity of the socio-environmental setting of the area calls for the careful analysis of these dewatering alternatives and the impact of their construction and operation phases. The extracted water will be discharged through a force main, which will have to be partly installed across the nearby village of Nazlet el Samman, to the Mansoureya irrigation canal.

The studypresents a description of the current environmental, socio-culturalsettings of the GizaPyramids' Plateau and its surrounding area, and a detailed analysis of the components and activities of the proposed groundwater lowering engineering solution. The study also presents an assessment of potential socio-environmental impacts of the project during its construction and operation phases, and an environmental management plan that includes measures to mitigate expected negative impacts. The legal framework within which the overall project will be implemented is added in Annex 1, and includes Egyptian laws and standards on the environment.

Figure 3 Capillary water rise at the base of the wall of the crow.

Figure 4 Capillary water rise at base of the wall of the crow. The darker area is the area that has been affected by capillary rise. The mark at the top of that area indicates a capillary rise level of 1.2 m.

SCA is the legal entity responsible for the project. The environmental impact assessment is carried out in accordance with EEAA requirements, as well with USAID procedures 22 CFR 216.

An important step in the EA of a project is scoping. This is carried out in the early stages of the environmental assessment in order to identify issues of particular concern that should be addressed by the study. It is a participatory effort, where the proponent government agencies, the Giza Governorate, USAID, the project consulting team, and the public, consult over a certain period of time. It consists of preliminary research by the project consultants, extensive literature reviews, field observations, and interviews with stakeholders; and, at the end of those activities, a public scoping session, where the project team formally informs the public on the project, its design, purpose, and institutional responsibilities for construction and implementation. The team also elaborates the major anticipated positive and negative socio-environmental impacts, and how these will be mitigated. The stakeholders are then invited to voice their opinion, criticism, and add their own concerns and observations, thereby bringing them to the attention of the government, funding agency, and team of consultants.

The outcome of the scoping session, which was held on the 11th of April 2010 in Giza, Egypt, was presented as a Scoping Statement to USAID for review. This Scoping Statement served as the basis for developing the present EA report. The scoping session also served the purpose of disclosing the project to the public, which is required by Egyptian law.

3. AFFECTED ENVIRONMENT

The following account of the physical and biological setting of the Pyramid's plateau and its environs is based on the thorough review of literature available on that area (see list of references) and several site visits to assess its present environmental status. Base measurements for air and water quality, and noise levels were also taken to further document the existing environmental conditions in the area, and subsequently compare how some of the project activities might affect the local environment. This will allow for impact monitoring during project implementation.

3.1 THE PHYSICAL SETTING

3.1.1 Geographical scope

The Giza Pyramids Plateau is located in the Giza Governorate, in the southwestern part of the Greater Cairo Region (GCR) (fig 5). The Plateau actually straddles the eastern fringe of the Western Desert, and overlooks the densely populated areas of the main Giza urban agglomeration, which extend eastward across the Nile Valley for approximately 9 km to the Nile River and Cairo city centre. The plateau is the home of the nine Giza pyramids, the Great Sphinx and numerous shaft tombs cut into the limestone bedrock.

The geographical scope of this study covers the Pyramids Plateau proper, which contains the archaeological site of the Giza Necropolis; some empty desert land southwest of the plateau; and part of the urban and cultivated areas of Giza, particularly the village of Nazlet el Samman, which is situated along the eastern edge of the plateau. The areas south of the plateau are empty desert, extending all the way to Fayoum Depression, or cultivated land in the Nile Valley. To the west and northwest are the new urban communities of 6th of October City and Pyramids' Heights, the latter being directly adjacent to the study area, along the Fayoum Road.

3.1.2 Geology and geomorphology

The highly urbanized GCR occupies the lower part of the Nile Valley, before the Nile's bifurcation point at Qanatir, where the delta begins. The Delta is a flat triangle about 166 km long from north to south, and 250 km wide across its Mediterranean front. It is covered in Nile sediments that are hundreds of meters thick in places. These alluvial Quaternary sediments were deposited during the Pleistocene and Holocene evolution of the river regime. The soil thus consists essentially of clay/silt overlying sandy loam and coarse gravel/sand.

South of the Delta, the Nile's flood plain is very narrow, although it is substantially wider on the western side, where the study area is located. The average width of the Nile Valley in Egypt is only about 10 km. In the relatively recent geological past, the river was much wider and more vigorous, as is evidenced by the wider terraces marking the floodplain of that ancient river. Here the silt and clay content of the topsoil are more prevalent than in the Delta to the north, but there is some variation in the eastern and western regions of the valley. The loamy soil in the west has higher lime content the soil in the east, which is sandier.

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

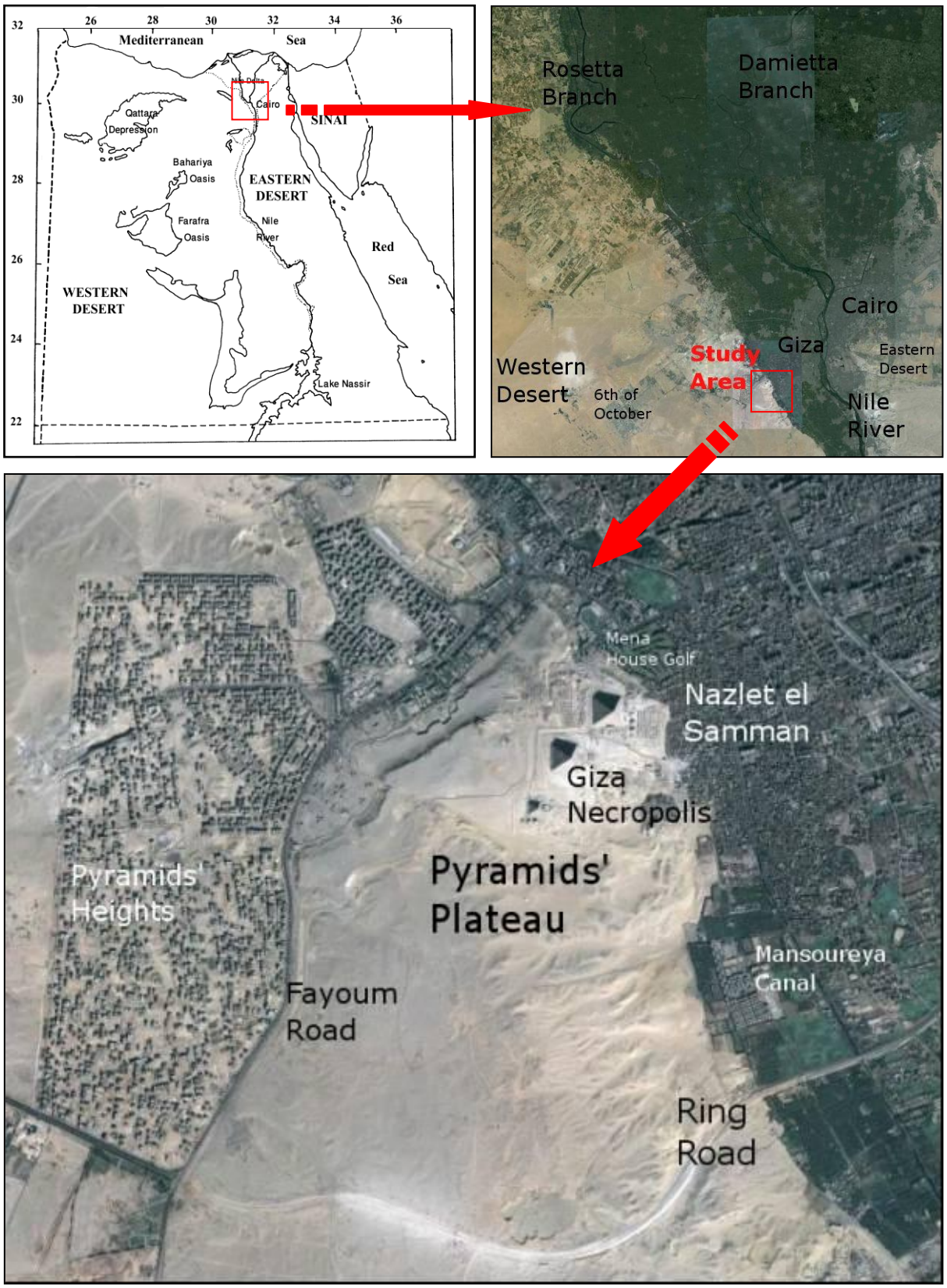


Figure 5 Location of the Giza Plateau and the EA study area, southwest of the GCR.

Figure 6 Agricultural fields southeast of the Giza Pyramids Plateau.

The eastern side of the floodplain is bordered by escarpments of limestone between Cairo and Esna, and sandstone from Esna to Aswan. Beyond the escarpments extend the Eastern Desert. Near Cairo, the Eocene plateau of Gabal El Moqattam extends southwards and eastwards, reaching an altitude of 500 m in places. It consists of sedimentary strata including white to grey limestone, and intercalations of brown limestone, sandstone, and clay. Numerous wadis cut through the limestone, draining the plateau either westward to the Nile, or eastward into the low-lying parts of the Eastern Desert.

On the western side of the floodplain, however, the desert is essentially flat, gently rising westwards from about 50 m immediately above the flood plain, to a height of about 200 m some 20 km west of the Nile. The Giza Pyramids Plateau is a promontory consisting of a series of nummulitic Upper Eocene Limestone of the Moqattam formation, with some Miocene and Oligo-Miocene surface deposits. The limestone formation is stratified in beds of different quality. The greater part is hard grey stone, but towards the south there are beds of softer yellow-drab stone. The promontory was greatly altered by the quarrying and the constructions carried out in the Old Kingdom of Egypt, and its original form can only be visualized with some difficulty now.

The general layout of the Giza necropolis centers on the three Giza pyramids, and on the oldest one, the pyramid of Khufu, in particular. The order of the kings, Khufu, Khafre, and Menkaure, is established with certainty and sets the chronology of the part of the necropolis situated on the rock promontory. The three pyramids lie in a roughly diagonal line running from northeast to southwest in the order named.

The pyramids' plateau slopes from northwest to southeast. The topographical map (fig. 7) and cross section below (fig. 8) show the topography and slope at the archaeological site atop the Pyramids' Plateau, where the Western Desert gives way to the Nile floodplain. As can be seen, the pyramids are built on terrain that is roughly 65 m above sea level, but the plateau continues to rise gently westwards to 80 m on average with peaks as high as 105 m only 300 m to the west. Approximately 300 m east of the pyramids, the Moqattam limestone plateau abruptly ends; falling to 20 m at the site of the Sphinx, and this marks the boundary of the floodplain. The southeastern escarpment (i.e.: the area southeast of Menkaure's pyramid and southwest of the Sphinx) of the plateau is marked by a wadi channel ending on the floodplain. The wadi separates the Moqattam formation from another limestone formation to the south: the Maadi formation. Archaeological sites have recently been found in the low lying floodplain at the mouth of the wadi. Part of this area is covered by modern cemeteries and a sports field.

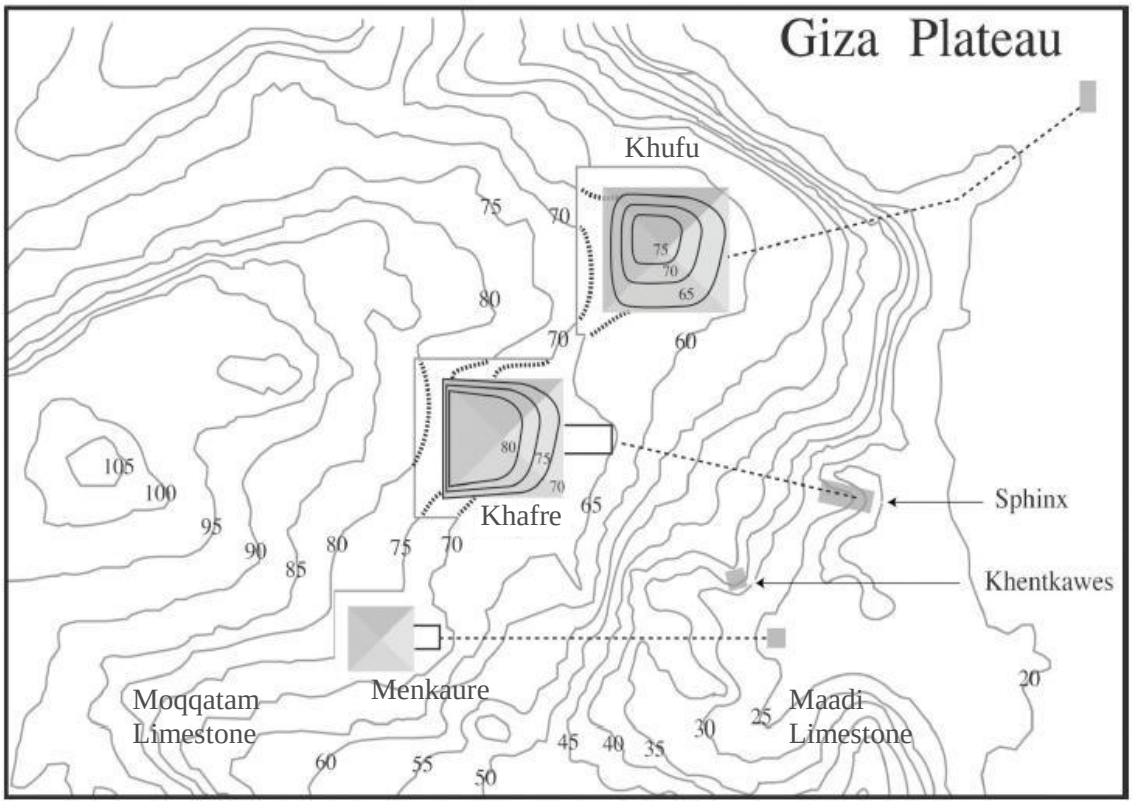


Figure 7 Topographical map of the Pyramids Plateau

The northern escarpment of the rock plateau abuts in several steeply terraced and eroded cliffs, at the bottom of which lies a large wadi (the Fayoum Road wadi). The Mena House golf course is located in the mouth of the wadi, immediately northeast of the Great Pyramid. From the lower northwestern terrace of the plateau, the slope ascends gently to merge with the upper terrace near the Khufu pyramid. On the northeastern side of the pyramid, the escarpment is steeper, all the way south to the Great Sphinx.

Considerable faults and cracks in the bed-rock cross the plateau generally in a southeast to northwest direction. One larger fault visible west of the Khufu Pyramid has resulted in a drop in the surface of the rock on its north side.

Northwest of the Giza plateau is a vast field of longitudinal dunes, known as Ghrude El Qataneya. These parallel "sword" dunes can be up to 30 m in height. They are orientated according to the direction of prevailing wind, i.e.: from northwest to southeast.

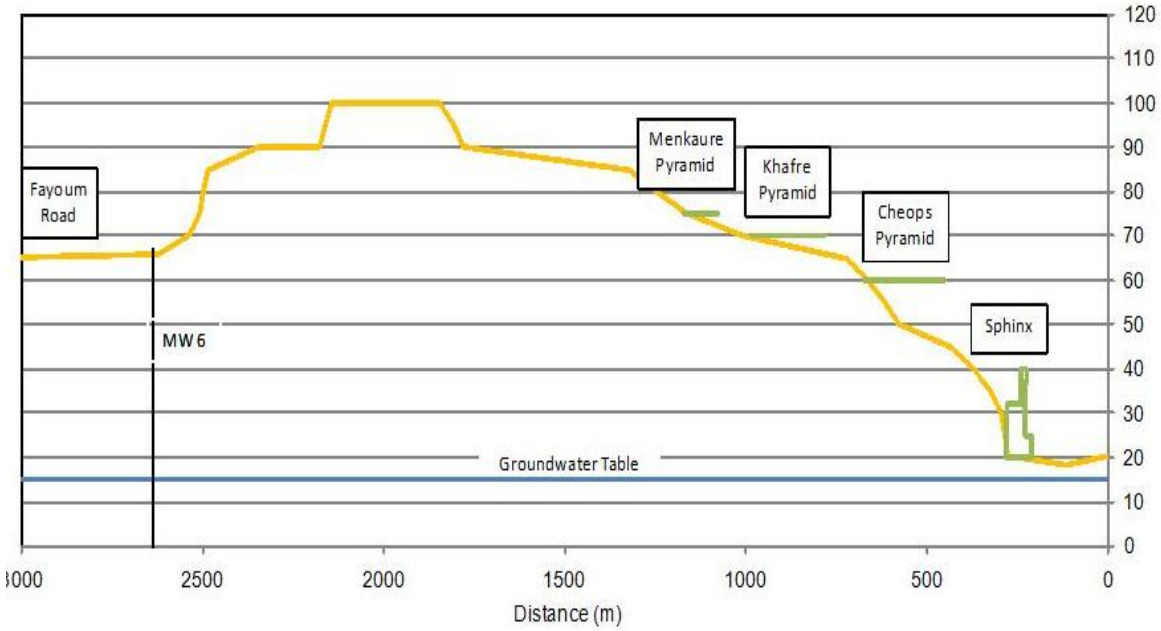


Figure 8 Cross section of the Pyramids' Plateau from West to East

3.1.3 Hydrogeology

3.1.3.1 Groundwater

Groundwater conditions in the Giza Plateau and its vicinity are related to the Nile alluvium aquifer, the Maghra limestone aquifer, and, to a lesser extent, the Nile Delta aquifer.

The aquifer underlying the floodplain region of the study area is the Nile Alluvium aquifer, which lies in the Quaternary and Tertiary deposits of the Nile valley floodplain. It extends beneath the delta and its desert fringe areas, and while it is only 5 to 70 m deep in the Cairo area, it becomes considerably deeper in the southern parts of the Nile valley (300 m at Sohag). It consists of a thick layer of graded sand and gravel with clay to silty clay aquitards (semipervious layers) at various depths in its major part, and an impermeable clay aquiclude at the bottom. Between the Mansoureya Canal and the Sphinx area at the bottom of the Giza Plateau, there are no aquitards, so the aquifer essentially consists of a single alluvium layer (AECOM, 2009; Said, 1962).

The transmissivity of the aquifer is relatively high, especially in its shallower depths near the Giza Plateau, where it averages about 11,500 m²/day. Northwest of the Plateau, its transmissivity may be somewhat lower, in the order of 3,500 m²/day. It is generally a good transmitter of water from recharge to discharge locations. Groundwater is essentially replenished through the aquifer's hydraulic interaction with the Nile River, seepage from irrigation and drainage canals, and deep percolation. The high productivity of the aquifer and the shallow depth to groundwater allow for high rates of water abstraction (100-300 m^3/hour) with relatively shallow wells and at relatively low pumping costs. It can be considered as a storage and regulation reservoir (NWRC, undated).

The Giza Plateau proper overlies the eastern edge of the Maghra limestone aquifer, which is adjacent to, and west of, the Nile alluvium aquifer. The Maghra aquifer system occupies the western edge of the Delta up to the Qattara Depression. It lies in the Miocene layers. This aquifer is relatively deep

(200 m) beneath the Giza Plateau, and goes deeper as it extends further west into the desert (800 m east of the Qattara depression). Recharge is mainly by deep percolation from the Nile alluvium and Delta aquifers, and groundwater flow across the common boundary of the Maghra and those two aquifers. However, the Maghra aquifer's groundwater resources are considered non-renewable, due to its distance from the Nile, and the long water travel time. Its transmissivity varies from 500 to 5,000 m^2/day, but at the desert fringe under the Giza Plateau, its transmissivity is comparable to that of the alluvium aquifer (NWRC, undated; Shahin, 1990; Said, 1962).

The Nile Delta aquifer is also influential in the area, since it is connected to both the Alluvium and Maghra aquifers, and is located immediately to the north of the study area. It is mostly recharged through seepage from the Nile River, canals, and excess irrigation water percolating downwards, and marginally, through groundwater flowing northward from the Alluvium aquifer. Much like the Alluvium aquifer, its bulk consists of Quaternary and Tertiary deposits (coarse sand and gravel) 200-500 m thick, but here it is confined between an impermeable clay aquiclude at the bottom, and a semipervious Holocene aquitard (clay/silt cap) lying at the surface. The thickness of the aquitard increases uniformly from about 5 m near Cairo and reaches 60 to 70 m at the Mediterranean coast. The aquifer's overall thickness follows a similar pattern: it is very deep near the Mediterranean coast (1,000 m), but actually almost vanishes near Cairo, which is why it is considered to be distinct from the Alluvium aquifer (NWRC, undated; Said, 1962).

3.1.3.2 Groundwater quality measured on-site

Samples of ground water extracted from dewatering wells operating on the Giza Pyramids Plateau were taken for laboratory analysis[1]. Table 1 shows the results of that analysis. As clear from the table the quality of the water to be discharged from the dewatering system to the Mansoureya Canal complies with the quality criteria set by Law No. 48/1982 (on Protecting the Nile and water ways from pollution) for discharge into the Nile and its irrigation canals network.

3.1.4 Surface water

3.1.4.1 The Mansoureya Canal

The Mansoureya canal is located 200 m east of the Giza Plateau. It is an irrigation canal that serves approximately 15,000 acres of cultivated land. The Canal is hydraulically connected to the upper alluvium aquifer, although the degree of connection may have been reduced by the lining of the canal that has been implemented in the past few years in conjunction with its covering in Nazlet el Samman.

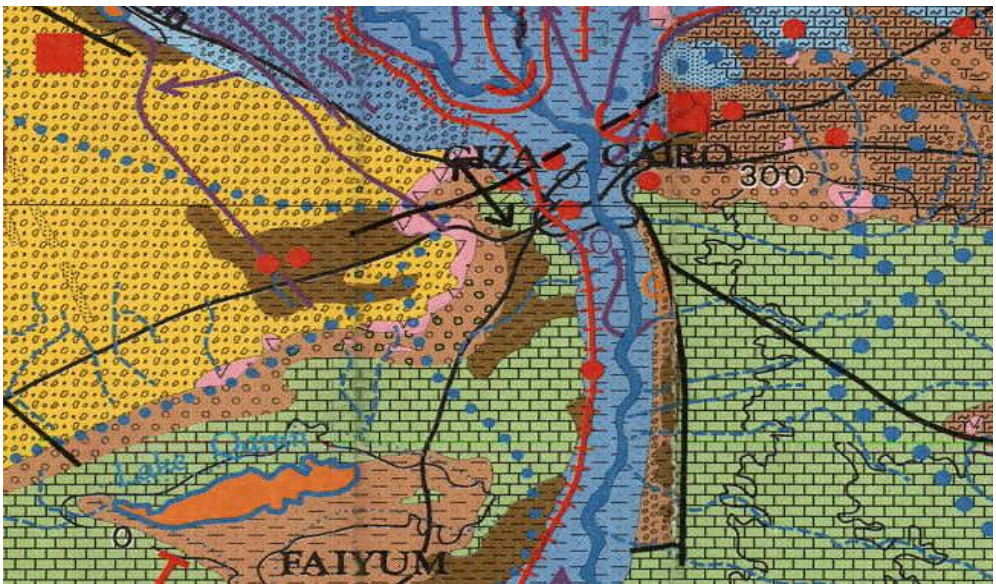
An important factor relative to the Mansoureya Canal is that its water level is on the order of 18.5 to 19 m, which is above groundwater levels in Nazlet El Samman and at the Sphinx. Therefore, groundwater flow between the aquifer and the Canal would be from the canal to the aquifer. A raised water level in the canal would have caused an increase in the discharge from the canal, and this may in turn have caused a rise in groundwater levels in Nazlet El Samman and in the Sphinx area. However, the water level in the Canal is close to ground level and any rise would have been limited. Between the Mansoureya Canal and the Sphinx, the upper and lower alluvium aquifers rejoin. Therefore, the impact of a raised water level in the canal on groundwater levels at the Sphinx is not obvious, since groundwater levels in the lower aquifer are largely controlled by the water level in the Nile.

3.1.4.2 Mansoureya Canal water quality

The Mansoureya Canal cuts through the project area from southeast to northwest, along the same alignment as El Mansoureya road. Since the section running through Nazlet el Samman is covered, samples to determine water quality were collected both up-stream (south) and downstream (north) of the village. Five samples were collected up-stream of the covered section, and 3 samples

[1] Analyis was carried out by the Water Laboratory, National Research Center.

downstream, on the 8th of April 2010. Sampling points were approximately 300 m apart and are shown in Figure 10. The samples were kept at low temperatures, properly labeled to avoid cross contamination, and analyzed in accordance with the WHO water analysis methodologies. Results are shown in Table 2 and Figures 11 and 12.



HYDROGEOLOGICAL UNITS

Granular Rocks

- Extensive and highly productive aquifers; continuous surface recharge from irrigation or the Nile.
- Local and moderately to highly productive aquifers; occasional surface recharge from rainfall, from surface runoff or from irrigation water.
- Local and low to moderately productive aquifers; insignificant surface recharge from rainfall, insignificant sub-surface recharge, deeper, highly productive aquifers not excluded.
- Extensive and low to moderately productive aquifers insignificant surface recharge, locally subsurface recharge from adjacent aquifers.

Karstified and Fissured Rocks

- Extensively and moderately low productive aquifers, with paleo-karstified features, containing fossil water, essentially no surface recharge; locally sub-surface recharge from adjacent aquifers.
- Local groundwater occurrence in fissured and weathered zones in hard rocks.

Essentially no Groundwater Resources

- Non-aquiferous clays and shales; generally underlain by deeper, more productive aquifers.

LITHOLOGY

Quaternary

- Fine sand; sand dunes.
- Silt and clay; cultivated Nile deposits.
- Coarse sand, mixed sand and gravel, mixed sandy loam, gravels and rock fragments.

Tertiary

- Limestone, clastics and gypsum; shallow marine and lagoonal deposits.
- Coarse sands and gravel with limestone interbeds; fluvio-marine and fluviatile deposits.
- Limestone with chert; shallow marine deposits.
- Gravel sheets and conglomerates (terrestrial deposits) and interbeded sand and clay (fluvio-marine deposits).
- Surface water divide.
- Direction of groundwater flow.
- 5 Contour line of piezometric head of Quaternary aquifer in the Nile Delta and Valley in m relative to sea level.

Figure 9 Hydrogeological map of the Nile Valley in the vicinity of Giza

Table 1 Groundwater quality from mixed samples of three dewatering wells in the Pyramids Plateau and Water quality at 8 sites along the Mansoureya Canal in comparison to the national permissible limits for discharge into a canal (Law 48/1982).

Parameter	Unit	Permissible limit	Ground Water	Mansoureya Canal water sampling sites							
				Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
BOD	mgO_2/l	20	3.4	16.00	8.00	8.00	16.00	11.00	10.00	10.00	16.00
COD	mgO_2/l	30	19	24.00	12.00	12.00	24.00	18.00	14.00	14.00	23.00
TSS	mg/l	30	10.5	25.00	10.00	10.00	14.00	13.00	14.00	12.00	20.00
TDS at 120°C	mg/l	800	785	450.00	430.00	430.00	460.00	430.00	440.00	450.00	460.00
Total coliform	MPN/l	25,000	700								
pH	-	6 – 9	7.4	6.21	6.22	6.13	6.09	6.37	6.27	6.27	6.28
Cadmium	mg/l	0.01	<0.01								
Lead	mg/l	0.05	<0.01								
Nickel	mg/l	0.1	<0.01								
Manganese	mg/l	1	<0.05								
Iron	mg/l	0.5	0.25								
Chloride	mg/l	-	118								
Sulfate	mg/l	-	35	34.90	37.50	35.00	36.00	35.00	36.00	37.40	36.00
Sulfides	mg/l	1	-								
Phosphorus	mg/l	1	0.9	1.52	1.00	1.89	1.69	1.32	1.53	1.10	0.83
Nitrate	mg/l	30	0.62	2.10	2.30	1.25	1.35	1.00	2.60	2.12	2.22
Phenol	mg/l	0.001	-								
Oil and grease	mg/l	5	-								
Location of sampling sites				N 29° 8.269′ E 031°08.738′	N 29° 57.502′ E 031°09.120′	N 29° 57.769′ E 031°08.950′	N 29° 57.769′ E 031°08.950′	N 29° 58.023′ E 031°08.790′	N 29° 58.269′ E 031°08.738′	N 29° 59.356′ E 031°08.258′	N 29° 59.407′ E 031°08.062′

Figure 10 Surface water sampling sites along the Mansoureya Canal

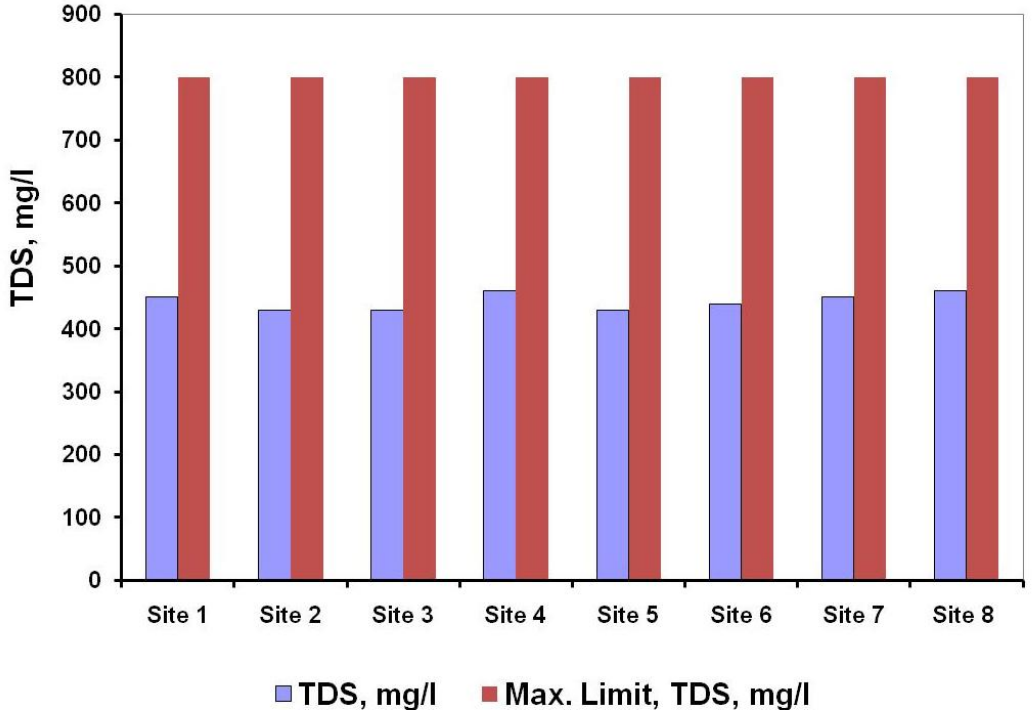


Figure 11 TDS of Mansoureya Canal water samples in comparison to maximum allowable levels for water discharge into the Nile River and its irrigation network according to Law 28/1982.

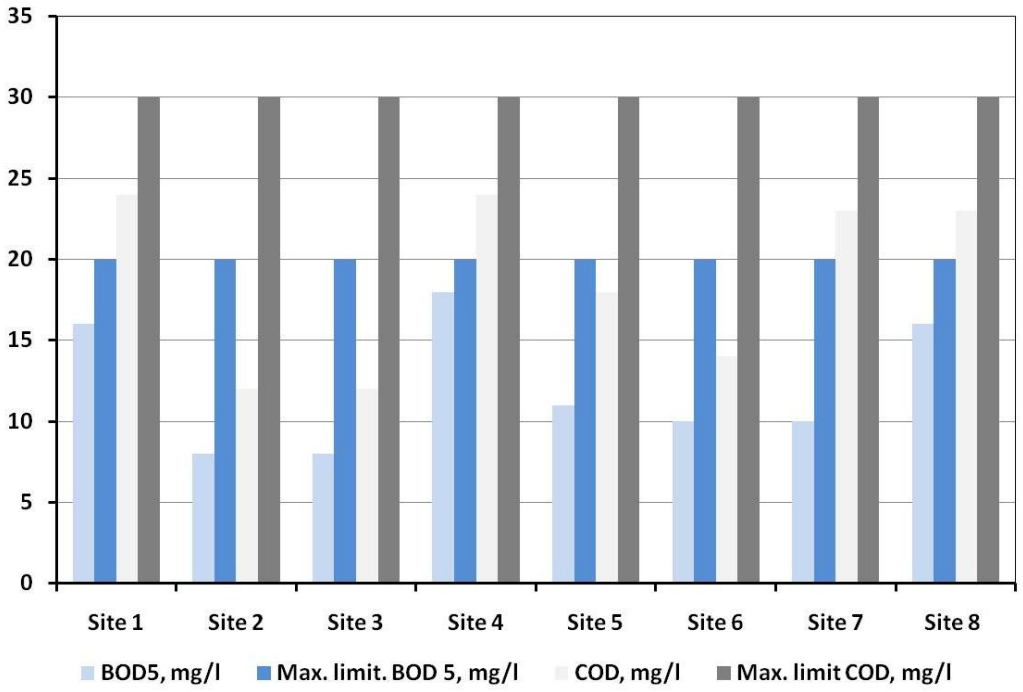


Figure 12 COD and BODS of Mansoureya Canal water samples in comparison to maximum allowable levels for water discharge into the Nile River and its irrigation network according to Law 28/1982.

Figure 13 Solid waste in the Mansoureya Canal, southern stream

3.1.5 Air quality

Sampling for air quality was conducted at three locations: west of Nazlet el Samman, in the vicinity of the Sphinx and Pyramid of Menkaure. The measurements were carried over a period of 3 consecutive days: between the 9th and 10th of April 2010 at location 1, the 10th and 11th of April at location 2, and the 11th and 12th at location 3. Measurements were recorded for 24 hours (100% recovery is 80% of the 24 hours, as per USEPA regulations and guidelines) at each location. The concentrations of NO_X, SO_2, CO, and PM-10 particulate matter were monitored on a real time basis. All the gas analyzers and PM-10 monitors are USEPA approved and designated methodologies. In addition, air temperature and relative humidity, wind speed and direction, and sigma theta (the standard deviation of the horizontal wind direction fluctuation) were recorded on a real time basis in order to assess atmospheric stability. An efficient Data Acquisition system that recorded the 1- minute averages was used to compute the 1-hour and 24-hours averages.

Figure 14 Air quality and noise monitoring sites

Results of air quality parameters are shown in Figures 15 - 18. Recordings indicate that SO_2, NO_X and CO values are in compliance with the national limits as per law 4/1994. The PM-10 values exceed the maximum limit, however, and this may due to the fact that sandy and dusty winds were blowing at the time of sampling.

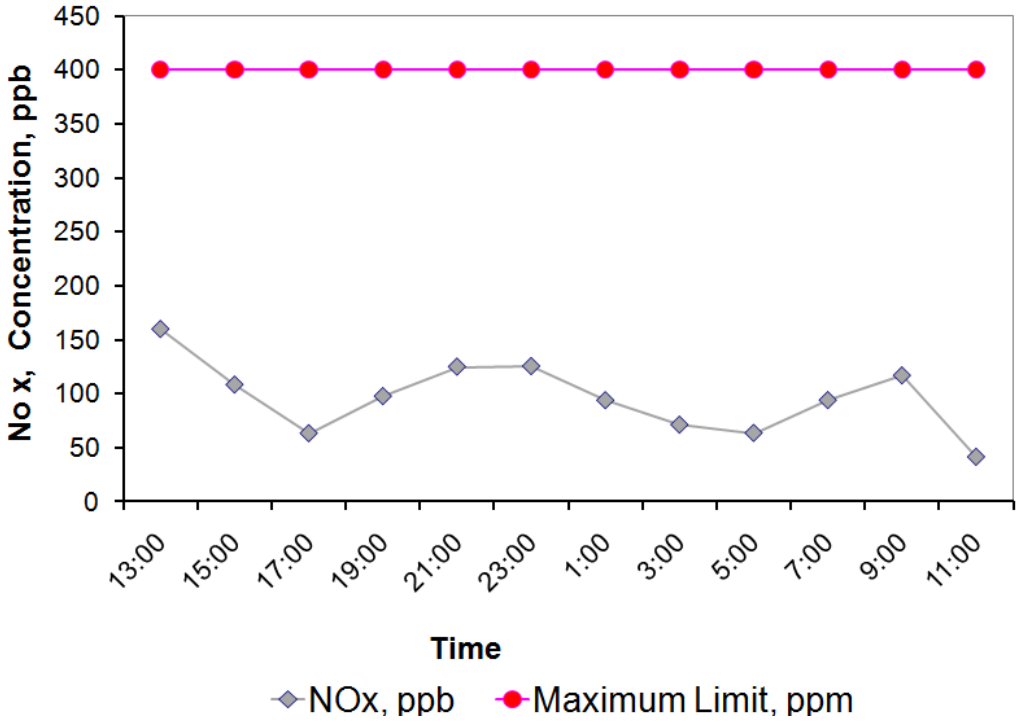


Figure 15 NOX values VS time, Ref. Law No.4/94

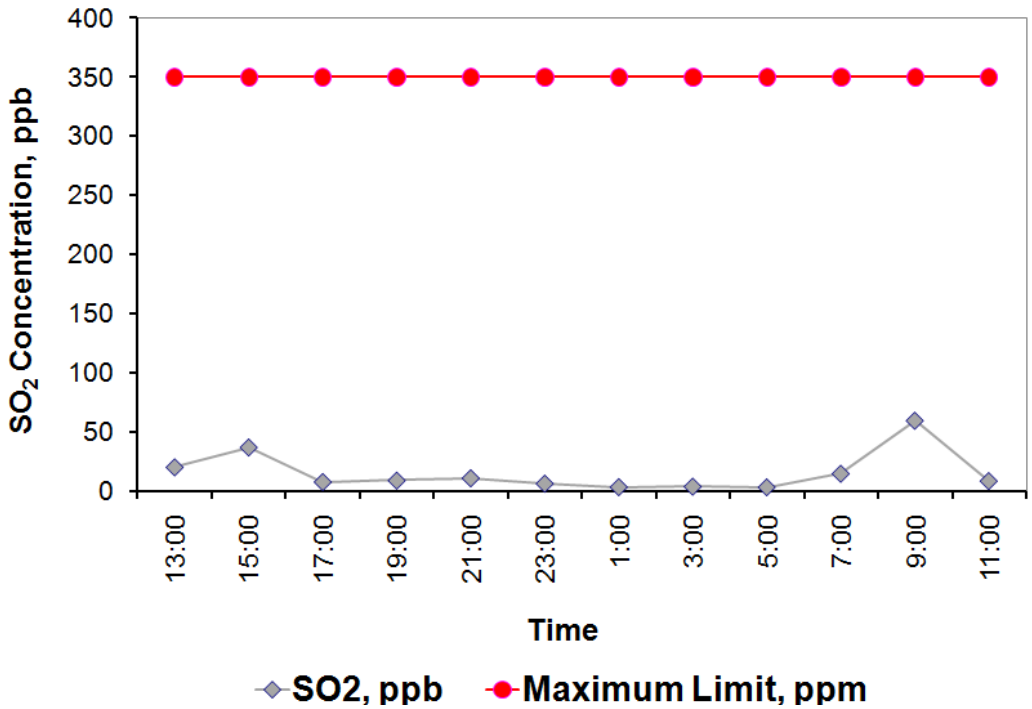


Figure 16 SO2 values VS time, Ref. Law No.4/94

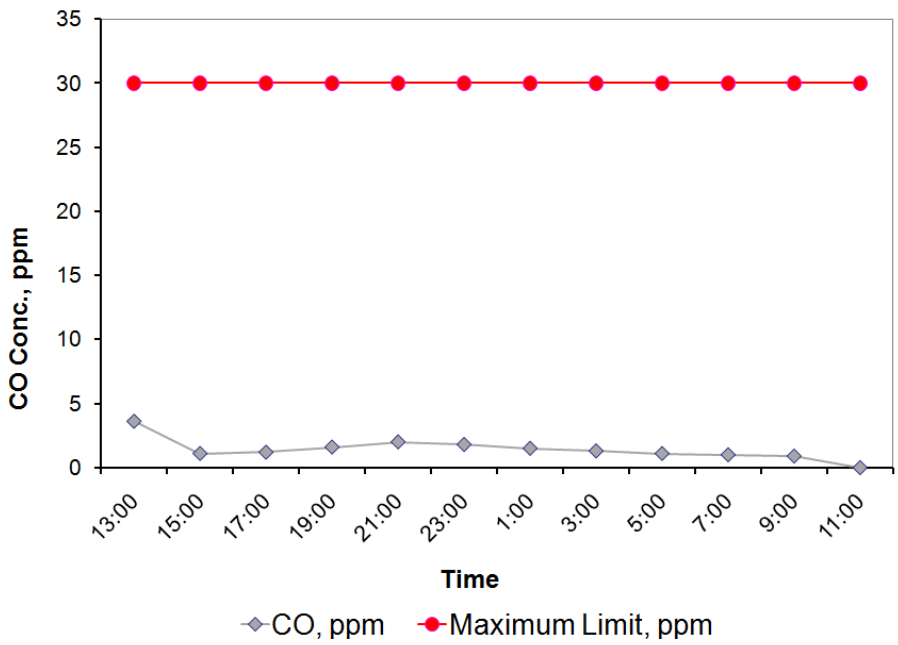


Figure 17 CO values VS time, Ref. Law No.4/94

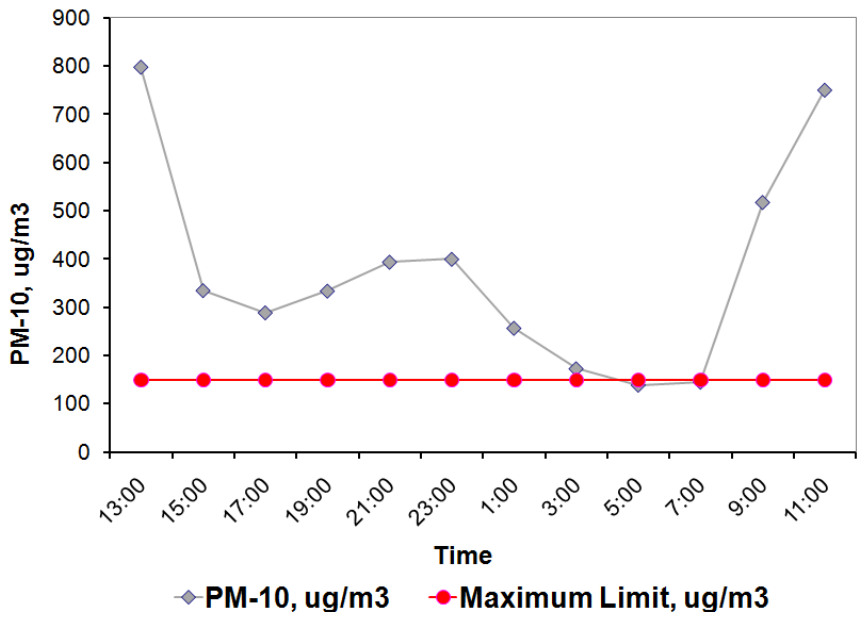


Figure 18 PM-10 values VS time, Ref. Law No.4/94

3.1.6 Noise levels

Maximum permissible limits of sound intensity are given in the Executive Regulations of Law 4/94 (see Annex 1). According to these regulations, noise intensity during an 8-hour work shift should not exceed 90 dB. The period of exposure to constant sound is divided by half for each 5dB increment beyond 90 dB, as shown in Table 2.

Table 2. Permissible exposure times to different sound intensities.

Noise intensity level decibel (a)	95	100	105	110	115
Period of exposure (hours)	4	2	1	1/2	1/4

The Executive Regulations of Law 4/94 also require that during working hours, the instantaneous level of noise intensity shall not exceed 135 dB at the source, during construction or operation. This is to protect the sense of hearing. Thus, intermittent noise (of the sledgehammer impact type) in the order of 110 to 135 dB is permissible for a certain number of hits, depending on the noise intensity of each hit, as shown in (Tables 3 and 4).

Table 3. Number of permissible intermittent impacts during the daily working hours.

Noise intensity (dB)	Number of permissible impacts
135	300
130	1000
125	3000
120	10000
115	30000

Article 42 of Law 4/94 requires that all organizations and individuals should maintain machinery or other sources below the permissible limits. Licensing authorities are to ensure that in a given area, the overall emanated sounds from fixed sources are within the allowable limits. In addition, licensing authorities are to ensure that machinery and equipments selected by establishments fulfill the law's requirements.

Law 4/94 also defines the maximum allowable noise intensity in different land use areas, as shown below:

Table 4 Maximum allowable noise intensity in different areas (Law 4/94)

Type of Area	Permissible Limit for Noise Intensity Decibel (dB L_{eq}(A))					
	Day*		Evening*		Night*	
	From	To	From	To	From	To
Commercial, administrative and downtown areas	55	65	50	60	45	55
Residential areas in which can be found some workshops or commercial establishments or which are located on a main road	50	60	45	55	40	50
Residential areas in the city	45	55	40	50	35	45
Residential suburbs with low traffic	40	50	35	45	30	40
Residential rural areas, hospitals and gardens	35	45	30	40	25	35
Industrial areas (heavy industries)	60	70	55	65	50	60

*Day: from 7 am to 6 pm; Evening: from 6 pm to 10 pm; Night: from 10 pm to 7 am.

3.1.6.1 Noise monitoring

Noise monitoring was conducted for a period of 1 minute at the top of each hour concomitantly with the air quality monitoring, and at the same locations (Sites 1 and 2 adjacent to Nazlet El Samman, northeast and southeast of the Sphinx; and Site 3 atop the Pyramids' Plateau). The measurements are presented in Annex 2.

The recordings show that ambient noise intensities exceed the maximum allowable noise limits (Article 42 of Law 4/94) for residential, urban, commercial areas throughout the day, evening, and night. It is noteworthy that noise intensities are only marginally lower at night; and never fall below the Egyptian night time standard of 45 dB maximum. The recorded L_{eq} are in the range of 47 to 72 dB at Site 1, 49 to 71 dB at Site 2, and 50 to 70 dB at Site 3. There is little variation between the measurements recorded at the three different sites, despite the proximity of Sites 1 and 2 to Nazlet el Samman, and the relative remoteness of Site 3. Disruptive sounds rising to more than 70 dB were frequently measured in all three sites, with the highest L_{max} values being in the range of 80 –86 dB. Sound levels of 30 to 50 dB are usually measured in calm environments. Much of this noise is attributed to vehicles and traffic.

3.1.7 Climate

3.1.7.1 Temperature

Temperature is generally hot to warm throughout the year in the study area (Fig. 19). July is the hottest month of the year with a mean ambient temperature of 27.7°C and a mean maximum of 34.8°C. January is the coldest month with a mean temperature of 13.7°C and a mean minimum of 8.8°C. Considerable daily fluctuations in ambient temperature occur in the area, ranging from 11.2°C in winter to 14.5°C in summer. Extremely high and low temperatures are often recorded, particularly in the desert areas in the west.

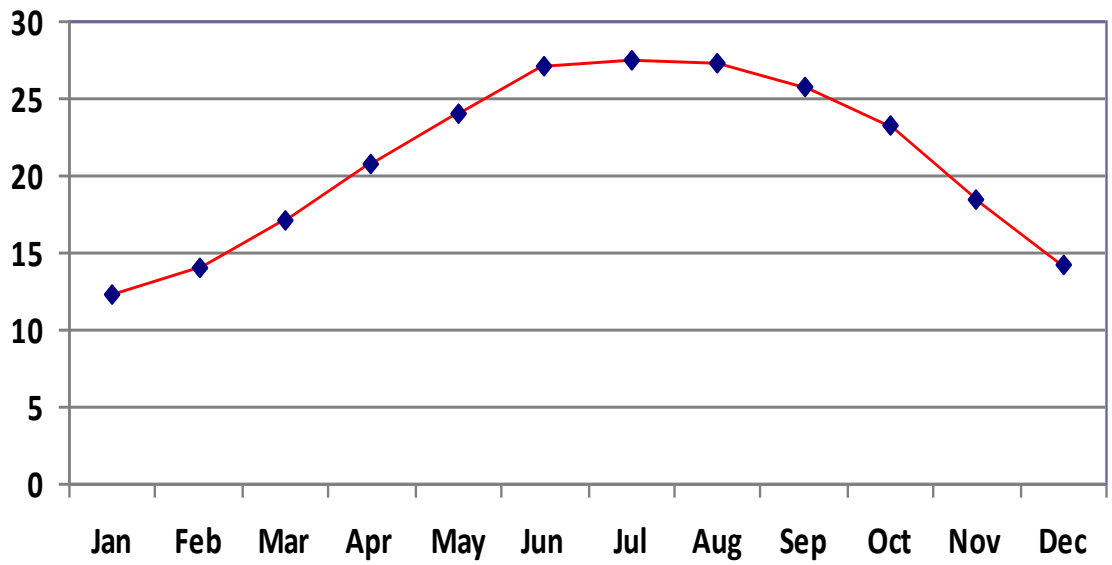


Figure 19 Mean monthly temperatures in Giza

3.1.7.2 Precipitation

Precipitation is generally low and consists mostly of winter rain (Fig. 20). Annual rainfall varies between 20.3 and 24.8 mm. The bulk of the rain (88%) falls during the five months from November to March. The period from July to September is practically rainless.

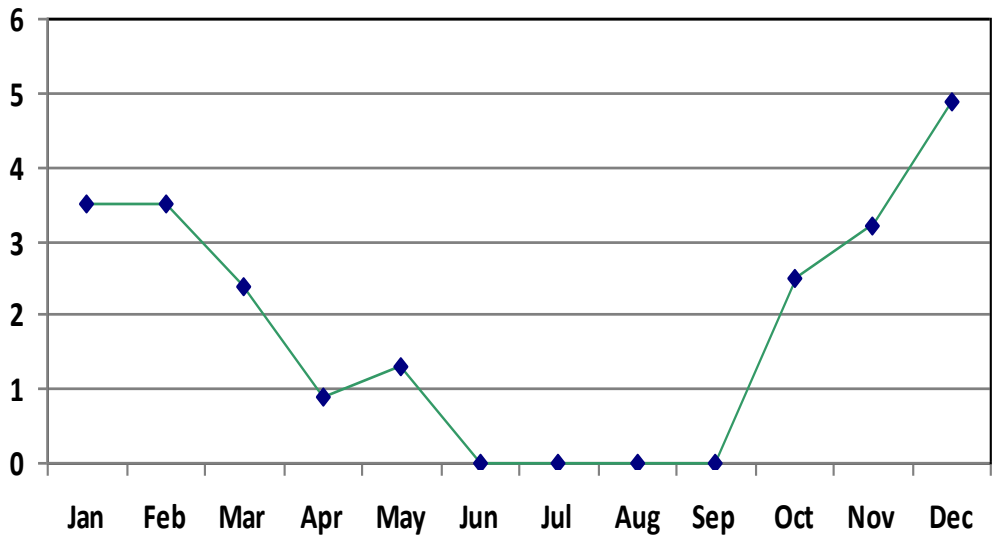


Figure 20 Mean monthly precipitation in Giza

3.1.7.3 Relative Humidity

Relative humidity is generally low in Giza, averaging 53.7% annually. Recorded relative humidity values range between 46% in April and May to 69% in December (Fig. 21). The highest relative humidity occurs in November, December, and January, and the lowest in the period between April to June. Relative humidity fluctuates during the day showing high values at night and early morning and low values at noon.

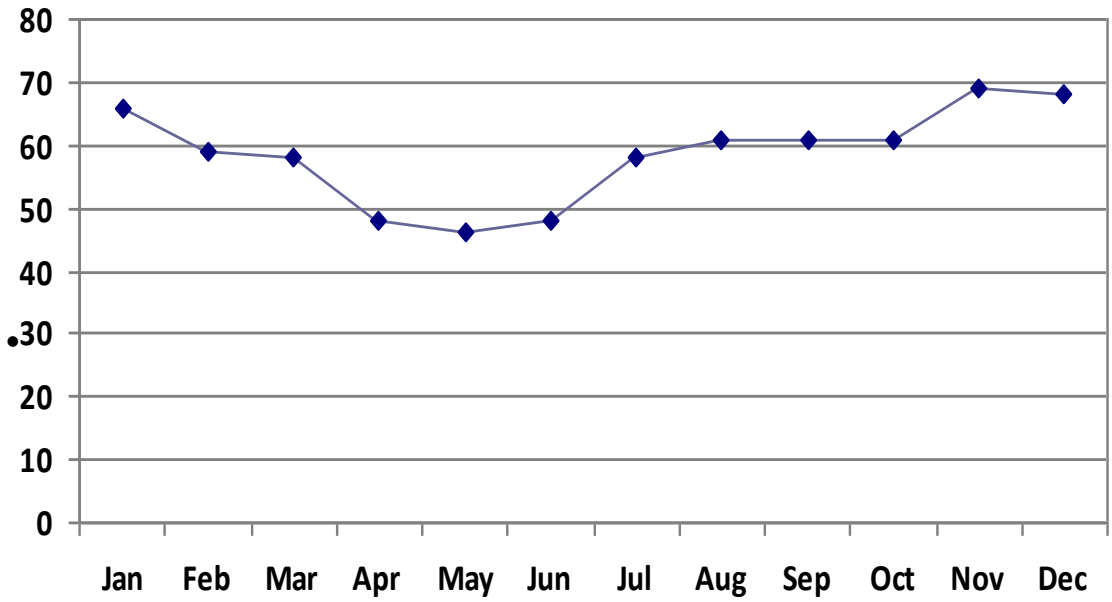


Figure 21 Relative humidity in Giza

3.1.7.4 Evaporation Rate

The Giza area is characterized by a very high evaporation rate (Fig. 22), which exceeds the precipitation rate. Daily evaporation rate ranges between a minimum of 4.7 mm in January and a maximum of 18.1 mm in June, with an annual average of 10.2 mm. The highest evaporation occurs during the three months April, May, and June (the time of low relative humidity), and the lowest evaporation rate occurs from November to January, the months of high relative humidity.

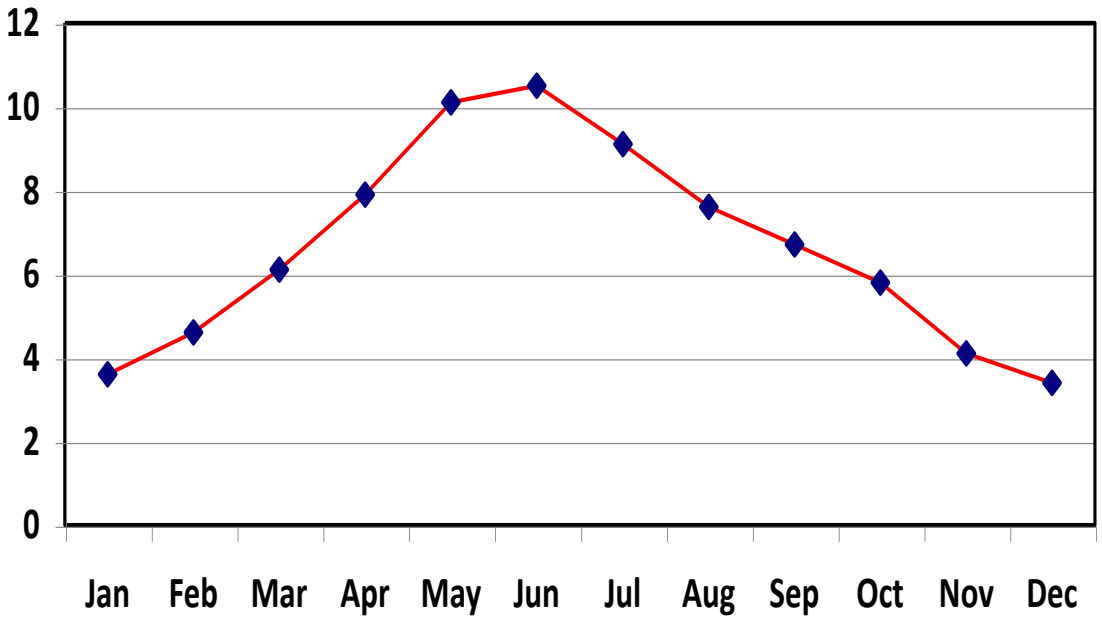


Figure 22 Mean monthly evaporation in Giza

3.1.7.5 Wind speed and direction

During most of the year, from March to November, the prevailing wind blows from the northeast, north, or northwest, with a moderate speed. From December to February wind direction is reversed and flows mostly from the south. Wind speed is also greater in January. Figure 23 summarizes the monthly wind regimes in Giza.

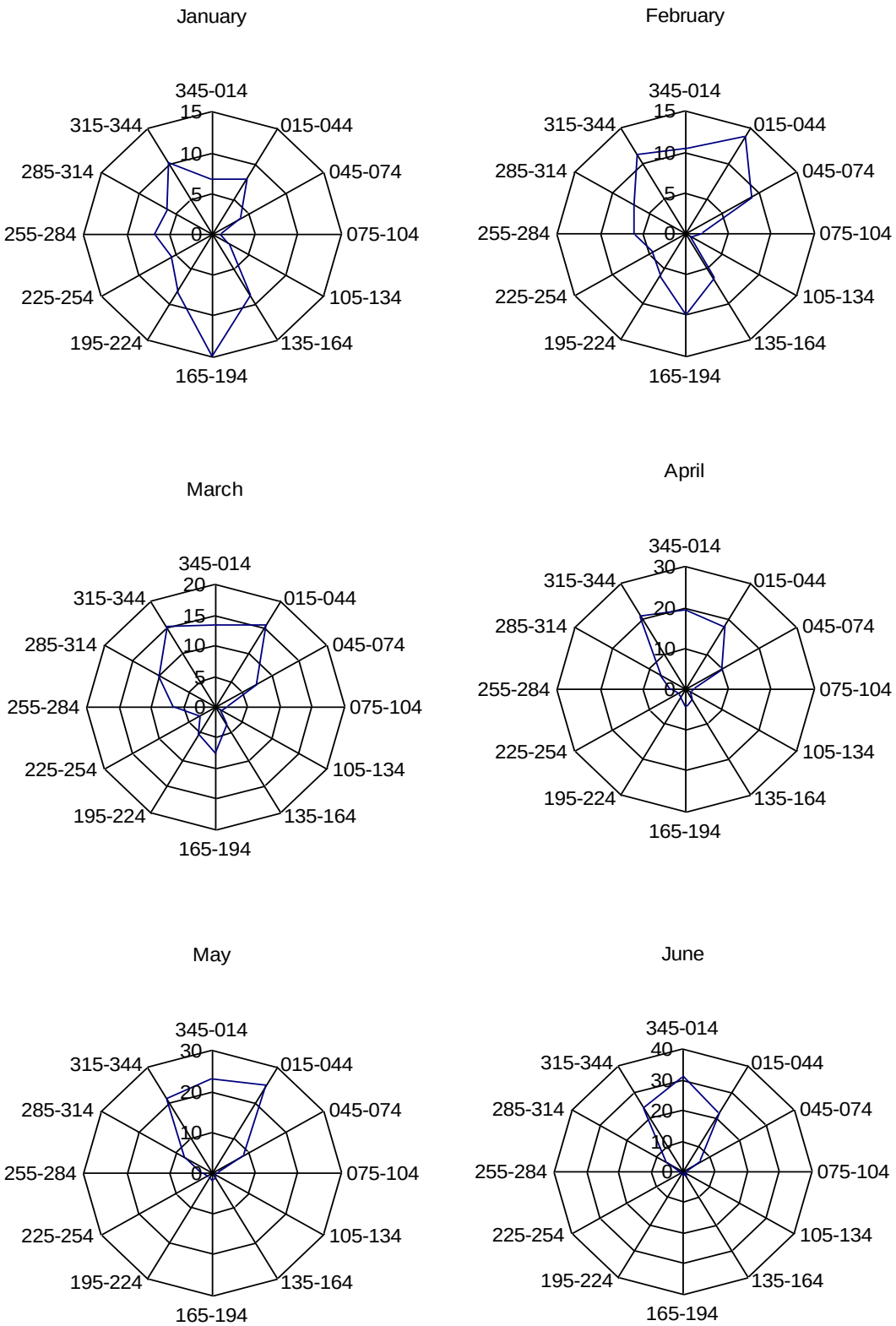


Figure 23 Monthly wind direction in Giza (in degrees)

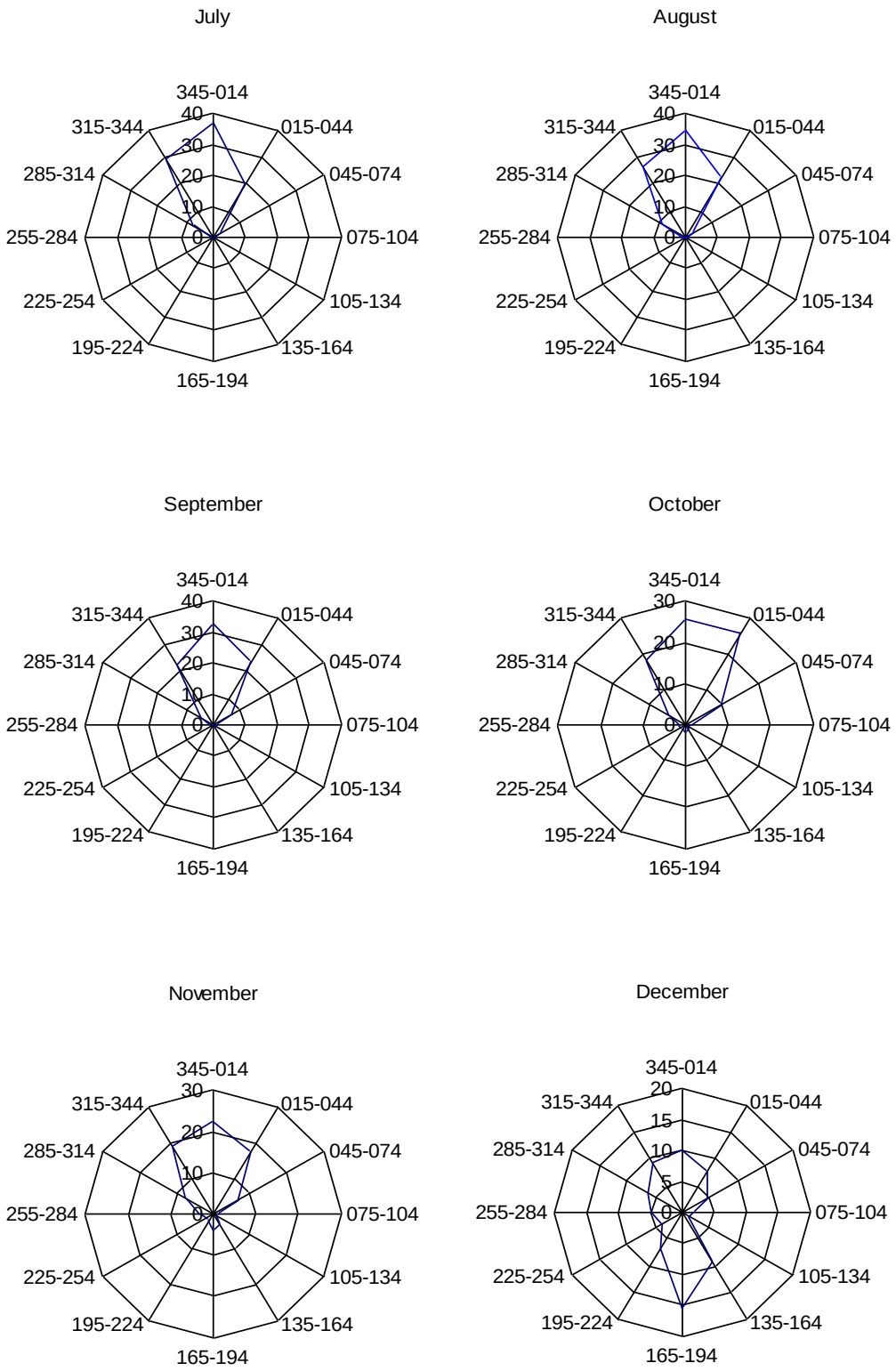


Figure 23, continued

3.2 THE CULTURAL HERITAGE SETTING

3.2.1 The Giza Necropolis

The Giza Necropolis is located roughly 20 km north of the ruins of Memphis, which was the capital of Egypt's Old Kingdom circa 3100 to 2200 BC. Following that period, Memphis remained an important cultural and administrative centre during the successive establishments and rule of Thebes, Alexandria, and Fustat, but was then largely abandoned in the late 7th Century AD. Its stone was scattered and reused for surrounding settlements in the following centuries. The present day towns of Dahshur, Saqqara, Abusir, Abu Ghorab, and Mit Rahina (on the site of Memphis) all lie within the administrative border of the historic capital. The general area between Dahshur and the Giza Plateau (Fig.24) holds a wealth of funerary monuments, including rock tombs, mastabas, temples and pyramids, and was declared a UNESCO World Heritage Site in 1979. The site is officially known as Memphis and its Necropolis – the Pyramids Field from Giza to Dahshur.

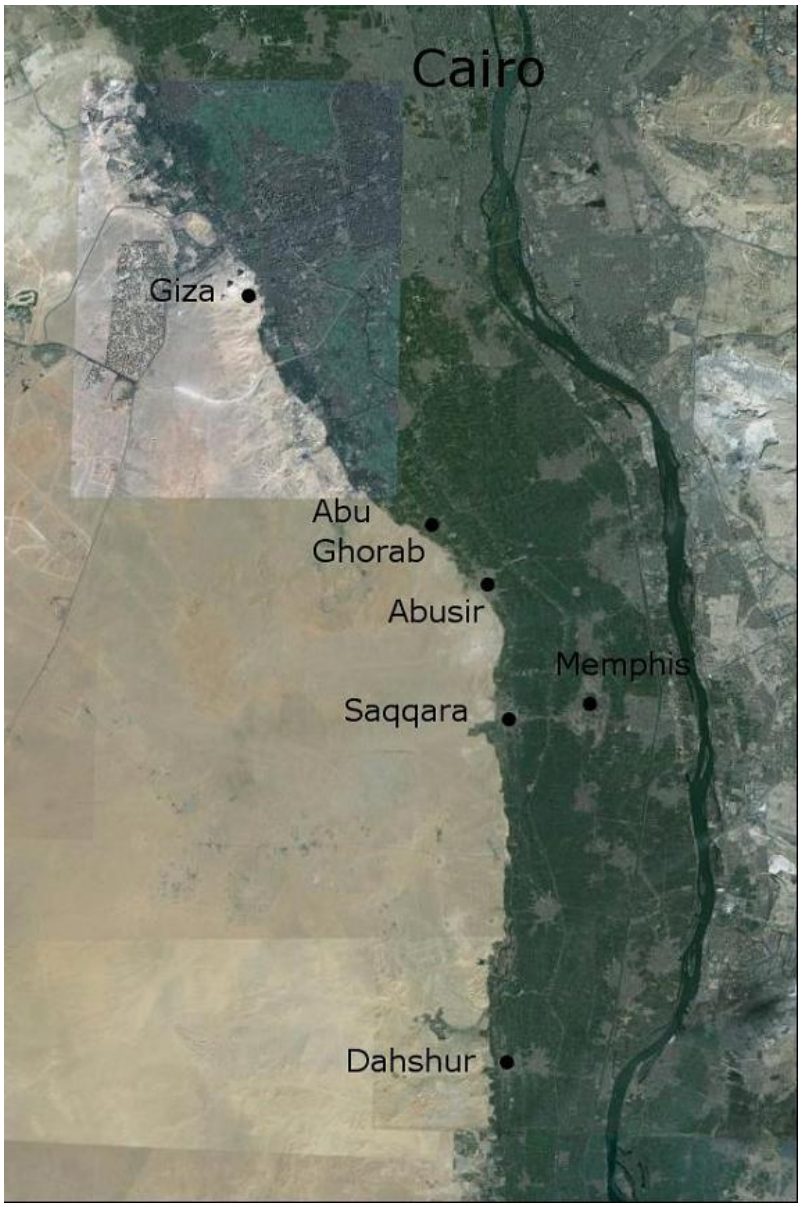


Figure 24 General area of the Pyramids Field from Giza to Dahshur.

The Giza Plateau includes the Giza Necropolis, which is especially famous for its 4th Dynasty (2575 - 2467 BC) pyramids, Khufu, Khafre, and Menkaure, and the Great Sphinx (Fig. 25). Together they are the last remaining wonder from the Seven Wonders of the Ancient World.

Figure 25 The Great Sphinx and the pyramid of Khafre in the background.
The modern-day village of Nazlet el Samman is immediately adjacent to the necropolis in the east.

The pyramids and Sphinx are not, however, the only vestiges from the past in the plateau (Figs. 26-27). Each lies within a group of related architectural components, including subsidiary pyramids, solar-boat pits, workshops, a harbor, funerary temples connected by causeways to valley temples, quarries, and mastaba fields/cemeteries. The reign of Khufu (2589-2566 BC), for instance, saw the construction of several minor pyramid structures in addition to the Great Pyramid that are believed to have been intended for other members of his royal household. These small pyramids are thought to belong to two of his wives, Henutsen and Meritetis, and his mother Hetepheres I. Another small pyramid belongs to this complex: the pyramid of the Ka, but only part of its casing stones remain today. Seven boat pits were also found on the eastern and southern sides the Great Pyramid, but only five of these belong to the Great Pyramid proper; the other two are associated with the pyramids of Hetepheres and the Ka.

Two fields of mastabas and tombs lie within close proximity of the pyramid. To the east of the small pyramids are the mastabas of the members of the royal family (eastern mastaba field). Along the eastern escarpment of the plateau are several rock-cut tombs from the 5th and 6th Dynasties. To the west of the Great Pyramid lies another field of mastabas (western mastaba field), which contains the tomb of Hemon, who is believed to be the architect of the Great Pyramid, and a relative of Khufu. South of the pyramid runs a line of about 12 mastabas.

The only remains of Khufu's funerary temple are its black basalt floor on the east side of the pyramid, and there is a causeway leading to the valley temple on the former banks of the Nile, which is now lost somewhere beneath the modern settlement of Nazlet el-Samman, in the vicinity of the Mansoureya canal. Several boat pits surround the pyramid, and disassembled boats have been found in two of these.

The Great Pyramid itself is unusual because the burial chambers are built within the structure, as opposed to underground, as is found in most pyramids. Originally the pyramid would have been covered by a layer of smooth white limestone and possibly crowned by gold sheet at the apex. This covering was stripped away in medieval times, but some still remains on the apex of the neighboring pyramid of Khafre.

The next largest pyramid of Giza is that of Khafre (2558-2532 BC). Though Khafre's pyramid is shorter (143 m) than his father Khufu's Great Pyramid (146 m high with a 230 m base), it is built at a slightly higher elevation, and still retains some of its limestone casing at the apex, which makes it appear somewhat larger than the Great Pyramid. It is more typical of Old Kingdom pyramids, having an underground burial chamber. Khafre's pyramid has only one subsidiary pyramid located on its southern side. It was completely razed, and now only its foundation blocks are visible. The area northwest of the pyramid has been leveled to 10m below the limestone bedrock, and quarry marks can still be seen in that area.

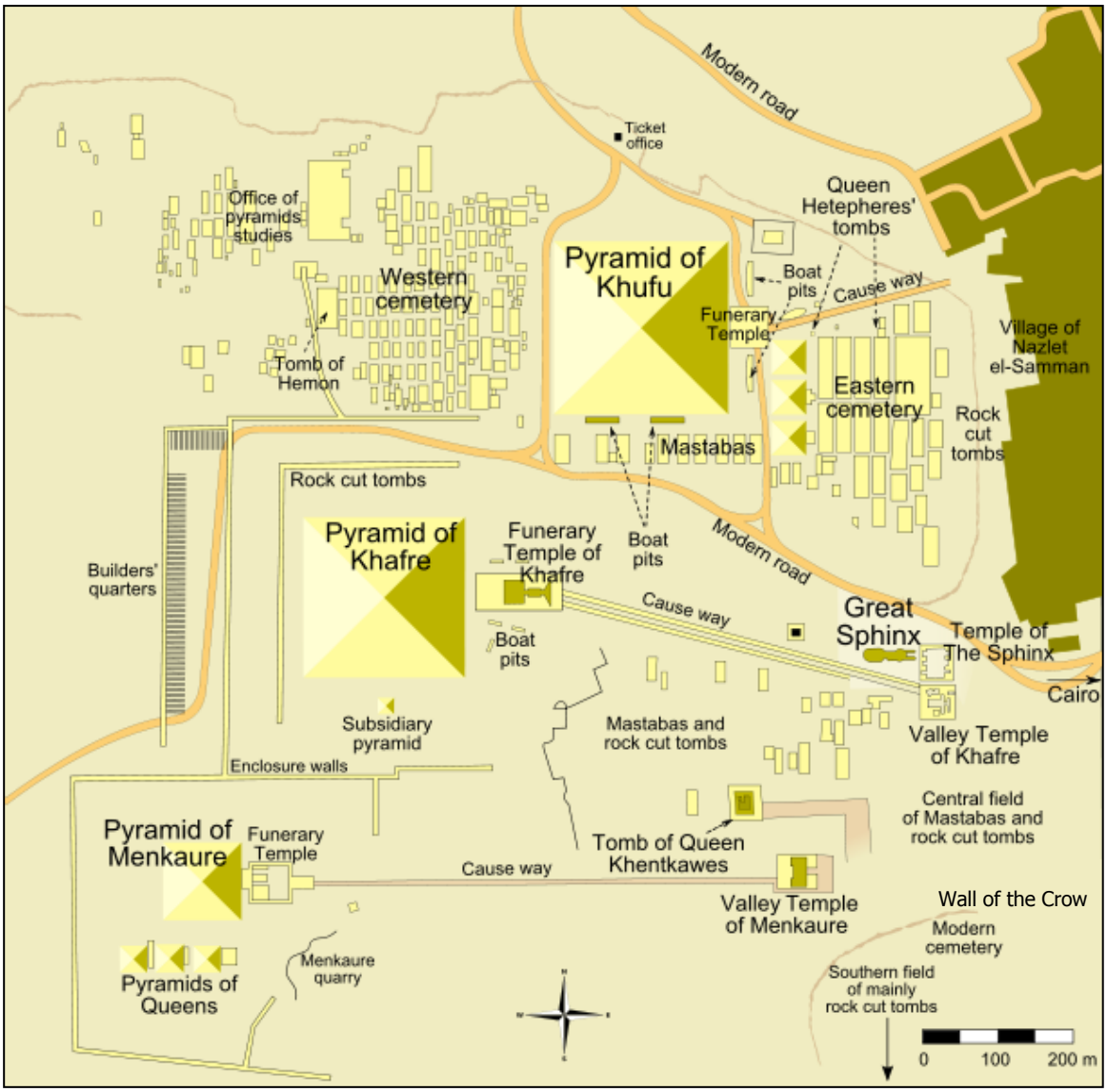


Figure 26 The Giza Necropolis

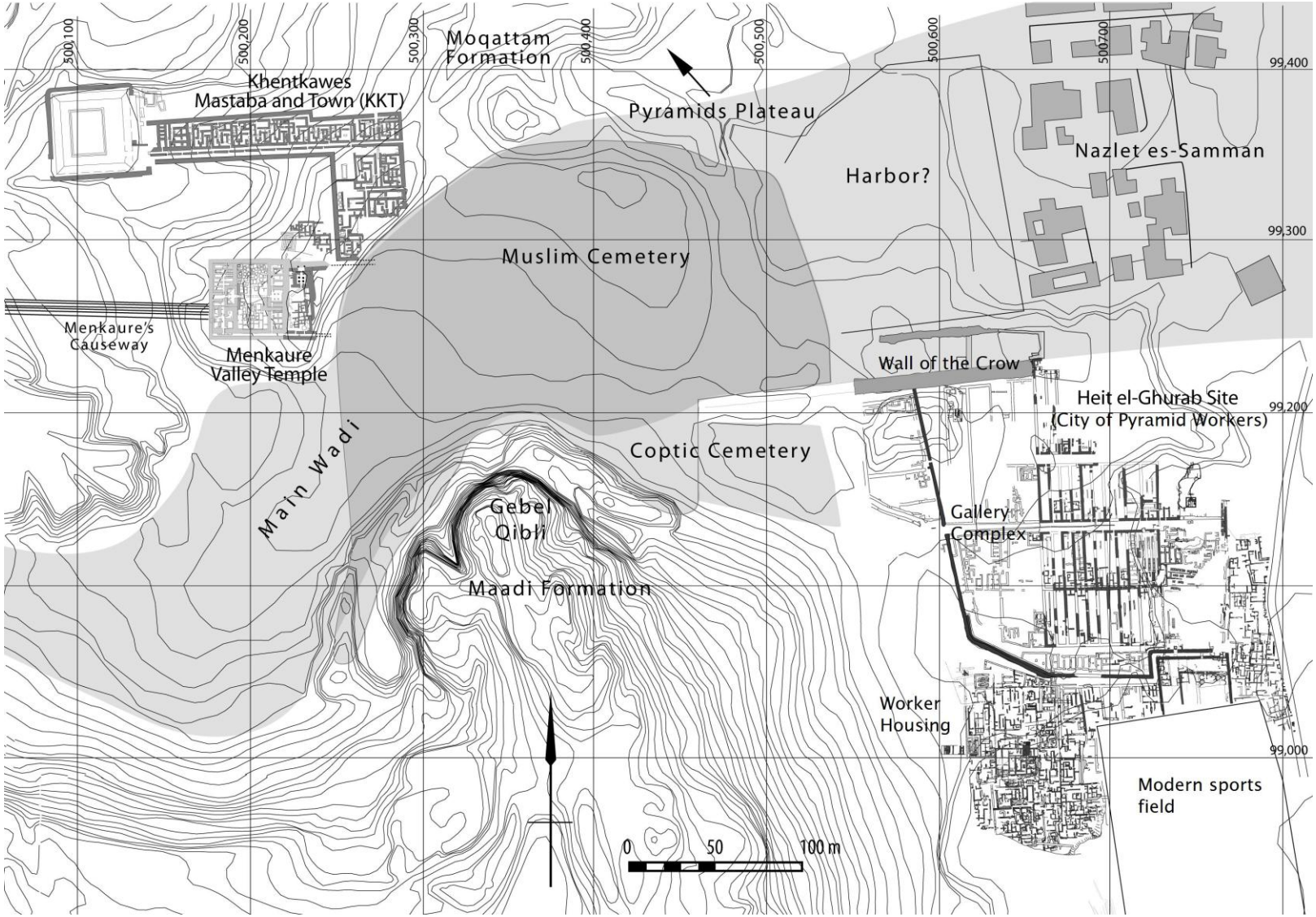


Figure 27 Giza Plateau south-eastern escarpment, main wadi, and the city of the pyramid builders south of Nazlet el Samman.

All the typical elements of subsequent Old Kingdom mortuary temples are found in Khafre's funerary temple outside. The temple consists of an entrance hall, colonnaded courtyard, and niches for royal statuary, storage chambers, and interior sanctuary. From there, Kafre's causeway leads down to the valley temple, a distance of 496 m. The ramp was originally covered and may have been beautifully decorated with bas-reliefs. It runs obliquely to the south-east. The valley temple of Khafre is remarkably well preserved. It is built of megalithic limestone core blocks sheeted in red granite. Many of the internal elements are still intact, including its many granite pillars and statues. Parts of the ancient quay are also still preserved in front of the temple.

Khafre's necropolis boasts an unprecedented profusion of statues, among which stands the Great Sphinx (Fig. 28). The Sphinx is carved from an outcrop of limestone, at the bottom of the Giza Plateau, in a quarry north of the causeway running between Khafre's funerary and valley temples. It is about 20 m high and 50 m long. This famous sculpture is usually assigned to Khafre's reign, and is considered to be the embodiment of Khafre as the god Horus. It depicts the pharaoh as a human-headed lion, wearing the headdress of the pharaohs. Other private tombs and mastabas are found in the quarry south of the causeway (central mastaba field) where the 4th dynasty builders took most of the stone for the inner core, and major bulk, of the Khufu and Khafre Pyramids. The Sphinx temple lies directly in front (east) of the Great Sphinx and next to Khafre's valley temple. It is constructed of blocks of locally quarried limestone and red granite pillars, but appears unfinished. Its layout suggests that it was used for solar worship, and is thus considered to be the first solar oriented temple associated with a pyramid complex.

Figure 28 The Great sphinx.

Note the effect of the differential wind erosion on the hard limestone of the head, and the soft limestone of the rest of the statue.

The smallest of the three Giza pyramids is attributed to Menkaure (2532-2503 BC). His valley temple was finished with mud brick, as opposed to granite for the other two Giza valley temples. Menkaure's

pyramid has its burial chambers below ground, just like that of Khafre. With its original height of some 65-66 meters, Menkakure's pyramid represents only about a tenth of the total mass constituting Khufu's pyramid. This may be due to practical reasons, or the result of an evolving theology which dictated more emphasis on the temples and less on the pyramid. At any rate, this trend appeared during the reign of Khafre, and continued throughout the Old Kingdom. Standing in a row along the south facing wall of Menkaure's pyramid are three subsidiary pyramids. These are referred to as the "pyramids of queens" and are attributed to Menkaure's royal consorts. Of these, only one of them is classed as a true pyramid, the other two having a four step core. All three of these pyramids were surrounded by an enclosure wall. The causeway the stretches from Menkaure's funerary temple to his valley temple are 608m long, and heads due east, but is unfinished.

Immediately to the north of Menkaure's valley temple is the tomb of Queen Khentkawes. This tomb is built from large masonry blocks sitting atop a cube of bedrock left in what was the quarry that provided stone for Menkaure's pyramid. The tomb appears like an unfinished pyramid or a giant mastaba. The surrounding quarry and tombs are cut into the low southeastern slope of the Moqattam Formation, which forms the Pyramid Plateau proper.

Figure 29 Wall of the Crow

Recent excavations near the valley temple of Menkaure and tomb of Khentkawes uncovered the remains of adjacent settlements, and a larger town, further south, that was inhabited by the workers who built and maintained the pyramids for generations after their construction. This general area is located about 300 meters south of the Sphinx, where stands a 200 m long and 10 m tall structure known as the Wall of the Crow (Heit el Ghurab in Arabic) (Fig. 29). The area (as shown in fig. 27) is low lying, mostly between 15 and 17 m above sea level, at the interface between the desert and floodplain. The area north of the Wall, which lays at the bottom of the main wadi separating the Moqattam and Maadi limestone formations at Giza, is now covered by a Muslim cemetery. This cemetery covers part of the Khentkawes/Menkaure settlements fills a deeper part of the wadi channel, about 125 meters wide. An area southwest of the Wall of the Crow is now covered by a

Coptic cemetery. The Wall of the Crow may have served as the main entrance to the Giza Necropolis, as a separation between the secular pyramid workers' town and sacred areas, and as a barrier for protection against the floodwaters of the contiguous wadi, when the Nile banks were still near the area.

Discoveries in the town south of the Wall include worker's houses, various storage areas, and part of a vast royal complex, comprising an administrative building and huge galleries separated by a paved street, which may have lead to a royal palace. Much of these low lying areas, however, are now concealed beneath the modern towns of Nazlet el Samman and Nalzet el Sissi, their cemeteries, and a sports field further south.

Indications of other vestiges were found during, the Greater Cairo (West Bank) Wastewater Project carried out by GoE , USAID , the American and British consortium AMBRIC, which started working near the Giza Plateau in 1988 as a water-lowering project for the Great Sphinx, then moved on to installing a sewage system for the village of Nazlet el Samman.

3.3 THE BIOLOGICAL SETTING

All the original habitats of the Pyramids' Plateau and its surrounding areas have been altered by more than 7,000 years of human activity. The ecosystems in place today are therefore essentially man-made, and the biodiversity of this peri-urban environment is now comprised for the most part of species that are either commensal, or at the very least tolerant to human activity.

The study area covers several distinct ecological zones, including cultivated land and gardens, water canals, residential areas and roads, and desert land.

3.3.1 Vegetation

Wild flora occurs mainly as weeds in the cultivated fields, and on the banks of the Mansoureya canal. Very few species of plants occur in the desert area and archaeological site (Annex 3). None of the plant species seen at the study area is listed as threatened or restricted in local Egyptian or international (IUCN) lists of threatened species.

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

The soil of the Nile Valley can nurture a wide variety of introduced fruits and vegetables as well. The agricultural areas of Giza are fairly important given their proximity to Cairo. The most commonly cultivated crops are berseem (Egyptian clover) and wheat in winter, and maize in summer, but other vegetables are also important. Fruit and vegetables are also important in the area, and are often grown in intercrops. Vegetables include tomatoes, potatoes, spinach, and molokhia, while fruits include citrus, (up 50 percent of total fruit production), bananas, grapes, and dates. Other significant crops include cotton, crop, sugar beet, and a number of bean crops for human consumption.

3.3.1.1 Freshwater vegetation in the Mansourey Canal

Vascular freshwater hydrophytes of the Nile and its irrigation network comprise 87 species of flowering plants, belonging to 45 genera and 25 families. These hydrophytes can be divided into 3 main groups: submerged, floating (free or fixed), and emergent. Vigorous growth of hydrophytes is observed in some parts of the Mansoureya Canal. This includes the floating Water Hyacinth *Eichhornia crassipes* which completely covers the water surface in some areas. Such vigorous growth

is probably due to the fact that the canal waters have elevated concentrations of nutrients. Emergent species such as *Phragmites australis, Typha domingensis, Juncus* subulatus, which can be considered as weeds, and several species of *Juncus* grow in the shallow areas near the canal banks. *E. crassipes* and *P. australes*, two invasive species, will tend to dominate in such poor quality water. A list of hydrophytes of the Nile and its canal system in the Cairo region is shown in Annex 3.

3.3.2 Reptiles and amphibians

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

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

The study area is inhabited by 5 families of lizards and 2 families of snakes. The latter include several poisonous species of viper, the Egyptian cobra *Naja haje haje*, the semi-poisonous African Beauty Snake, *Psammophis sibilans*, the Tessellated Water Snake, *Natrix tessellata*, which is common in streams and irrigation canals, the Ocellated Skink, *Chalcides ocellatus*, and the Bean Skink. Most of lizard species are associated with the rocky, sandy, and/or sparsely vegetated desert habitats, although some, such as *Chalcides ocellatus* and *Mabuya quinquetaeniata* are associated with mesic environments, and are found on the banks of canals. None of the species listed from the area is on the Egyptian or international lists of threatened species. Annex 3 shows a list of amphibians and reptiles reported from the GCR.

3.3.3 Birds

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

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

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

3.3.4 Mammals

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

3.3.5 Invertebrates

3.3.5.1 Terrestrial Invertebrates

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

Scorpions and spiders are represented by 6 orders in Egypt, but not all are present within the Study area.

3.3.5.2 Freshwater Invertebrates

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

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

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

None of the invertebrate species of the area is listed on international or local lists of threatened species.

3.3.6 Freshwater fish

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

3.4 SOCIAL SETTING

3.4.1 Methodology of sociological investigation

The community's mind set and issues that they perceive as critical to their wellbeing and livelihood are central to any discussion of impact areas. Accordingly, the EIA was intent on undertaken an investigation of the social setting and economic activities in the area using a methodology that combined observational methods (transect walks), as well as focus group sessions with stakeholders and in depth interviews with key community members.

The following is a detailed description of our methodology:

Preparatory Phase

The team went on a field reconnaissance visit to the area, based upon which a decision was made to focus investigative activities on the commercial street of Abol Hol covering it and going further to the depth of approximately 1 kilometer on either side, so as to cover the residential streets closer to the walled area of the Giza Plateau.

Given people's sensitivity to any unusual movement in the area, the team developed its field information gathering plan with a view to going into the area and getting out of it as rapidly as possible. The aim was to understand the social and economic setting of the area without facing any obstruction from the community or from the authorities concerned with maintaining security.

Implementation of the Research

The implementation phase started with the secondary research. Information regarding the demographics of the area and businesses and services available was collected from both Central Authority for Public Mobilization and Statistics (CAPMAS) and the district Information Center (2006 census). The information from both sources was compared to make sure that there were no contradictions and to identify information gaps.

Generic focus group and interview guides were developed and tested and adapted to the specific target group. The focus group guides were structured to elicit the following:

- Basic information on the participants (age, education, profession, birth place etc)
- Profession, location of workplace, transport facilities
- Infra-structure services and public and private facilities available
- The historical importance of the area and how residents relate to it
- Participant awareness/perception of the ground water problem
- Solutions proposed to minimize any potential inconvenience that the project might temporarily cause
- Community leadership

Five focus group sessions were planned and conducted; 2 with residents (which turned out to be men), 1 with women, 1 with bazaar owners, and 1 with stable owners.

The key community leaders were identified through the focus groups and were interviewed to confirm the findings from the focus groups and to get their opinion as to the issues to be taken in consideration during the implementation of the project. Ten such interviews were administered.

The EIA team went on two transect walks along Abol Hol Street which was pointed out by the engineering team as being a potential project site, and along the streets of Abu Fayed and its extension in El Torab (El Hefnawi) where the cemetery is located, as well as the funeral hall and some

stables. These walks occurred during the weekend (Friday and Saturday) while tourist and commercial activities are at a peak. The purpose was to observe tourist movement during these hours and also to get a feel for how the people of the area live and conduct their business during peak days and hours.

The overlap in the implementation of the focus groups, transect walks and in depth interviews was intentional so that information obtained through one method could be cross checked by information obtained through the other methods.

Finally a public consultation was held to which representatives of the various stakeholder concerns within the community were invited. A presentation about the project and its expected positive impacts was made. The results of the scoping exercise that was conducted to assess the current situation and mitigate for negative environmental, social and economic hazards that could potentially occur during the construction and operation phases were presented, and participants were encouraged during a lengthy discussion session to provide their input to the mitigation plan and to ask for clarifications concerning the engineering solutions/options that were outlined.

The results of the public consultation confirmed the findings of the initial scoping exercise, and the community concerns that were reaffirmed during the consultation were integrated in the proposed mitigation plan.

3.4.2 Existing social and economic conditions

3.4.2.1 Demographic characteristics

Nazlet el Samman is the neighborhood or administrative unit (shiakha) with the second largest population in El Ahram district (Markaz) which comprises 6 shiakhas. According to the last district census, by January 2010, Nazlet El Samman had 52,259 inhabitants representing 18% of the total population of the district, only preceded by Mansheat El Bakary with 31% of the total district population. It is mostly a young population with approximately 60% (31.827) aged 25 years or less, more or less equally distributed between males and females, which indicates that it is a stable and not transient population. The 2006 CAPMAS census reports that more than half of the inhabitants own their homes (melk, tamleek, heba). The rest is living in different forms of rentals, mostly old, which indicates that that they have been living there for a long time; however, there are also a few (2029) that are living in new and furnished rentals. Half of the inhabitants of Nazlet el Samman are educated, holding intermediate and university degrees. Approximately 20% are illiterate, with women as expected, constituting the majority. There are lawyers and other white collar professions among the population of Nazlet El Samman, as well as tour guides, construction and factory workers, shop keepers, street vendors, and clerical employees. Many of the residents leave the area during the day to go to work, while others work in the tourist-centered businesses of the area.

3.4.2.2 Land use and public facilities

Nazlet El Samman is a predominantly urban district with scarce agricultural holdings on its outer fringes (Figs. 29-32). According to the last district census, most buildings are residential (5122 out of a total of 5588), and the rest are small commercial enterprises and offices. Water and waste water coverage is quite comprehensive. According to residents only a few dispersed houses in some areas are un-serviced (28 households according to the 2006 census are completely un-serviced, and 114 households rely on septic tanks). There are no complaints about the quality of the water. Electricity is also available; however, household owners complain that they are not allowed to apply for additional household connections for the extensions that they subsequently made to their buildings. According to the 2006 census, there are only 5 households that remain totally un-serviced in terms of water and electricity; however, 385 households do not have electricity.

The EA team was warned not to be misled by the dilapidated state of some of the houses in the area, which is a result of the government's decision not to issue any permits allowing any construction or renovation work.

Medical services though available to people through a number of private clinics, a private hospital, and the family health clinic, are not well regarded by residents who resort to facilities outside the area when serious treatment is needed. Educational and recreational facilities are scarce. There are only three public primary schools in the area, one of which is closed. There are no preparatory and secondary schools in the area. Abol Hol Club was the recreational facility available to youth; however, the Supreme Council of Antiquities (SCA) had the club closed down, saying that there were antiquities on site. To date no alternative to that club has been provided for youth related activities.

There are a number of community development associations (CDAs) in the area, some of which have religious affiliations like El Gamea El Shareya, El Shaheed Marguiguis and others that have been established by prominent individuals or families to provide among other services, various charities to pensioners and orphans (El Ghad Wal Mostakbal). Not all CDAs are perceived by residents as effective, however, El Gameya El Shareya's branch in Nazlet El Samman which is headed by Sayed Manaa, is considered to be the most active. In addition, a number of key leaders (Magdy Khattab, Abdel Nasser El Gabry) have their office or home door open to the public (Maktab khedmat El Moatteneen)

Nazlet El Samman has a post office, prayer facilities, and a police station. There are a number of mosques and zawwiyas (small prayer areas) and a church (Mar Guirguis). In addition to the Al Ahram district police station, police presence is very noticeable in the area, to ensure the security of tourists.

Figure 30 Nazlet El Samman, with visiting tourist buses.

3.4.2.3The social and economic setup

There are no social divisions among the population in Nazlet El Samman. There are a number of big families (Khattab, El Gabry, El Shaer, Abu Fayed, El Kamatty, Ghoneim). Tracing their ancestry to the Arabian Peninsula, these families have been living and conducting business in the neighborhood for generations. Interviews conducted for the purpose of this EA confirmed that most respondents (men &women) had been born in the area to parents, and grandparents who had also been born in Nazlet El Samman.

In each family, there is one or more individual who is politically active, and is a member of the People's Assembly or the Shura Council. The families are large and like all extended families in Egypt, they include both prosperous and less prosperous members, with the more fortunate often taking care of other family members.

The revenues accrued to the area from tourism and other related activities constitute the backbone of Nazlet el Samman which has a vibrant enterprise sector providing employment to family members mostly but also to other residents of the area. Business people claim that the lack of fundamentalist incidents in Nazlet El Samman is a positive outcome of their presence in the area and contribution to the livelihood of the community. There are 72 bazaars in Nazlet El Samman, and close to 100 stables. Focus groups with bazaar and stable owners revealed that a stable employs on average 3-6 persons, while bazaars can provide permanent and part-time employment to up to 30 persons.

Many of the business owners live in apartments above their business, or nearby. It is not unusual to find some owning residences outside of the area; however, they continue to live in the shiakha where their businesses are located. Some of the business people own more than one enterprise centered on tourism. Bazaar owners can also own stables and tourist agencies. Business interests often extend outside the area of the neighborhood, but Nazlet El Samman is where it all begins.

Revenues from tourism have given rise to other businesses which cater to the needs of the residents of the area, while providing additional employment opportunities e.g. groceries, tailor shops, pharmacies.

Figure 31 Nazlet El Samman, stables, horses and camels.

3.4.2.4 Traffic

Abol Hol Street is the main gateway to the area and its main commercial hub. The traffic is constant as are the commercial activities catering to tourists as well as residents. Weekends (especially Fridays), are noted to be somewhat busier because of school excursions and Egyptian visitors coming to the Pyramids and sphinx area. The two bus stops that are accessible to the residents of the area are on Abol Hol Street, one facing the Family Health Centre, and the other located at its entrance near the Abu Taleb Bridge. Public and tourist buses, school buses, micro-buses, private cars and taxis pass by at different intervals and stop to take on or drop residents, tourists and students. Trucks and carts transporting goods are continuously coming in and out of the street. Focus groups with residents revealed that the density of traffic is a problem that they suffer from especially while going out of the neighborhood. They are often obliged to wait for long stretches of time until the arrival of the public bus that is the primary means of transport for coming in and going out of the area. The second means of transport that is available is the microbus, which residents are not happy with because they are often obliged to commute more than once to reach their final destination. The remaining streets in Nazlet el Samman are more narrow residential streets, with limited traffic capacity. The toc toc a private and cheap means of transport that has become very popular in certain low income areas is one of the means of transport that the people of Nazlet El Samman use quite extensively because it is affordable and because of its easy access to the narrow streets. While prohibited in the tourist area, the toc toc is still seen in Abol Hol Street braving the traffic control unit that is attempting to regulate the flow of traffic and ensure the safe passage of tourist buses. Finally, the horses are also observed passing through the street going in and out of their stables which are located for the most part in Gamal Abdel Nasser Street but also in the other streets. During late afternoon, when the tourist buses start leaving the area for a couple of hours and until it is time for the Sound & Light show, Abol Hol Street becomes a play ground for the children and their bicycles.

3.4.2.5 The Mind Set of the Community

Interviews and meetings with stakeholders in Nazlet El Samman (business people & residents) revealed widespread skepticism about the government's intentions with regards to Nazlet El Samman in general and the area of intervention around the Pyramids and Sphinx. Accordingly, such wariness is extended to the motive behind any intervention in the area, whether it is concerned with public works or the preservation of touristic sites which most residents describe as being "the life line and bread and butter of the people of Nazlet El Samman". Government interventions are perceived to constitute steps towards the gentrification of the area and their eventual if not imminent eviction. There is much misinformation in the community that is due to haphazard statements that were made in the People's Assembly as well as through the media, all of which contribute to people's feeling of insecurity and their noticeably defensive attitude.

Not being allowed to refurbish dilapidated housing and to introduce electricity to un-serviced housing units is perceived by people as being unjust measures taken by the government against them, as is the closure of the only youth club in the area, "forcing our young ones onto the streets." The SCA is the main culprit in people's minds, exhibiting a total disregard for the fact that for most people, the area is their birth place and for many a source of lively hood. However, it is also from the SCA that they claim reassurance that they will not be evicted.

The community is unanimous in its rejection of the "SCA claim" that groundwater is affecting the Pyramids and the Sphinx, labeling as "another SCA ruse". They are aware of the rise of ground water; however, the more informed among them, believe it is mostly due to the Mena House golf course and to luxury developments along the Mansoureya canal. The less informed community members say that the water has always existed and that prior to the construction of the high dam, the area was often flooded without any damage being inflicted on the Pyramids, Sphinx and archeological sites. They even believe that the Pharaohs, whom they describe as having been astute architects, knowingly built their Pyramids and the Sphinx on a bedding of groundwater. Their conclusion

therefore, is that they should not be penalized for the rise of the groundwater, an occurrence which has nothing to do with their presence in the area.

The community feels resentful but not helpless, thanks in large part to having a number prominent families and leaders in the area. During interviews with key members of the community, a definite statement was made to the effect that the SCA will not be able to force people out, and that any attempt to do so will be met by resistance.

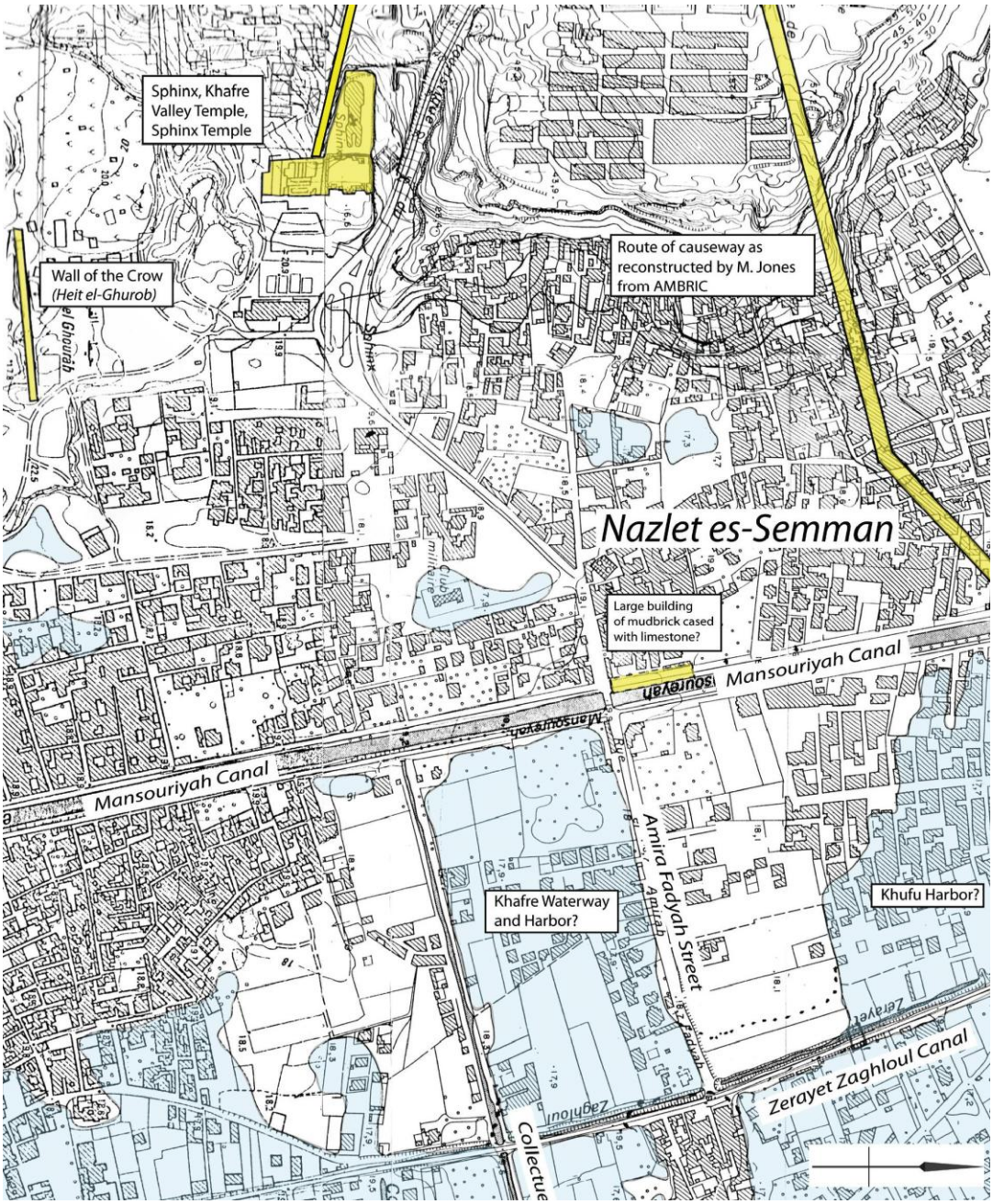


Figure 32 Inhabited area (Nazlet el Samman) east of the Khafre Valley Temple and Sphinx. A rectilinear low tract (colored blue) defined by the 18-m contour line and patches of low ground closer to the valley temple are hypothesized as residual depressions from a 4th Dynasty waterway or harbor.

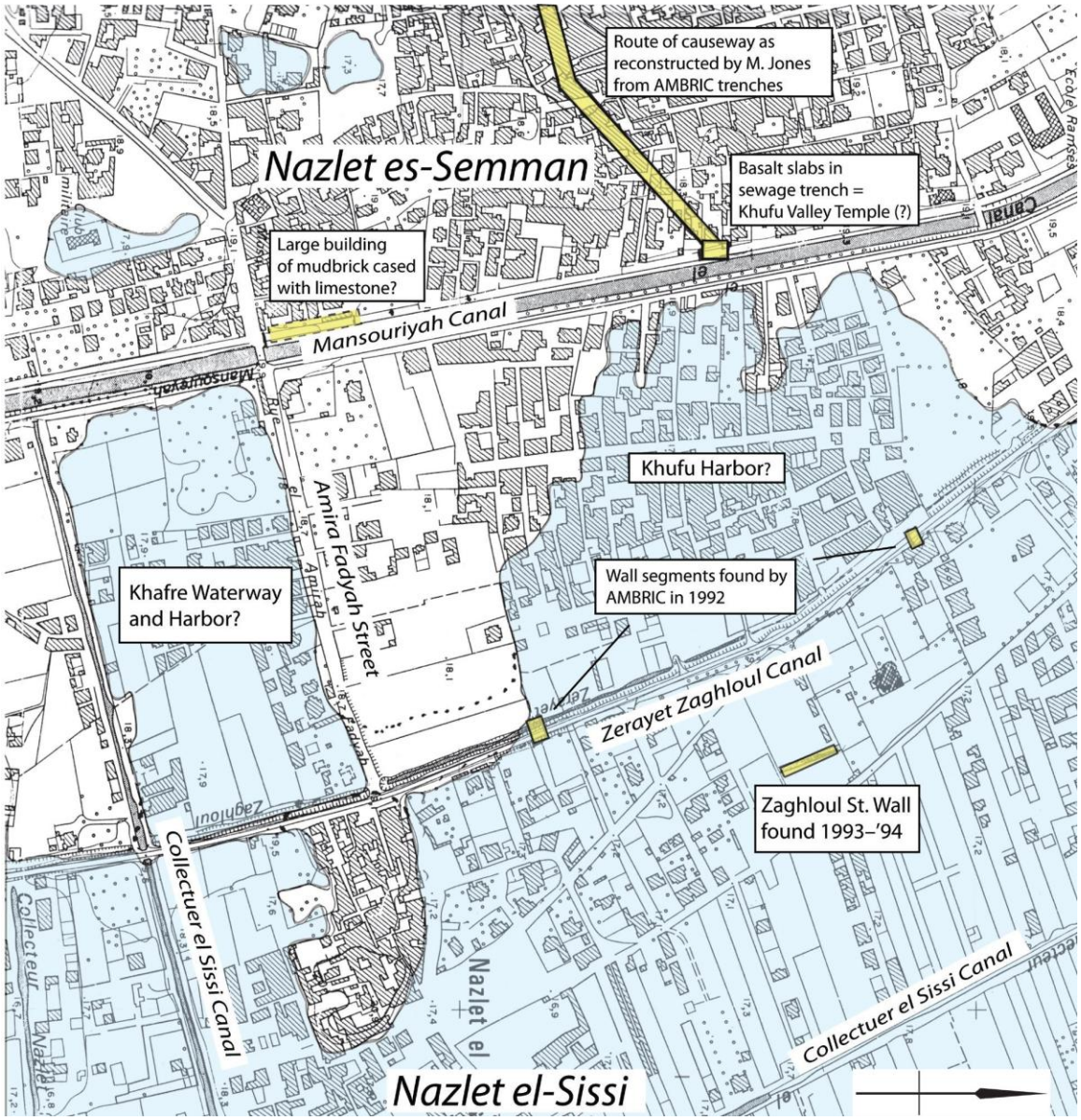


Figure 33 Inhabited area (Nazlet el Samman) east of the Khufu Pyramid.

4. ALTERNATIVES INCLUDING THE PROPOSED ACTION

4.1 GROUNDWATER LEVELS AND DEWATERING TARGET

Groundwater reaches the soil surface and moves up the monuments' foundations through capillary rise. The distance travelled by water is in general inversely proportional to the radius of the conduit. AECOM team's field investigations indicated capillary rise in soil and limestone in the order of 1.2 to 1.7 m in the Pyramids Plateau. The study also assumes that the capillary fringe should be approximately 2 m below the elevation of the structures' foundations. This value was therefore used for the design of the Pyramids Plateau groundwater lowering systems described below.

The archaeological sites in the low lying areas of the Giza Necropolis, mainly at the bottom of the southeastern corner of the Pyramids' Plateau, are the most likely to be impacted by rising groundwater. These areas include the Great Sphinx, the Sphinx and Khafre Valley Temples and the recently discovered city of the pyramid's workers.

AECOM's April 2010 Groundwater Modeling and Alternatives Evaluation Report indicated groundwater lowering target levels as listed below:

12.5 m above sea level (asl) to 13.0 m asl in the Sphinx area, including the limestone bedrock at and around the Sphinx.

13.0 m asl to 14.0 m asl in the Workers area south of the bus parking area.

These target elevations were recommended based on field investigations relative to capillary rise in limestone and sandy soils, and discussions and consultations with SCA and Dr. Mark Lehner of AERA regarding significant existing archeological features in the project area which should be protected from the effects of groundwater.

Discussions in this regard were held among representatives of SCA, USAID and AECOM team. Groundwater lowering target levels at the site as noted below were established through meeting discussions:

East of the Wadi Temple at the low portion of the existing underpass in limestone bedrock. SCA indicated in the meeting that they would like to protect the lowest point in the Wadi Temple area (which is in the underpass) from moisture. Therefore, the groundwater lowering Target Level of 12.5 m asl was determined for the Sphinx area.

For the Workers Area south of the bus parking area, SCA requested a groundwater lowering target level of 13.0 m asl.

The Giza Pyramids and other exposed antiquities on the Plateau are on the north and west sides of the affected areas near the Sphinx. These antiquities are situated at higher levels, starting from about 20 m asl, and are unlikely to become affected by the groundwater; therefore, for these antiquities protection from groundwater will not be required.

4.1.1 Pre-dewatering conditions

SCA and CU actually initiated groundwater pumping activities in July 2008, following a series of measurements carried out between November 2007 and January 2008 (Figure 34). Groundwater levels in the Sphinx area were on the order of 15.4 to 15.7 m, without any significant gradient. Similar levels were found in Nazlet El Samman, while slightly higher values were measured both north and south of the Sphinx area. There is only one measurement point north of the Pyramids' Plateau, near the Mena House golf course, and this point had the highest groundwater level in the area.

Thus, the groundwater levels shown in Figure 34 are an interpretation of conditions prior to implementation of the dewatering system based on available data, subjected to as much verification

and analysis as is possible given that these conditions cannot be returned to. The groundwater levels do not point to a clear source of groundwater recharge, but rather to a regionally stable groundwater system with little groundwater flow.

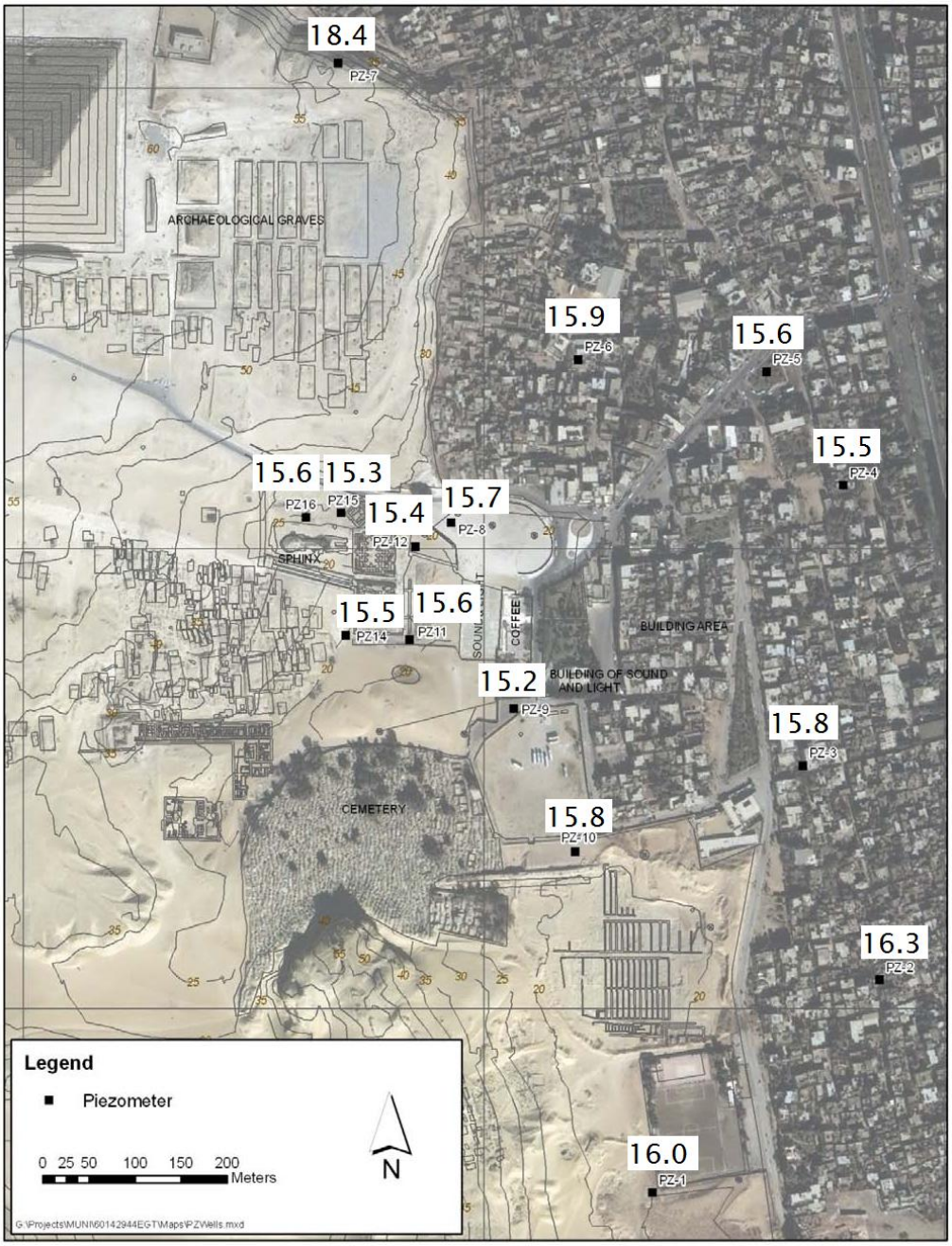


Figure 34 Pre-dewatering groundwater levels

4.1.2 Groundwater conditions following the intervention of SCA/CU

The SCA/CU dewatering system started operating in July 2008 with 3 wells, which were supplemented by 4 wells in November 2008, and an 8th well in January 2009. The well locations are shown in Figure 35 and estimates of the well flows are listed in Table 5. Groundwater levels following initiation of the dewatering system are shown in Figure 36. The piezometers where the measurements were made are shown in Figure 35.

Table 5 SCA/CU dewatering well flows

Well No	Pumping Start	Flowrate (m^3/hr)
1	22-Jul-08	90
2	1-Jul-08	65
3	12-Jul-08	105
4	Nov-08	40
5	Nov-08	105
6	Nov-08	90
7	Nov-08	105
8	Jan-09	24
Total		624

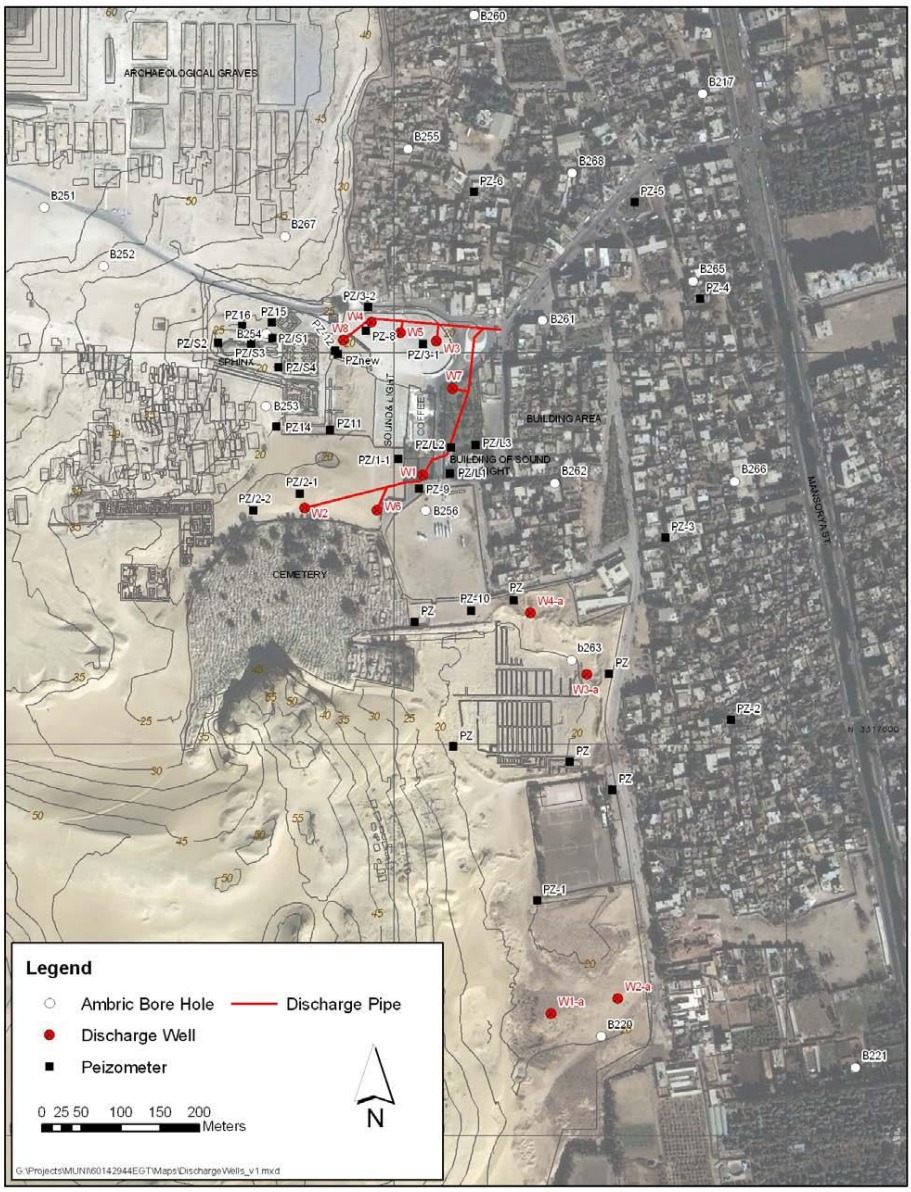


Figure 35 Locations of SCA/CU dewatering wells and piezometers
(only the wells in the Khafre and Sphinx temples area are pumping)

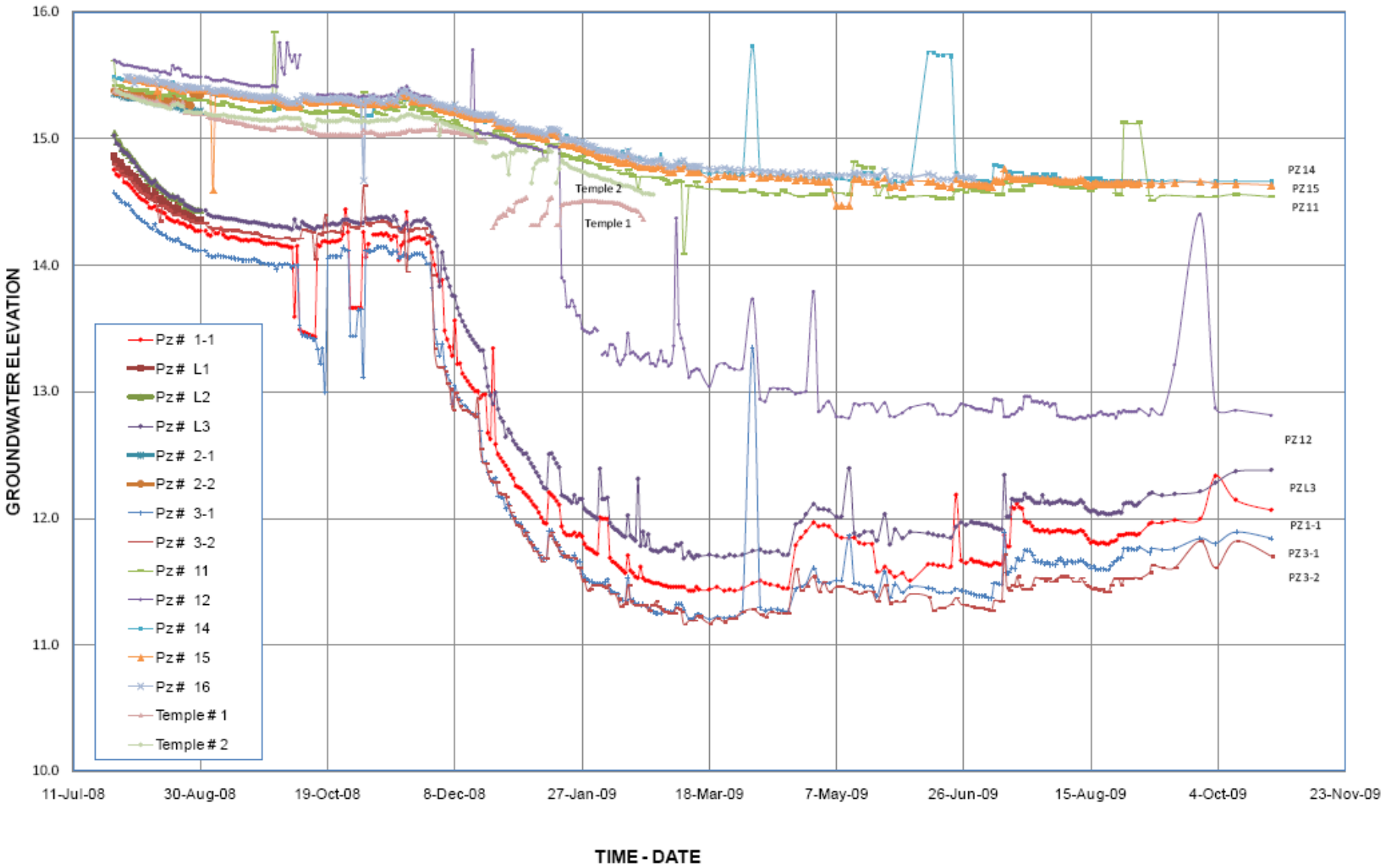


Figure 36 Groundwater levels since implementation of SCA/CU dewatering scheme

4.2 ALTERNATIVE APPROACHES TO GROUNDWATER LOWERING

A number of alternative approaches to lowering groundwater levels in the Pyramids Plateau area have been considered. These approaches are based on extensive groundwater modeling and geotechnical investigations. Although several alternatives were initially considered, ony three were retained for a more detailed analysis, including environmental analysis, with the others discarded for various reasons. These include potential implementation requirements that are out of control of the SCA, insufficient groundwater lowering capacity, high capital cost, lack of required technology and experience in Egypt, potential damage to buried antiquities, and visual impacts. The three selected alternatives are as follows:

1. Ground awter source curtailment
2. Dewatering vertical wells
3. Dewatering drains in trenches

The overall system requirements common to all the approaches are that they must account for:

- Minimum visual impact to preserve the aesthetic quality of the archaeological sites.
- Minimal risk of damage to archaeological resources, whether known or unknown.
- Minimum need for maintenance and human supervision.

Table 6 shows a comparison of advantages and disadvantages of the three alternatives.

Table 6 summarizes the advantages and disadvantages of the various alternatives.

Alternative	Advantage	Disadvantage
Ground water source curtailment	- Addresses cause rather than effect - Less risk to Giza antiquities. - No visual impact at the Giza Plateau. - Less construction work; less disruptive to local community.	- Require extensive actions mostly out of SCA's control. - Unlikely to achieve the dewatering target alone. - Cannot be accomplished in a timely manner.
Dewatering vertical wells	- Builds upon an existing, operational system of dewatering wells. - Modularity: additional wells can be easily added as needed. - Lower capital cost. - Simple construction and short term visual impact. - No need for pump stations.	- High operating cost due to high levels of energy consumption. - Electromechanical equipment require frequent maintenance. - Numerous near-surface piping extensions on the plateau. - Construction of force main will impact local community.
Dewatering Linear drains in trenches	- Largely passive system, with only one pumping station - No maintenance within touristic/ archeological area. - Lower maintenance cost.	- Deep trenches, resulting in greater construction impact. - High initial capital investment. - Difficult to retrofit. - Risk of impact to buried antiquities.

As source curtailment cannot achieve the target alone, the SCA selected the vertical pumping wells alternative, in which the existing CU wells will be utilized and modified to discharge to the Mansoureya Canal, rather than to the sewers. The technology used for installing vertical wells is widely available in Egypt and is relatively economical. The selected dewatering scheme will, therefore be based on installing a system of vertical wells, in combination with introducing some ground water source curtailment measures.

4.2.1 Ground water Source curtailment

The groundwater modeling study identified the following ground water recharging sources:

- Recharge from Mansoureya Canal. The canal has been culvertized over much of its length in the area of the Sphinx, and reconditioning it to increase its imperviousness may be difficult and costly. However, significant portions of the canal are in clay, so leakage is not expected to be very large.
- Leakage from water supply pipes and sewers in Nazlet el Samman. The larger of the two factors is likely leakage from the water supply system, and measures can be undertaken to detect and repair the leaks.
- Irrigation at Mena House golf course and Sound and Light Show garden. An under drain system has been designed for the Mena House Golf Course (Fig. 37) but not implemented. The groundwater recharge due to irrigation of the Mena House Golf Course was estimated at 420 m^3/day by the engineering consultant. The Sound and Light Show garden is too small to have a significant impact.
- Restart operation of the El Ahram well field. The El Ahram wells (Fig. 37) were used for several years as the source of raw water for the local potable water production facility, extracting ground water at an average rate of 25,000 m^3/day. In September 2005, the facility shifted to another source of water and the El Ahram wells were shut down. Analyses conducted to date show that the El Ahram well field likely produced a drawdown on the order of 1.1 m in the area of the Sphinx. This drawdown disappeared when the well field was shut down in 2005. Although the drawdown generated by the well field was not sufficient to meet the desired level of groundwater lowering, it would contribute a significant amount, and would reduce annual pumping costs. Therefore, the possibility of restarting the well field will be investigated with the relevant water agency, as it is out of control of the SCA.
- Irrigation in agricultural areas south of the site. Reducing this groundwater recharge significantly would likely be difficult.

Thus, while addressing these issues would potentially reduce the rate of ground water recharge, they would not be sufficient to reach the desired target alone.

4.2.2 The vertical wells

A system of 8 wells with above ground well heads was set up as a temporary measure by CU around the Khafre Valley and Sphinx temple (Fig. 38). Another 5 wells were also installed near the City of the Pyramids' workers, but these are not operating yet (Fig. 38). The system in place is inadequate for lowering groundwater to the required level, and discharges 624 m^3/hr to the sewer. In order to achieve the dewatering target of 1,300 m^3/hr, another 7-10 wells would be needed (Fig. 38). As the volume of water extracted would be larger, it would be entirely discharged to the Mansoureya Canal, rather than the sewers.

The current system has above ground well heads, but an entirely underground system would be possible, as shown in Figure 38. This would require submersible pumps in each well with power and control located below the ground surface inside a chamber at each well, and discharge piping systems to a force main. No further pumping facilities will be required to convey the collected water through the force main to the Mansoureya.

4.2.3 Excess water discharge

Extracted water will be discharged to the Mansoureya Canal via a force main running from the Giza Necropolis to the canal. Each well will be equipped with its own pump. The vertical well individual pumps will then pump the water at a rate of 1,300 m^3/hr into a force main, which will eventually discharge the water into the Mansoureya Canal. The discharge force main will be installed under and along either Abol Hol Street, or Abu Fayed Street, from the archaeological enclosure to the Canal (Fig. 39). The SCA has taken the decision to install the discharge force main along Abu Fayed Street, rather than the more easily accessible Abol Hol street, as many of the stakeholders involved in the consultation process expressed concern over the blockage of such an economically significant street for several month. SCA's layout for implementation is shown on Fig. 40.

Figure 37 Location of Ahram Well Fields and Mena House Golf Course.

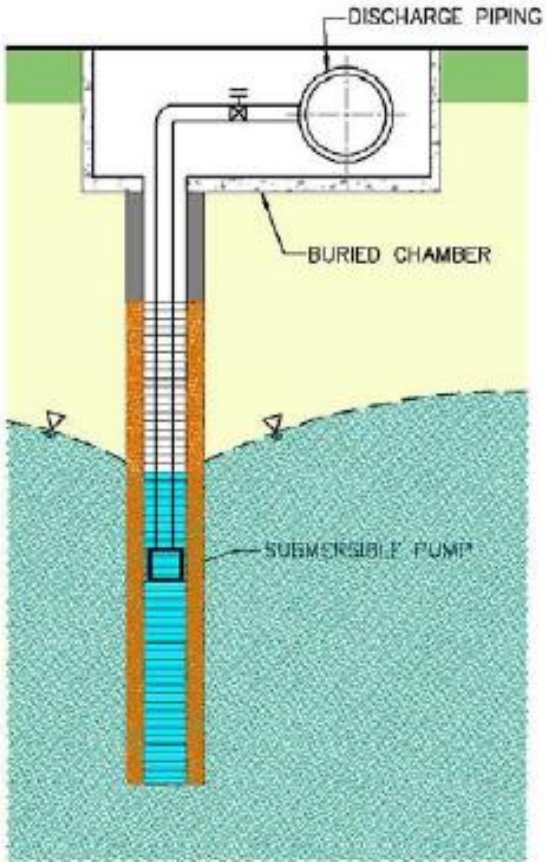


Figure 38 The proposed vertical wells dewatering system.

- ● Existing operational wells (installed by CU)
- ○ Existing non-operational wells (installed by CU)
- ● Planned wells

Figure 39 Alternative discharge force main routings to the Mansoureya Canal

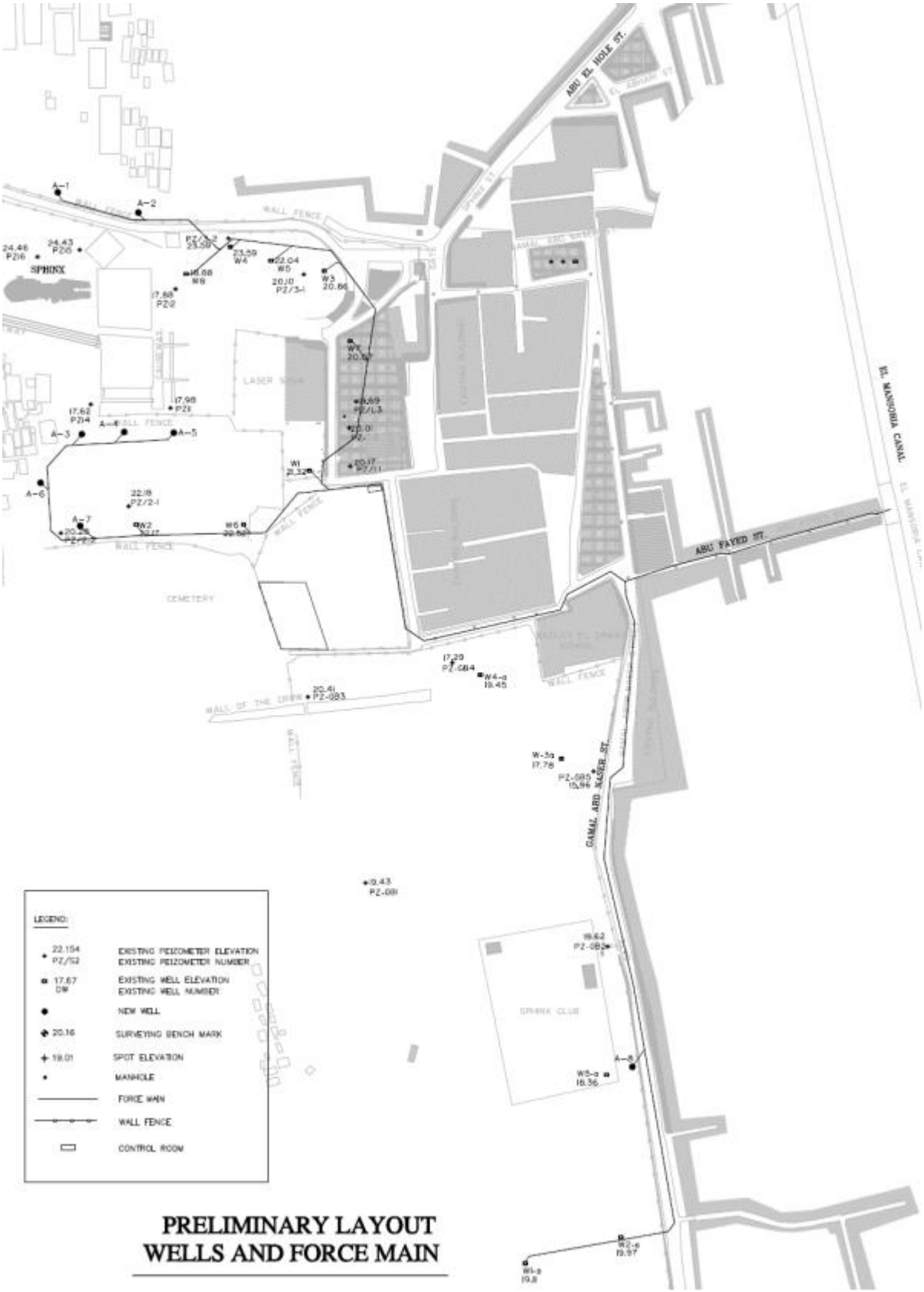


Figure 39 Preferred layout of wells and force main along Abu Fayed Street

5. ENVIRONMENTAL CONSEQUENCES

5.1 IMPACT IDENTIFICATION

5.1.1 Impact Scoping

Scoping activities for potential environmental impacts were carried out on the basis of a thorough review of literature available on the area and several site visits to assess the present environmental setting at the area. Base measurements for air and water quality, and noise levels were also taken to further document the existing environmental conditions in the area, compare how some of the project activities might affect the local environment, and to allow for monitoring during project implementation. The original list of impact areas and environmental and socioeconomic attributes was then scrutinized to identify environmental components that are more unlikely to be affected by the project either because of their innate resilience, or because they are physically outside the potential impact area of the project. Potential impacts were presented and discussed with the stakeholders.

During impact scoping activities, stakeholders were consulted to identify those attributes of the environment and society for which there are concerns. The project team informed the public on what they intend to design and build, including several alternatives. The team also listed the anticipated positive and negative socio-environmental impacts, and how these may be dealt with. Stakeholders were invited to add their own concerns and observations, and so bring them to the attention of the government, the funding agency, and project team.

Figure 40 The public scoping meeting, 11 April, 2010.

<u>Environmental and Social Issues Raised</u>

In general, the results of the public scoping session confirmed the findings of the initial field scoping exercise. Several, significantly positive impacts of the project are identified and seem to be

appreciated by most of the stakeholders, including the Nazlet El Samman community. Identified positive impacts of the dewatering activities are as follows:

- Preventing further deterioration of the world celebrated monuments of the Giza Plateau.
- Fulfilling Egypt's role and international commitment to protect and preserve the Giza Pyramids Plateau as a World Cultural Heritage Sites of a very special global significance.
- Facilitating archaeological exploration, as it is difficult to carry out in saturated soil.
- Improving tourism services in the area by enhancing tidiness and the general aesthetic qualities of the monuments as a result of removing the pools of stagnant water often appearing in low–lying spots.
- Drying the stagnant surface water will also prevent the breeding of mosquitoes which constitute a major nuisance and a public health hazard for the local community.
- A temporary enhancement of the local economy during construction as a result of the presence of the construction crews, and the increased demand for some construction supplies.

<u>The Nazlet El Samman community's concerns:</u>

Scoping interviews and focus group meetings with stakeholders from Nazlet el Samman, as well as the outcome of the public scoping session revealed that the local community is generally skeptical as to the government's intentions, and therefore doubtful that the dewatering intervention will be of much benefit to them. There appears to be much misinformation in the community, and the issue of groundwater affecting some of the antiquities is seen as a tactic that will allow the government to seize greater control in the informal Nazlet El Samman area. This is clear as many of the interventions during the scoping session were not related to the dewatering activities per se.

Issues affecting local communities, particularly Nazlet El Samman dominated all the scoping discussions, while potential impacts of the project on the physical, biotic or cultural environment did not come up in such discussions with the local inhabitants or during the public scoping meeting. Issues related to noise and dust pollution that is expected to result during construction work did not seem to be of any concern. People in general seem ready to put up with project-related inconvenience as long as it does not interfere with their livelihood, the well being of their children or threaten their "rightful claim" as residents of Nazlet El Samman. The following are the main issues of local community concern:

- Construction work in the Abu Al Hol Street is seen as a potentially major problem for shop owners and the residents of Nazlet Al Samman at large. Blocking entrances to shop, traffic congestion and the unsightly accumulation of construction waste and material are expected to impact touristic services in the area. Selecting an alternative route for the force main, through a minor street was suggested.
- Abu Fayed Street was mentioned as an alternative but a sensitive one because it leads to the cemetery of Nazlet El Samman and to the funeral hall. However, if need be, then the construction works could be effected in the area adjacent to the wall of the primary school of El Samman, beginning after the Nasser mosque, and the funeral hall.
- The ability of the houses especially the more dilapidated ones to withstand the pumping of ground water is at the forefront of issues stressed by household residents, not so much because of the cost of the damage, but because the very existence of the structure signifies their l claim to residing in the area.

- The duration of project, the nature and size of the equipments that will be used are critical issues especially for bazaar and stable owners who worry that the access of tourists to their shops and stables will be restricted as a result of the works especially if these are to take place in the main street of Abol Hol and in Gamal Abdel Nasser Street where the majority of stables are found.
- The unfettered access of the area around Abol Hol Street to emergency and rescue services (ambulance, fire engines) was mentioned by community leaders and focus group participants, especially the residents among them, as being critical.
- Focus group with women revealed their concern about their children. Children walk to school and often play in the street in front of the houses. They should not be endangered by construction activities and equipment that is left unattended.

5.1.1.3 Environmental assessment scope

Based upon field scoping activities (interviews, focus groups, transect walks, etc…), technical judgment of the EA team and engineering consultant, and the public scoping session, the following issues merit further analysis during the impact assessment:

- The layout of the dewatering components and their spatial relationships to the monuments.
- The potential visual impact of above ground structures that will be erected on the plateau as part of this project.
- Impact of construction activities either on the plateau or in Nazlet Al Samman, including potential impact on air quality, noise levels, traffic, accessibility of monuments, tourist movement and aesthetic quality of the area.
- Effects of discharging the extracted groundwater on water quality in the Mansoureya Canal.
- Impact of dewatering on the stability of the foundations of the ancient monuments, and of other structures nearby should be investigated.

Impact screening showed that one impact area, namely biodiversity, is not likely to be of significance for this particular project and can be safely dropped from further analysis. This highly urbanized and densely populated area supports no significant natural habitats and only a low diversity of organisms that are normally associated with human habitations. No threatened habitats or species of animals and plants occur in the area or depend for their survival on its resources. It is also highly unlikely that any of the project activities will adversely affect the habitat or the wildlife of the area.

Table 7 presents a list of impact areas that may be affected by project implementation and that will examined in the impact analysis.

5.1.2 Project components and activities

The identification of potential impacts of the project on the environmental areas listed in Table 8 requires the examination of the project's components and activities in detail. Two project phases, namely construction and operation, are considered in this analysis. Components and activities of both phases are identified on the basis of careful scrutiny of the project plans, as well as extensive discussions with the project engineers. The lists of these components and activities (Tables 8 and 9) provide the basis for the environmental impact analysis. The following are issues deemed by the EA team to merit further analysis during the impact assessment.

5.1.2.1 Construction phase

The construction phase covers the installation of the underground dewatering infrastructure on SCA premises, as well as the discharge pumps and pipes that will have to cross through the densely populated town of Nazlet el Samman. This will invariably involve one or several of the construction activities listed in Table 8. These activities, along with the large quantities of earth spoil are expected to be produced may impact different elements of the environment.

Table 7 Impact areas

Ecological Characteristics	Socio-economic Elements
- *Desert land*	- General economic activities
Natural drainage	- Horseback tourism business
Other surface features	- Tourism guiding business
Groundwater	- Souvenir business
- *Cultivated land*	- Other tourism-related businesses
Eco-system integrity	- Property value
Natural drainage	- Employment opportunity
Other surface features	- Local economy
Surface water	- Cost of living
Groundwater	**Public and Private Services**
Soil	- Drinking water supply
- *Nazlet El Samman urban area*	- Sanitary drainage services
Eco-system integrity	- Solid waste collection
Surface drainage	- Energy services
Surface water	- Education
Groundwater	- Health care facilities
Environmental quality	- Housing
- Air quality;	- Emergency services
- Solid waste management	- Traffic flow
- Liquid waste management	- Commuting time
- Noise level	- Public transportation
- Surface water quality	- Parking
- Groundwater quality	- Accessibility to Nazlet El Samman
Aesthetic and Cultural Aspects	- Accessibility to the plateau
- Antiquities of the Giza Necropolis	- Public health and safety
- Aesthetic quality	- Shopping opportunities
- View opportunities	

Construction activities will take place both in the SCA Archeological Zone in close proximity of the ancient monuments, which are visited by thousands of tourists every day and in the crowded area of

Nazlet El Samman to install the force main. It will require the transportation and storage of construction material and waste and will involve the use of heavy construction equipment. Construction activities may also generate some noise and dust.

The force main construction will only require the excavation of simple, shallow trenches. Nevertheless, it will take place both on the plateau and across Nazlet El Samman and involves the most extensive component of the construction activities. For the analysis of potential impact of its construction, the force main is divided into six sections, two of which will take place on the plateau in the immediate vicinity of important archeological sites (Fig. 41). Section 1 will be located just south of the Valley Temple and the Sphinx and is the longest of the two plateau sections. Section 2 will run on the southern side of the Sphinx road, just to the north of the Sphinx. The construction of these two sections of the force main may potentially interfere with the tourist activities in the Sphinx area.

Table 8 Construction activities and components

General Construction activities
- Transport of construction material - Storage of construction material - Operation of heavy equipment - Disposal of construction waste - Disposal of excavated material - Paving & asphalting
Excavations & installation of force main
- Section 1 (on the plateau) - Section 2 (on the plateau) - Section 3 (Gamal Abel Nasser Street) - Section 4 (Abu Fayed Street) - Section 5 (across Mansoureya Street)
Vertical wells construction:
- Buried chamber excavation - Deep well drilling - Concrete casting and curing - Individual pumps installation

The plateau sections of the force main will discharge into the third section which runs along the outer side of the SCA Archeological Zone wall in the Gamal Abdel Nasser Street of Nazlet El Samman. The street is not particularly busy, has very limited commercial activities and is mostly lined on its eastern side with horse stables. The remaining section of the force main that will take the water to the Mansoureya Canal along Abu Fayed Street (Section 5), which is a minor street with limited commercial activities but cuts across the residential part of Nazlet El Samman. The last part of the force main (Section 6) crosses the busy Mansoureya Road at its intersection with Abu Fayed Street to reach the Mansoureya Canal. Force main construction activities within Nazlet El Samman are expected to result in most of the temporary impact of this project on the local community.

Construction activities may potentially affect the quality of the experience sought by the visiting tourists If not properly planned and conducted, construction operations may impact the aesthetics of the area, and possibly hinder viewing opportunity of the monuments and the landscape. Careful planning and management of construction activities will be necessary to minimize the construction duration and avoid impacting tourism activities in the area.

Furthermore, construction activities in the crowded Nazlet El Samman area and even on the plateau where thousands of tourists will be moving on foot in the immediate vicinity of construction sites pose a potential risk of accidents and would have to be addressed.

Figure 41 Force main sections.

Construction activities including force main trenching and the use of large and cumbersome construction equipment will affect traffic flow, accessibility to basic services such as health care facilities, educational institutes, housing, shops, restaurants and emergency services, particularly during the installation of the discharge network that will run along important roads of Nazlet el Samman. The traffic on the Mansoureya Street, which connects the Al Ahram district to the entire Giza Pyramids – Saqqara Pyramid area, will be temporarily interrupted. Although this traffic interruption is expected to be relatively brief, occurring only during the connection of the force main to its discharge outlet in the Mansoureya Canal, it is expected to create a significant congestion of the already heavy traffic flow of that busy street.

Finally, potential interruptions of water or electric utility services as a result of construction activities should be evaluated.

5.1.2.2 Operation phase

Impact analysis of the selected dewatering system requires the identification of the environmental and social consequences of the activities associated with its day-to-day operation. Table 9 shows components and activities of the proposed project which may directly or indirectly impact the area's environmental and socioeconomic elements.

Table 9 Operation activities

Groundwater lowering
Under the monuments Under adjacent areas in Nazlet El Samman
Discharge of water in Mansoureya Canal
Vertical wells
Groundwater pumping

Engineering studies showed that the foundations of the ancient monuments on the Giza Plateau rest on the bed rock and will not be structurally affected by the lowering of the ground water table. Residents of Nazlet el Samman expressed their concern that lowering the ground water table, if reaching their area, will threaten the structural integrity of the foundations of their homes. However, ground water modeling studies showed that the expected lowering of the ground water table will affect only the immediate area around the dewatering wells. The water table lowering effect quickly diminishes as the distance from the wells increases. It is therefore expected that no significant lowering in the water table will affect the area outside the fenced SCA zone, including structure in Nazlet el Samman.

The impact of discharging a large volume of extracted ground water (1,300 m^3/hr) into the Mansoureya Canal needs to be considered. The quality of the water that will be discharged into the canal is particularly important, and will be carefully examined in the following parts of this report. Analysis of the groundwater that will be discharged into the canal indicates that it meets all permissible limits for discharge into the irrigation canal system set by Law 48/1982. Nevertheless both positive and negative impacts of discharging this volume of water on the functioning of the operation of Mansoureya as an irrigation canal, the different uses of its water, and the survival of its associated biota will be considered.

The operation of well pumps is not expected to result in any negative environmental or social impacts. The electric, submersible pumps will generate very little noise and no air pollution.

Socio-economic consequences are expected to include both positive and negative impacts. The aim of the project is to prevent further damage to the archaeological monuments of the Giza Necropolis and to preserving Egypt's cultural heritage. This will secure the Necropolis' position as one of the most popular tourism destinations in the world.

5.2 IMPACT PREDICTION AND INTERPRETATION

The environmental and social impact matrix shown below (Table 10) is based on the exhaustive lists of scoped impact areas and project activities developed in the previous section and during public consultation exercises. The matrix shows the interaction between these project components and socio-environmental elements during the two project phases.

Each of the potentially impacting activities is interpreted in relation to the sensitivity of the existing socio-environmental elements that may be affected, and the legal framework of the project. The relative importance of each of the predicted impacts is then evaluated. The matrix shows both potentially positive and negative interactions between project components/activities, and socio-environmental elements/impact areas. Negative impacts are graded on a relative scale as minor, moderate, and severe.

5.2.1 Potential impacts of the construction phase

Table 10 is a graded impact analysis matrix showing the interaction between activities/components of the project construction phase, and elements of the socio-environment. Construction will involve a variety of activities and techniques, as well as an assortment of construction materials. The matrix shows that the majority components are unlikely to have significant negative environmental impact. Those negative impacts that may occur will be short-term and temporary, which reduces their significance considerably. If appropriate precautions are taken, these impacts will be negligible.

Such impacts will mainly be in the form of dust and noise generation, other minor air polluting gases and fumes (vehicle exhaust, asphalting), traffic congestion and road blockage, but again, only temporarily. These impacts will be localized and will only occur during the actual construction process. Construction process will also result in localized changes in some surface features.

The above minor negative impacts of the construction process will be restricted to the project site proper. On the plateau, construction of Sections 1 and 2 of the force main may affect the normal movement of tourism around the Sphinx and the Valley Temple. If not properly planned and conducted, it may also impact viewing opportunity of these great monuments and may even degrade the quality of the tourism experience. Construction of Section 2 of the force main, if not properly managed could affect the traffic flow on the Sphinx road on the plateau. Such impacts, however, can be easily mitigated with the proper management of the construction site and process.

Construction of the force main along Abu Fayed Street will require temporary, partial blockage of the street to vehicular traffic and may cause some traffic congestion in adjacent streets. Traffic congestion will be caused by that partial blockage of the streets and the additional traffic for the construction transportation requirements (excavation/drilling or other heavy equipment, spoil, construction waste) of the construction process.

Construction will also partially hinder accessibility to the some shops that line Abu Fayed Street where the force main construction will take place. This, in turn, will adversely affect these businesses which will become temporarily difficult to reach by customers.

The excavations and drilling operation will also likely generate solid waste in the form of excavated sand and rocks. This excavated material may temporarily be stored on-site or re-used, but in the event that this material is found to be excessive, it will have to be transported to a specially designated site. The disposal of this solid waste can potentially impact the environment, if not properly done.

Effects on natural resources and the terrestrial habitats of the area will be minimal. The flora and fauna of the desert areas of the Pyramids' Plateau are common and typical of the Western Desert, and will not seriously be affected. The adjacent area of the Nile Valley, including Nazlet El Samman and the Mansoureya Canal offer limited habitat value, and in any case the total land area that will be affected by permanent land use changes is relatively small. None of the habitats or species of plants and animals found in the area is considered threatened. The urbanized and densely populated areas support only a relatively low diversity of organisms that are normally associated with human settlements.

The construction process will also have a positive economic impact for some of the people of Nazlet El Samman, since construction activities are of a labor intensive nature, and will require a diverse labor force. The constructor of the dewatering infrastructure may benefit from a broad range of available skilled and unskilled workforce in the area.

5.2.2 Potential impacts of the operation phase

The interaction between components/activities of the project's operation phase and elements of the environment are also shown on Table 10. The matrix shows that the operation of the proposed project is not expected to result in any adverse impacts that will directly or indirectly affect elements of the environment.

Positive impacts that are directly evident are related to the preservation of the invaluable monuments that are now threatened by the dangerously high ground water table. The lowering of the ground water table will not only save the known monuments such as the Great Sphinx and adjacent temples, but will also save a multitude of buried monuments that are still to be unearthed. The waterlogged, largely undiscovered City of the Pyramids Builders is a case in point. Water appeared on the surface at this low-lying area, not only inundating possible buried treasures but also creating breeding grounds for mosquitoes and other vectors of pathogens.

The cumulative impact of the project will be the preservation of the antiquities of the Giza Necropolis, which are currently being degraded by rising groundwater, and which are a substantial source of income not only for the community of Nazlet el Samman, but for the country as a whole.

The quality of ground water to be discharged into the Mansoureya Canal is in accordance with the quality standards set by Law 48/1982 for discharging water into the Nile River and its irrigation network. The Ministry of Irrigation and Water Resources issues the permit to allow the discharge of the water of the quantity and quality that will not affect the functioning of the canal as an irrigation canal and the services it provides to the farmers in terms of quantity and quality of irrigation water.

The volume of the discharged water and its quality will not significantly alter the basic ecological conditions in the canal, including its biota.

Table 10 Impact prediction matrix: construction and operation phases

Impact Type

Positive impact	Slightly negative
Moderately negative	Severely negative

Project Components & Activities	Construction Phase															Operation Phase			
	General Construction Activities						Excavations & installation of discharge force main					Vertical wells							
Impact areas	Transport of construction material	Storage of construction material	Operation of heavy equipment	Disposal of construction waste	Disposal of excavated material	Paving & asphalting	Section 1: plateau	Section 2: plateau	Section 3: Gamal Abdel Nasser St.	Section 4: Abu Fayed Street	Section 5: across Mansoureya St.	Buried Chamber excavation	Well drilling	Concrete casting & curing	Individual pump installation	Dewatering under monuments	Dewatering under Nazlet el Samman	Discharge to Mansoureya Canal	Groundwater pumping
Ecological Characteristics																			
Desert land																			
Natural drainage																			
Natural surface features																			
Groundwater																			
Cultivated land																			
Eco-system integrity																			
Natural drainage																			
Other surface features																			
Surface water																			
Groundwater																			
Soil																			
Nazlet el Samman urban area																			
Eco-system integrity																			
Surface drainage																			
Surface water																			
Groundwater																			

Table 10, *continued*

Project Components & Activities	Construction Phase															Operation Phase			
	General Construction Activities						Excavations & installation of discharge force main					Vertical wells							
Impact areas	Transport of construction material	Storage of construction material	Operation of heavy equipment	Disposal of construction waste	Disposal of excavated material	Paving & asphalting	Section 1: plateau	Section 2: plateau	Section 3: Gamal Abdel Nasser St.	Section 4: Abu Fayed Street	Section 5: across Mansoureya St.	Buried Chamber excavation	Well drilling	Concrete casting & curing	Individual pump installation	Dewatering under monuments	Dewatering under Nazlet el Samman	Discharge to Mansoureya Canal	Groundwater pumping
Environmental quality																			
Air quality																			
Solid waste management																			
Noise level																			
Surface water quality																			
Groundwater quality																			
Aesthetic and Cultural Aspects																			
Antiquities of the Giza Necropolis																			
Aesthetic quality																			
View opportunities																			
Tourism																			
Socio-economic Elements																			
Nazlet el Sammaan																			
General economic activities																			
Horesback tourism business																			
Tourism guiding business																			
Other tourism-related business																			
Property value																			
Employment opportunity																			
Local economy																			
Cost of living																			

Table 10, *continued*

Project Components & Activities	Construction Phase															Operation Phase			
	General Construction Activities						Excavations & installation of discharge force main					Vertical wells							
Impact areas	Transport of construction material	Storage of construction material	Operation of heavy equipment	Disposal of construction waste	Disposal of excavated material	Paving & asphalting	Section 1: plateau	Section 2: plateau	Section 3: Gamal Abdel Nasser St.	Section 4: Abu Fayed Street	Section 5: across Mansoureya St.	Buried Chamber excavation	Well drilling	Concrete casting & curing	Individual pump installation	Dewatering under monuments	Dewatering under Nazlet el Samman	Discharge to Mansoureya Canal	Groundwater pumping
Public and Private Services																			
Drinking water supply																			
Sanitary services																			
Solid waste collection																			
Energy services																			
Education																			
Health care facilities																			
Housing																			
Emergency services																			
Traffic flow																			
Commuting time																			
Public transportation																			
Parking																			
Accessibiity to Nazlet el Samman																			
Accessibility to the plateau																			
Public health & safety																			

5.3 ANALYSIS OF ALTERNATIVES

All predicted negative impacts of the proposed project can be mitigated by taking appropriate measures. These measures range from work planning measures that affect certain components of the project, to simple precautionary measures that are taken to minimize or avoid negative impacts.

5.3.1 Dewatering scheme and the no-action alternative

Table 11 shows an analysis of the proposed vertical wells dewatering system, and its expected negative socio-environmental impacts. The table covers the predicted negative impacts of the construction and operation phases of that dewatering system. The no-action alternative, which would be the deletion of project components or activities that are expected to result in negative environmental impacts, is also included in the analysis. The proposed actions, as described above, are seen to promise distinctive benefits with minor, temporary, adverse effects during implementation.

Based on the analysis in Table 11, the no-action alternative is not a feasible option for the construction activities. These activities are integral parts of the dewatering alternative and cannot be deleted without affecting its basic function and structure, and the fulfillment of its planned objective. If the no-action alternative is implemented water table will continue to rise with further damage to the antiquities. Excavation, backfilling and drilling operations are necessary site preparation and construction activities that cannot be avoided; however their negative impacts can be mitigated through a set of mitigation measured that are covered below. Other project components and activities are either environmentally sounds

5.3.2 Discharge alternatives

Two alternatives are considered for disposing of the extracted ground water. One is the discharge of the 1,300 m^3/hr of pumped groundwater to the Mansoureya Canal, as planned, and the other is the discharge to the municipal sewage system. The no-action alternative is not applicable here, because pumped groundwater will have to be discharged if any dewatering system is implemented. The municipal sewage system is already receiving discharge water at a rate of 624 m^3/hr from the SCA/CU wells, and 1,300 m^3/hr of water would exceed the sewage collection network capacity. Accordingly, the Mansoureya Canal becomes the only available alternative.

The possibility of using an evaporation pond was ruled out at early stages of the project development because of the large area it would require and the need for disposing of the large quantities of salts that will result.

5.3.3 Discharge force-main and station alternatives

Two alternative routes for the section of the force main that runs through Nazlet El Samman were originally considered:

- Abol Hol Street
- Abu Fayed Street

Abol Hol Street is a very important street in terms of traffic flow, and tourist and economic activity, and the installation of the discharge force main will inevitably adversely affect these. Construction in any smaller street may be impractical due to the relatively large size of the construction equipment.

Construction in Abu Fayed would be more difficult, as it is not as wide an Abol Hol, but would affect the local economy to a much lesser extent. As noted by the social research team, however, Abu Fayed Street is still one of Nazlet el Samman's most important and bustling streets, with many shops. Any smaller street would likely become totally obstructed, and the situation may be unmanageable for the residents. Al Thalaga Street, which was recommended by some of the stakeholders involved

in the public consultation sessions, was not considered as a viable option, as it is located 4 km to the south of the project site.

The following are the predicted impacts of the construction and operation of the proposed force main along the Abu Fayed Street.

Construction Phase

Site selection

- Residential area will be affected.
- Aesthetic nuisance for resident community.

Excavations

- Partial road blockage: increased traffic congestion, reduced parking opportunities for residents.
- Blocked access for emergency vehicles.
- General nuisance for residents.
- Noise, dust.
- Disposal of excavated material.
- Emissions.
- Danger to public (danger of injuries from falling and slipping, being struck by moving construction equipment, and other hazardous activities inherent to construction).

Operation Phase

Drainage water discharge (roughly 1,300m^3/hr)

- *No impact*

Table 11 Analysis of alternatives

Project component/activity	**Negative impact from 2 alternatives**	
	Vertical wells	**No action**
Construction phase		
Excavation	- Dust & noise. - Shallow but numerous excavations. - Traffic congestion. - Aesthetic nuisance. - Spoil disposal. - Use of heavy equipment. - Interference with tourism - Hindering viewing opportunity	- No construction work can be carried out. - Continued reliance on existing dewatering system. - Insufficient dewatering, as groundwater continues to rise.
Well drilling	- Noise. - Vibrations. - Use of heavy equipment.	
Operation phase		
Ground water pumping	- High energy demand to operate well pumps.	- Pumps are currently operational for the 8 vertical wells installed by CU. - Ground water table will continue to rise. - Structural damage to Sphinx and other monuments will occur. - Flooding of buried, undiscovered monuments will continue.

6. MITIGATION MEASURES AND MONITORING PLAN

6.1 MITIGATION MEASURES AND ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

The project's potentially adverse socio-environmental impacts identified in the previous sections are all localized. No irreversible or regional negative impacts were identified. In order to eliminate, offset or reduce the adverse impacts to acceptable levels, it is necessary to integrate environmental and social management into the project's engineering, construction, operation and maintenance processes. Environmental management procedures should therefore be applied and followed at all stages of project development. These procedures are described in an Environmental and Social Management Plan (ESMP), which presents a set of mitigation, monitoring, and institutional measures to be taken during both the construction and operation phases of the project.

SCA and CAPW, which are the agencies charged with implementing the required mitigation and monitoring plans needs to:

- Set up an institutional structure capable of monitoring environmental and social issues related to project construction and operation activities, including the implementation of the mitigation plan;
- Integrate environmental mitigation measures into construction contracts
- Define and monitor the environmental obligations of the construction contractor;
- Specify arrangements for rehabilitation of sites degraded during construction work (residential areas, workers camp, storage areas, etc.);
- Monitor the ESMP implementation during the operation of the dewatering system.

To be effective, the environmental and social obligations of the contractor (expressed in the ESMP) must be comprehensively specified through the contract documents. Detailed environmental and social specifications must therefore be written into the legal document that establishes the obligations of the contractor, the quantities of work involved, and the related cost of measures. It is thus of utmost importance that the construction contract includes provisions to ensure that:

- The contractor clearly understands the environmental mitigation measures and its obligations;
- The mitigation measures are specified in sufficient detail, so that the contractor can make reasonable estimates of actual costs in the tender document;
- SCA and CAPW should require the construction contractor to give local residents proper assurances that any damages to their property that may occur as a result of construction activities will be repaired, or at least they will be adequately compensated.
- SCA and CAPW have the legal and financial power to enforce the application of mitigation measures through the contractor; and
- The project management has the capability to monitor the contractor's performance in this regard.

6.1.1 Mitigation of construction impacts

Construction planning, management and supervision, with environmental and social impacts in mind are essential to avoid or minimize most of the impacts of this project. Issues such as traffic management, construction site management, health and safety are of key importance and should be taken into consideration when planning construction activities.

The following mitigation measures (summarized in Table 12) are necessary and should be included and priced in the construction contractor's tender and contract documents:

Construction phase

6.1.1.1 Surface features

Ground surface features that may become affected by construction work, particularly the accumulation of excavated soil, should be brought back to their original condition by proper leveling. Excess excavated soils remaining after backfilling should be properly disposed of and not left at the construction site.

6.1.1.2 Dust and noise abatement

Dust generation should be controlled by measures such as

- Minimizing the area disturbed by construction at any one time
- Wetting down or using acceptable chemical treatment of unpaved roadways for construction vehicles (at least in areas frequented by tourists and near dwellings)
- Covering or wetting spoils piles adjacent to excavations.

Noise abatement should be instituted by:

- Abide by the legal standards for noise as provided by the executive regulations of Law 4/1994.
- Limiting construction activities to daylight hours only.
- Implementing health and safety measures related to noise.

6.1.1.3 Construction waste generation and potential spillage

- All construction solid waste should be disposed of at official dumpsites designated by local governments.
- Vehicles transporting construction material or waste to, or from the construction sites, should be covered to avoid material spillage.
- Excavation and construction material temporarily stored at the site should be covered to minimize spillage and dust generation.
- Construction contractors should be required to prepare and follow a Spill Prevention and Management Plan. SCA/CAPW and their construction supervision contractor will be responsible for auditing compliance with the Spill Prevention and Management Plan. The contract documents should include penalties for repeated failure to comply with the plan.

6.1.1.4 Temporary degradation of aesthetic quality, viewing opportunity and tourism experience of the archaeological site attractions.

- Construction contractors should be permitted to operate only in areas assigned for that purpose by the SCA. Areas disturbed by construction activities should be kept to a minimum.
- Site(s) for storage of construction material and equipment or for other construction-related facilities should be assigned by the SCA and should be kept to the minimum necessary for construction operations to proceed efficiently. Such sites should locate as far as possible from areas frequented by visitors of the monuments and should not block view of archeological features of the area.
- All construction sites should be fenced off and shielded from public view.
- Construction site should be kept as tidy as practical throughout the construction process.
- Work scheduling for construction at some critical sites should be carried out in consultation with local community representatives, local authorities, SCA and other relevant parties. For example, working during weekends, holidays and at the hours when tourists come to the bazaars and Sound and Light should be avoided as much as possible.

6.1.1.5 Impact on local businesses and local economy

- Entrances to homes, shops and other business facilities along Abu Fayed and Gamal Abdel Nasser streets should be kept free of any blockage throughout the force main construction work.
- Construction work should be planned to minimize the duration of the construction process in Abu Fayed and Gamal Abdel Nasser streets. The plan should include the phasing of construction activities to avoid the complete blockage of the full lengths of Abu Fayed and Gamal Abdel Nasser streets at any one time.
- Avoid any unnecessary storage of equipment and supplies at Abu Fayed and Gamal Abdel Nasser streets that may unnecessarily contribute to blocking movement of people and vehicles.
- Free access and parking spaces for tourist busses in Nazlet El Samman should be kept at all times. This should be arranged in coordination with local authorities, SCA and other relevant parties.
- A re-routing plan for sight-seeing tours may have to be considered to avoid construction work areas if deemed necessary. The SCA should develop the plan in coordination with tour operators and other stakeholders before adoption.

6.1.1.6 Risk of interruption of public utilities and services

- If necessary, plans for re-routing of solid waste collection service trucks and other equipment should be prepared in coordination with the relevant authorities or service providers to ensure service to continue during construction.
- Construction activities should be coordinated with the relevant authorities and service providers to ensure that drinking water, sanitary drainage and electricity services are not interrupted.
- Test pits may be needed at some of the construction sites to identify underground utilities and to avoid breakage during construction. Re re-routing of utilities, if needed, will have to coordinate with relevant authorities.
- Alternative routes for emergency services and vehicles should be identified and adopted by the relevant authorities prior to starting construction work.

6.1.1.7 Undermining of existing structures

- A dilapidation survey for buildings in area close to the plateau should be carried out and their condition documented.
- The foundations of all structures near excavated areas should be assessed to determine structural stability and potential impacts associated with undermining.
- Excavation in areas near building foundations should employ shoring techniques to preserve the structural integrity of existing structures.
- These mitigation measures should be included in the design construction tender and contract documents.

6.1.1.8 Traffic congestion

Traffic management during construction is particularly important, because of the expected partial blockage of streets in Nazlet El Samman and the additional transportation requirements (excavation/drilling or other heavy equipment, spoil, construction waste) of the construction process. Traffic detours will have to be introduced and implemented in coordination with the Giza Traffic Department. Traffic (cars & pedestrians) detours will have to be clearly marked and indicated with proper direction signage for incoming traffic.

6.1.1.9 Accessibility to Nazlet El Samman and the Pyramids Plateau.

Accessibility to Nazlet El Samman and the Pyramids Plateau should not be interrupted. Alternative access routes and traffic re-routing plans will have to be developed to allow at least residents, tourists and emergency vehicles free access to the area. If absolutely necessary, blocking accessibility to other vehicles (e.g. heavy trucks) should be as brief as possible.

6.1.1.10 Risk to public health and safety

- Construction sites should be closed to the public at all time.
- Proper health and safety measures for work place should be enforced and monitored at all construction sites.

6.1.1.11 Risk of Undermining of existing structures

- A dilapidation survey for buildings in area close to the plateau should be carried out and their condition documented.
- The foundations of all structures near excavated areas should be assessed to determine structural stability and potential impacts associated with undermining.
- Excavation in areas near building foundations should employ shoring techniques to preserve the structural integrity of existing structures.
- These mitigation measures should be included in the design construction tender and contract documents.

6.1.1.12 Impact on undiscovered archeological sites

The Egyptian Law 117 of 1983 stipulates that any discovery of antiquities must be reported to the SCA. The law provides penalties for removing, damaging or destroying found antiquities. Construction activities involving digging within 3 km of a known antiquities site require permission from the SCA. Thus:

- When the proposed construction work is implemented, construction crews must report to the SCA any archaeological material that may be uncovered during excavation.
- All work should be implemented under the full supervision of the SCA. During construction, a SCA inspector should observe all excavation work and alert construction crews and authorities if antiquities are uncovered.

6.1.1.13 Decommissioning

This involves the dismantling, decontamination, and removal of construction equipment and facility structures at the end of the construction stage. It also involves re-contouring the land as appropriate.

- Assuming there is no other use for construction infrastructure and facilities, these are to be dismantled by the contractor.
- The sites used temporarily by the contractor will be fully rehabilitated at the end of the construction stage and shall be returned to their initial use. These include areas for borrowing earth, for temporary access roads, workers' camps and facilities, and for material storage and machinery storage/maintenance.

Operation phase

No adverse impacts have been identified for the operation of the proposed dewatering system.

Table 12 Potential adverse impacts and proposed measures for their mitigation. All adverse impacts are predicted during project construction.

Environmental /social impacts	Proposed mitigation measures
Alteration of ground surface features	Ground surface features affected by construction work should be brought back to their original condition
Dust generation	Dust generation should be controlled by the following measures: - Minimizing the area disturbed by construction at any one time - Wetting down or using acceptable chemical treatment of unpaved roadways for construction vehicles (at least in areas frequented by tourists and near dwellings) - Covering or wetting spoils piles adjacent to excavations. - Excavation and construction material should be covered to minimize dust generation. - Vehicles unloading material should maintain the lowest possible fall height to reduce noise and dust generation.
Noise generation	Noise abatement should be instituted by: - Abide by the legal standards for noise as provided by the executive regulations of Law 4/1994. - All construction activities in Nazlet El Samman should be carried out during the day time. Those on the plateau may be carried out at night to minimize noise disturbance to tourists. - Implementing health and safety measures related to noise.
Construction waste generation and potential spillage	- Construction waste should be disposed of at dumpsites designated by local governments. - Vehicles delivering construction material or waste to, or from the work sites, should be covered to avoid material spillage. - Excavation and construction material should be covered to minimize spillage and dust generation. - Construction contractors should be required to prepare and follow a Spill Prevention and Management Plan.

Table 12, *continued*

Environmental/ social impacts	Proposed mitigation measures
Temporary degradation of aesthetic quality, viewing opportunity and tourism of the archaeological site attractions.	- Area disturbed by construction activities should be kept to a minimum. - Construction site should be kept as tidy as practical throughout the construction process. - Construction material and equipment to be stored at the site should be kept to the minimum required for the efficient construction operations. - Construction site should be fenced off and shielded from public view. - Storage areas and other construction support facilities should not block view of archeological features of the area. - Work scheduling for construction at some critical sites should be carried out in consultation with local community representatives, local authorities, SCA and other relevant parties to minimize impact on local community or tourism activities.
Impact on local businesses and local economy	- During force main construction work in Nazlet El Samman, attention must be paid to keeping the entrance to shops, homes and stables accessible at all times. - Plan construction work to minimize the duration of the construction process in Abu Fayed and Gamal Abdel Nasser streets. - Implement a phasing plan for construction activities to avoid the complete blockage of the full lengths of Abu Fayed and Gamal Abdel Nasser streets at any one time. - Avoid any unnecessary storage of equipment and supplies at Abu Fayed and Gamal Abdel Nasser streets that may unnecessarily contribute to blocking movement of people and vehicles. - Whenever necessary, a re-routing plan for sight-seeing tours should be considered to avoid construction work areas. - Tourist busses should be allowed free access to Nazlet El Samman at all times.
Risk of interruption of public utilities and services.	- Plans for re-routing of solid waste collection service trucks should be prepared in coordination with the relevant authorities or service providers to ensure service to continue during construction. - Construction activities should be coordinated with the relevant authorities and service providers to ensure that drinking water, sanitary drainage and electricity services are not interrupted. - Identify alternative routes for emergency vehicles.

Table 12, *continued*

Environmental/ social impact	Proposed mitigation measures
Risk of undermining of existing structures	- A dilapidation survey for buildings in area close to the plateau should be carried out and their condition documented. - The foundations of all structures near excavated areas should be assessed to determine structural stability and potential impacts associated with undermining. - Excavation in areas near building foundations should employ shoring techniques to preserve the structural integrity of existing structures.
Traffic congestion as a result of reduced road traffic capacity.	- Traffic detours will have to be introduced and implemented in coordination with the Giza Traffic Department to avoid congestion at construction sites. - Traffic (cars & pedestrians) detours will have to be clearly marked and indicated with proper direction signage for incoming traffic.
Accessibility to Nazlet El Samman and the Pyramids Plateau.	- Accessibility to Nazlet El Samman and the Pyramids Plateau should not be interrupted. Alternative access and/or traffic re-routing plan will have to be developed to allow at least residents, tourists and emergency vehicles access to the area. - Blocking accessibility to other vehicles (e.g. heavy trucks) should be as brief as possible.
Risk to public health and safety	- Construction sites should be closed to the public at all time. - Proper health and safety measures for work place should be enforced and monitored at all construction sites.
Impact on undiscovered archeological sites	- It should be the responsibility of the construction contractors to report to the SCA any archaeological material that may be uncovered during excavation. - All construction work should be fully monitored by SCA. The SCA should assign one or more inspector to observe all excavation work and alert construction crews and authorities if antiquities are uncovered.

6.2 MONITORING PLAN

The effectiveness of the proposed mitigation plan to counteract the negative impacts of the project requires constant monitoring and reassessment. The following is a proposed plan for monitoring indicators for key environmental and social parameters. The plan will allow the environmental supervision of the construction work and the monitoring of long-term impacts of the construction and operation of the proposed dewatering system.

To ensure the effectiveness of mitigation measures, complaints made by the public, their representatives, government environmental inspectors, or members of work crew should be regularly investigated and reported to SCA/CAPW. A log of these complaints should constitute an important means for monitoring not only the extent of adherence to mitigation plan, but also the effectiveness of that plan.

The environmental monitoring plan is summarized in Table 13. The implementation of the plan will be the responsibility of the SCA/CAPW and its construction supervisor. Details of the implementation plan of the proposed monitoring scheme should be worked out by the SCA/CAPW in collaboration with the construction team and the different operation departments of the drainage system once it is operational.

6.2.1 Monitoring construction activities

Through a regular and comprehensive review, by SCA/CAPW construction supervision, of the actual status of the environmental obligations of the construction contractor, this monitoring aims at ensuring compliance of the Contractor's activities with his contractual commitments and the environmental regulations.

6.2.2 Monitoring during operation

6.2.2.1 Environmental monitoring

Periodic monitoring should measure and record on site and outside the perimeter of the archaeological zone:

- The quality of the water discharged. Under Laws 4/94, 48/82, and 93/62, which regulate the discharge of water to surface water bodies, SCA will have to receive a license from the Ministry of Water Resources and Irrigation prior to discharge, and keep an environmental register of the discharged water's quality, which will be inspected by EEAA and The Ministry of Health and Population (MoH).
- A potential risk to physical and biotic and socio-economic elements of the environment is closely linked to the quality of the extracted ground water that will be discharged into the Mansoureya Canal. Analysis of ground water samples from existing dewatering wells in the vicinity of the Sphinx area showed water quality that fits the standard set by the Egyptian law for discharge into the irrigation network. While the present impact analysis did not identify any potentially adverse impact of the release of water of the present quality, the risk of future deterioration in the quality of the extracted water should be considered. While there is no reason to expect any immediate changes in the ground water quality as a consequence of the operation of the dewatering system, unforeseen causes may result in changes in water quality that render it unfit for release into the canal. If this does occur, environmental damage may occur. The present monitoring plan, therefore, calls for the continuous monitoring of the quality of the water being released into the Mansoureya Canal, as long as the dewatering system remains in operation.
- A scheme for the continuous monitoring of physical and chemical properties of water to be discharged into the Mansoureya canal is suggested. The scheme should be agreed upon with the government authorities responsible for monitoring surface water quality, namely the Egyptian

Environmental Affairs Agency (EEAA) and the Ministry of Water Resources and Irrigation (MWRI). Water sampling and analysis should be carried out at least once a month (or more frequently if necessary) by the EEAA and/or MWRI laboratories in coordination with the SCA/CAPW operators of the dewatering system. Monitoring data will allow the early detection of any deterioration trends in the quality of the discharged water, and hence taking the necessary corrective actions to prevent any negative impacts on the physical or biotic components of the canal, its surroundings and water users.

6.2.2.2 Social monitoring

As part of the public involvement process, it is proposed that a local monitoring team (LMT) representing a cross-section of the community (residents, community leaders, bazaar and stable owners, local officials including the SCA, CAPW, women, and youth) be formed. The LMT will monitor the implementation of mitigation measures, participate in revisions to the plan as needed, and report back to the project on the effectiveness of the various measures. The LMT will conduct periodic meetings with the community to ensure that their concerns continue to be addressed throughout the course of implementation of construction activities.

Table 13 Environmental monitoring plan

Proposed mitigation measure	Parameters to be monitored	Location	Procedures	Frequency of measurement	Institutional responsibilities		
					Enforcement	Supervision	Reporting
Construction phase							
Measures for minimizing public nuisance.	Complaints recorded and validated	All construction sites	Review weekly logs of complaints	Weekly	Contractor	Third party construction supervisors	SCA/CAPW
Measures for minimizing dust generation.	Application of dust suppression measures.		Construction site inspections				
Measures for minimizing noise generation.	Application of noise suppression measures.						
Proper storage of construction material.	Construction material storage practice.						
Measures for safe disposal of solid waste.	Disposal of construction waste practice.						
Measures to protect work environment.	Application of workers' health and safety procedures, including closing the site to the public.		Inspection of application of health and safety protocol				
Daily work schedule	Adherence to work schedule.		Review work schedule				
Operation phase							
Discharge of extracted ground water	Water quality monitoring parameters as stipulated by Law 48/1982)	Discharge point	Standard water quality monitoring protocol (Law 48/1982)	Monthly	EEAA/MWRI	EEAA/MWRI	SCA/CAPW

6.3 CONCLUSION

If no action is taken, the groundwater in the Pyramids' Plateau will likely continue to rise possibly damaging ancient antiquities. The deterioration of the foundations of the antiquities in the low-lying areas of the Giza Necropolis will threaten their integrity, risking enormous cultural and economic losses. The cumulative impact of the project will, therefore, be the preservation of the antiquities of the Giza Necropolis, which are a substantial source of income not only for the community of Nazlet el Samman, but for the country as a whole. Furthermore, lowering the ground water enhance efforts to unearth unknown archaeological sites in the Necropolis.

SCA has found that vertical wells is the most efficient and adaptable method for dewatering in the area, since such a system is already in place. Following the scoping and public consultation activities, SCA has also decided to install the discharge force main along Abu Fayed Street, rather than along Abol Hol Street. This will minimize impacts to tourism and the local economy.

Other methods of source curtailment, such as upgrading water and wastewater distribution networks, implementing a controlled irrigation plan in the area, or possibly restarting the neighboring the Ahram well fields could bring about overarching benefits to the community and the project, and should therefore be encouraged.

The construction and operation of the proposed dewatering system will not incur any irreversible, adverse impact on the environment or the local community. Temporary, slightly to moderately negative impacts may potentially occur during construction. All these impacts can be mitigated through proper site management practices, monitoring, coordination, and communication with stakeholders.

The operation of the proposed system is not expected to have any negative impacts and require any special mitigation measures. However, the risk to the aquatic environment in the Mansoureya Canal as a result of the discharge of the extracted ground water is an issue that requires a special attention including a vigilant water quality monitoring scheme, as long as the dewatering system remains in operation. At the present time water quality extracted from the operating wells in the Sphinx area fits the criteria for discharging into the irrigation network as stipulated by Lay 48/1982. In fact water quality in the Mansoureya canal will actually improve as a consequence of the dilution effect of the discharged ground water which is of a better quality.

Although rather unlikely, deterioration in the quality of ground water may occur in the future for a multitude of reasons that are very difficult to predict at the present time. A scheme for the continuous monitoring of physical and chemical properties of water to be discharged into the Mansoureya canal is, therefore, suggested. The scheme allows the early detection of any deterioration in the quality of the discharged water, and hence taking the necessary corrective actions to prevent any negative impacts on the physical or biotic components of the canal, its surroundings and water users.

The proposed actions will benefit the affected antiquities in protection of cultural resources, the inhabitants of Nazlet el Samman, and those who treasure the historical significance of the Pyramids' Plateau and the Giza Necropolis. The no-action alternative is not considered to be a viable solution. It should also be noted that following the implementation and completion of the dewatering actions, conservation measures will still need to be undertaken to preserve the antiquities from further damage, as salt concentrations on the stone surfaces are still high.

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ANNEX

ANNEX 1 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

Relevant Egyptian laws and regulations

The main legal instrument dealing with environmental issues in Egypt is Law number 4 of 1994, commonly known as the Law on Protection of the Environment. The law deals mostly with the protection of the environment against pollution. The Prime Ministerial Decree number 631 of 1982 established the Egyptian Environmental Affairs Agency (EEAA) as the competent body for environmental matters in Egypt. Law number 4 also stipulates the role of the EEAA as the main regulatory agency for environmental matters.

According to Article 1, the legal entity responsible for a given project is required to carry out an assessment of the project's potential impact on the natural and socio-cultural environment before implementing that project. The findings of the assessment are submitted to the EEAA for review and approval before other relevant governmental authorities can issue their permits for implementing the project. According to that article, Environmental Impact Assessment (EIA) is defined as "studying and analyzing the environmental feasibility of proposed projects, whose construction or activities might affect the safety of the environment". For any given project, one of three categories of environmental/social assessment, representing different levels of detail are considered, depending on the nature of the project and the environmental and social settings of its influence area. The Executive Regulations of Law 4 of 1994, also state that "all infrastructure projects …. are among developments subject to environmental impact assessments" and define the requirements for the EIA.

Law 4 of 1994 and its executive regulations define the permissible levels for air quality, water quality, noise, and solid waste management. According to article 1.1 of Law number 4 of 1994, environment is defined as: "*The biosphere which encompasses living organisms together with the substances it contains and the air, water and soil that surround it, as well as the establishments set up by man*". Law 4 of 1994 and its Executive Regulations are, therefore the main legal instrument dealing with environmental issues in Egypt, particularly the protection of the environment from pollution, and preserving it from deterioration. According to that law, environmental pollution, degradation, and protection are defined as follows:

> ***Environmental pollution:***
>
> *Any change in environmental properties which may result directly or indirectly in harming living organisms or establishments or in affecting the ability of people to lead a normal life.* Article 1.7
>
> ***Environmental degradation:***
>
> *Effect on the environment that reduces its value, or changes its nature, depletes its resources or harms living organisms or monuments.* Article 1.8
>
> ***Environmental protection:***

Protecting and promoting the components of the environment and preventing or reducing their degradation or pollution. These components encompass air, seas, internal waters, including the river Nile, lakes and subterranean water, land, natural protectorates, and other natural resources.
Article 1.9

In addition to Law 4 of 1994, other relevant legislations and regulation include:

- The Prime Ministerial Decree 631 of 1982 established the Egyptian Environmental Affairs Agency (EEAA) as the competent body for environmental matters.
- The Law 102 of 1983 concerning Natural Protectorate.
- The Prime Ministerial Decree 1067 of 1983 designates the Egyptian Environmental Affairs Agency (EEAA) as the authorized administrative body charged with the implementation of law 102 of 1983.
- Law 12 of 2003 on Labour (replacing Law 137 of 1981
- The Agricultural Law 53 of 1966, which is the main legislation protecting wildlife and specially birds and wildlife.
- Law 48 of 1982 on the Protection of the Nile River and the Waterways from Pollution. It regulates discharge into underground reservoirs and branches or canals of the Nile, to the main stream of the Nile, and to municipal and industrial drains.
- Law 93 of 1962 and amended Executive Decree 44 for year 2000 regulates discharge to sewer systems.
- Law 27 of 1978 on public water sources
- Law 3 of 1982 on urban planning. Law 3 and its executive regulations also identify conditions for land use, and the planning and design of road, squares and green areas.
- Law 140 of 1956 on the utilization and blockage of public roads.
- Law 84 of 1968 concerning public roads.

These two laws govern the utilization or temporary obstruction of public roads. They define the regulations related to any construction works to be carried out on or in the vicinity of public roads. Law 84 also states that planting or cutting trees in any public road require prior approval of the relevant governmental authority.

- Law 117 of 1983 concerning the protection of antiquities.

The law gives the Supreme Council of Antiquities the responsibility of management and protection and management of antiquities and archaeological sites. The law requires prior approval by that authority of plans for construction work on archaeological sites. Any legal person encountering any evidence of archaeological presence is required by law to report his finding to the General Authority for antiquities.

The SCA is responsible for:

- prehistoric, ancient Egyptian and Graeco- Roman sites in Egypt.
- Islamic and Coptic monuments and sites.
- central and local museums.
- architecture, restoration, engineering works concerning all antiquities.

According to the Law 117, the term antiquity is applied to any building or movable object resulting from the different civilizations that span the totality of the Egyptian History (reflecting human, artistic, technical, military, religious aspects) and of more than one hundred years old. However, a building or a movable object of great cultural value could be listed a national Heritage regardless of its age by a decree of the Prime Minister after the presentation of a specialized report to the permanent committee of the sector concerned and the approval of the committee and the minister of culture. Private owners of listed antiquities are responsible for their preservation.

Moreover, Egypt has adhered to the UNESCO convention of 1970 concerning the banning of illegal import and export of cultural property (Presidential Decree 114/1973).

The permanent committees of Egyptian antiquities, Islamic and Coptic antiquities as well as the board of trustees of museums are responsible for studying the problems of antiquities, urban and habitation problems and foreign missions undergoing excavations by applying Law 117 and are supported by the police of antiquities and the central police authorities.

Inventories of antiquities in sites and museums are accomplished by two centers of Documentation, for Egyptian antiquities and for Islamic and Coptic antiquities through the Information Center of the SCA (computer) and by the collaboration with the center of Information and Decision making of the Ministries council. Documentation sheets are diffused and filled by local authorities together with photos and inventory exists only on administrative and scientific level; juridical intervention takes place only in case of illegal traffic.

However, a draft of a new antiquities law replacing the current Law 117/1983 is now awaiting the approval of the People's Assembly after the coming legislative elections. The new law will properly and legally identify the SCA's permanent committee, the inviolable area around every monument, and the land adjacent to the archaeological site. It will repeal the section of the law allowing possession of antiquities: a year after the approval of the law all owners of Egyptian antiquities must hand over all objects to the SCA, which will store them in their archaeological storehouses. Article 7 of the old law stipulating that the police is the only department authorised to remove any encroachments on archaeological sites or monuments had been changed. Such responsibility is to be given to the SCA's secretary-general, or to someone he entrusts, while the police agencies will only be a safeguarding agency while executing the secretary-general's decision. Article 30 has been added to the law stipulating that the SCA is the only authority competent to carry out restoration and preservation work for all Egyptian monuments, archaeological sites and historical edifices. The minister of culture will have the authority to assign any scientific authority or mission to execute any such work, but under complete supervision of the SCA's secretary-general.

Penalties will be doubled or tripled. The new law allows clemency for anyone who confesses to or divulges information about an antiquities crime in condition that his or her confession leads to the arrest of partners in the theft or smuggling.

- Law 38 of 1967, amended by Law number 31 of 1976 and Law number 4 of 1994, on public cleanliness and collection and disposal of solid waste control the collection and disposal of solid waste. Article 32 of the law provides the regulatory framework for the handling of hazardous materials, including hazardous waste.

Relevant articles of Law number 4 of 1994 are:

- Articles 29 to 32 of the law on handling of hazardous materials, including waste.

- Articles 35 of the law and 34 of its executive regulations on maximum permissible levels of pollutants in ambient air.
- Articles 36 of the law and 37 of its executive regulations on maximum permissible pollution levels in exhaust gases.
- Articles 40 of the law and 42 of its executive regulations on maximum permissible pollution levels resulting from burning fuel.
- Articles 42 of the law and 44 of its executive regulations on maximum permissible noise levels.
- Article 43 of the law on the necessary precautions to ensure a safe and healthy work environment.

These are covered in greater detail below:

Waste management

Article 29 to 32 of Law 4 of 1994 provides the regulatory framework for the handling of hazardous materials, including hazardous waste. Of relevance is also Law 38 of 1967, amended by Law 31 of 1976 and Law number 4 of 1994, on public cleanliness and the collection and disposal of solid waste, which control the collection and disposal of solid waste.

The owner of an establishment whose activities may result in hazardous wastes shall, according to the provisions of this law, maintain a register of these wastes and the method of disposing thereof, as well as contracting concerned agencies for receipt of these wastes. The EEAA shall be responsible for following up the register to ensure its conformity with the truth.

Air quality

Articles 35 of the law and 34 of its executive regulations on maximum permissible levels of pollutants in ambient air. The national standards stipulated in Annex 7 of the Executive Regulations of Law 4 of 1994 for outdoor air pollution limits in terms of maximum permissible limits and exposure period are shown in Table 1.

Articles 36 of the law and 37 of its executive regulations set the maximum permissible pollution levels in exhaust gases. Articles 40 of the law and 42 of its executive regulations define the maximum permissible pollution levels resulting from burning fuel.

Noise level

Article 42 of the Law 4 of 1994 requires that all organisations and individuals to maintain emanating sounds from different operating machinery or other sources below the permissible limits. Licensing authorities are to ensure that in a given area, the overall emanated sounds from fixed sources are within the allowable limits. In addition, licensing authorities are to ensure that machinery and equipments selected by establishments fulfil the law's requirements.

Maximum permissible limits of sound intensity according to Annex 7 of the Executive Regulations specify that noise intensity during an eight-hour work shift shall not exceed 90 decibels. Maximum allowable noise intensity in different areas is shown in Table 1. In case the noise level surpasses the 90 dB L_{eq} (A) value, the exposure period has to be reduced according to Table 2. The criterion of the values set per the Executive Regulations is the protection of the sense of hearing.

Permissible outdoor air pollutants limits
(in µg/m^3 unless otherwise specified)

Pollutant	**Maximum Limit**	**Exposure Period**
Sulphur Dioxide	350	1 hr
	150	24 hrs
	60	1 year
Carbon Monoxide	30 mg/m^3	1 hr
	10 mg/m^3	8 hr
Nitrogen Dioxide	400	1 hr
	150	24 hrs
Ozone	200	1 hr
	120	8 hr
Suspended Particles measured as black smoke	150	24 hrs
	60	1 year
Total Suspended Particles (TSP)	230	24 hrs
	90	1 year
Respirable Particles (PM 10)	70	24 hrs
Lead	1	1 year

Maximum allowable noise intensity in different areas

Type of Area	**Permissible Limit for Noise Intensity Decibel dB L_{eq} (A)**					
	Day*		**Evening***		**Night***	
	From	**To**	**From**	**To**	**From**	**To**
Commercial, administrative and downtown areas	55	65	50	60	45	55
Residential areas in which can be found some workshops or commercial establishments or which are located on a main road	50	60	45	55	40	50
Residential areas in the city	45	55	40	50	35	45
Residential suburbs with low traffic	40	50	35	45	30	40
Residential rural areas, hospitals and gardens	35	45	30	40	25	35
Industrial areas (heavy industries)	60	70	55	65	50	60

*Day: from 7 am to 6 pm; Evening: from 6 pm to 10 pm; Night: from 10 pm to 7 am.

Permissible exposure times to different sound intensities.

Noise intensity level decibel (a)	95	100	105	110	115
Period of exposure (hours)	4	2	1	1/2	1/4

The Executive Regulations of Law 4 of 1994 further requires the following:

- During working hours, the instantaneous level of noise intensity shall be maintained below 135 dB.
- In the case of the exposure to the intermittent noise (of a sledgehammer impact type), the number of permissible impacts – which depends on the generated noise intensity – has to be limited according to Table 10.

Number of permissible intermittent impacts during the daily working hours

Noise intensity (dB)	Number of permissible impacts
135	300
130	1000
125	3000
120	10000
115	30000

Work environment

Several laws and decrees tackle occupational health and safety provisions at the work place, in addition to Article 43 of Law 4. These laws and decrees apply to the work crew that will be involved in construction activities. The following laws and decrees should be considered:

- Law 12 of 2003 on Labour and Workforce Safety and Book V on Occupational Safety and Health (OSH) and assurance of the adequacy of the working environment
- Minister of Labour Decree 48 of 1967.
- Minister of Labour Decree 55 of 1983.
- Minister of Industry Decree 91 of 1985
- Minister of Labour Decree 116 of 1991.

With Regard to soil and water resources, the following applies:

Soil and water pollution

Wastewater quality criteria are regulated by Law 93 of 1962 regarding the discharge of wastewater to sewer systems, Law 48 of 1982 concerning the protection of the Nile River and waterways from pollution, and Law 4 of 1994 on the discharge of wastewater to the marine environment. Under all of these laws, Ministry of Health and Population (MoHP) is responsible for monitoring water quality and effluent/discharging. These laws aim to:

- Compensate any natural or juridical person for any damage caused due to the pollution of the water.
- Protect the employees who are working to maintain the sewerage system from harmful industrial waste.
- Protect the structures, equipment, and biological treatment operations from harmful industrial waste.

Relevant governmental institutions

The following is the list of governmental institutions concerned with potable or irrigation water supply, and wastewater discharge to water bodies. These are the agencies implementing the above mentioned, water-related laws, and may become stakeholders in the present Groundwater Lowering Activity:

The Ministry of Water Resources and Irrigation

The MWRI is responsible for formulating the national water policy with respect to water scarcity and water quality deterioration. Under Law 12/1984, the MWRI retains the overall responsibility for the management of all water resources, including available surface water resources of the Nile system, irrigation water, drainage water and groundwater. The MWRI is the central institution for water quality management. It is responsible for providing water to all users, but emphasis is put on irrigation. It has authority to issue licenses for domestic and industrial discharges. The responsibility to monitor compliance to these licenses through the analyses of discharges has been delegated to the Ministry of Health and Population (MoHP). The MWRI implements its monitoring activities through several institutes grouped under the umbrella of the National Water Research Centre (NWRC). These include, among others the Nile Research Institute (NRI), the Drainage Research Institute (DRI), the Channel Maintenance Research Institute (CMRI), and the Research Institute for Groundwater (RIGW).

Ministry of State for Environmental Affairs (MSEA) -Egyptian Environmental Affairs Agency (EEAA)

The protection of the water environment from pollution represents one of the important priorities of the Ministry of State for Environmental affairs (MSEA) and its executive institution the EEAA. According to Law 4, EEAA has the enforcing authority with respect to environmental pollution except for fresh water resources. Through Law 48, the MWRI remains the enforcing authority for inland waterways. The lines of action in this regard encompass water quality monitoring activities and initiatives, as well as pollution abatement and mitigation efforts.

Ministry of Health and Population (MoHP)

The MoHP is the main organization charged with safeguarding drinking water quality, and is moreover responsible for public health in general. Within the framework of Law 48/1982, MoHP is involved in standard setting and compliance monitoring of wastewater discharges. The Central Laboratories of the MoHP undertake monitoring for all intakes and treated outflows, including wells of drinking water treatment plants with the objective of ensuring that all such treatment plants in Egypt meet drinking water standards

Ministry of Housing, Utilities and New Communities (MHINC)

Within the Ministry of Housing, Utilities and New Communities, the National Organization for Potable Water and Sanitary Drainage (NOPWASD) has the responsibility for planning, designing, and building municipal potable water treatment plants, distribution systems, sewerage systems, and municipal wastewater treatment plants. It regulates matters related to the disposal and treatment of domestic wastewater, and to the formulation of standards and regulations for the maintenance of wastewater treatment plants.

Ministry of Agriculture and Land Reclamation (MALR)

MALR is in charge of water distribution at the field level, and the reclamation of new agricultural land. With respect to water quality management issues, their policies on the use and subsidy reduction of fertilizers and pesticides is important. The Soil, Water and Environment Research Institute (SWRI) is part of the Agricultural Research Centre, and is

responsible for research on water, drainage water and soil quality, pollution, bioconversion of agricultural wastes, reuse of sewage wastewater for irrigation, fertilizer and pesticide use and effects.

The General Organization for Greater Cairo Water Supply (GOGCWS)

The GOGWCS produces potable water complying with world health specifications according to reports of the Ministry of Health and Population. The main responsibilities of the GOGCWS are:

- Operating and maintaining water treatment plants, developing existing plants and constructing new ones.
- Operating and maintaining master and branch distribution water mains as well as replacing worn-out mains and constructing new ones.
- Operating and maintaining water reservoirs to be used in the peaking capability time also constructing and operating posters to get over water level differences.
- Constructing and updating labs in plants which control quality and ensuring they are pollutants-free in accordance with world health standards.

Law 4, 48, and 93

Law 48 of 1982 on the protection of the Nile River and the waterways from pollution is the main legal instrument for preventing pollution of inland surface water. It regulates discharge into underground reservoirs, lakes, the Nile river, its irrigation and drainage canals. The law and its executive regulations set the limits for water quality allowed to be discharged into these bodies of water, and prevents its discharge without a license from the Ministry of Water Resources and Irrigation (MWRI). The license includes both the quantity and quality that is permitted to be discharged. Discharging without a license can result in a fine. Licenses can be issued as long as the effluents meet the standards of the relevant laws. They may be withdrawn in case of failure to immediately reduce discharge, in case of pollution danger, or failure to install appropriate treatment within a period of three months.

The MWRI's Decree 8 of 1983 implementing Law 48 sets regulations standards for treating wastewater before discharge to surface waters. Article 60 indicates the quality of freshwater to which wastewater discharge is allowed. Articles 61 and 62 describe criteria of treated industrial wastewater to be discharged to fresh surface and groundwater. Article 63 prohibits the discharge of treated sanitary effluent to the Nile and its canals; and such waste must be chlorinated before discharge to other water bodies (Article 67).

Law 93 of 1962, amended Executive Decree 44 of 2000, regulates discharge to sewer systems. It also concerns the construction of sewers and sewage treatment facilities, as well as allowable discharge standards from residential, commercial and manufacturing facilities to the sewer. When a sewerage network is in place, wastewater should be discharged into the sewerage, subject to the fulfillment of certain wastewater quality criteria and the obtainment of a permit from the Ministry of Housing. Otherwise, wastewater can be discharged into waterways, but subject to the compliance to specific wastewater quality criteria.

Articles 6 - 8 of Law 93 prohibit the discharge of liquid wastes other than wastewater into the sewerage network, unless authorized by the Ministry of Housing, and subject to the fulfillment of specifications. Article 9 necessitates the sampling of wastewater produced by authorized plants.

Law 93 of 1962 is amended by decree 44 of 2000 of the Ministry of Housing concerning law, in which wastewater discharge is mainly regulated by articles 10, 11, 14, 15, 17 and 21. Articles 10 and 11 deal with the nature of wastewater to be discharged into the sewerage network and obligations exerted upon the discharger, where unwanted substances (e.g. solids, flammable material, oils…etc) is prohibited. Article 14 sets the specifications of wastewater to be discharged into the sewerage. Regarding wastewater resulting from industrial and commercial establishments, wastewater should be free from petroleum ether, calcium carbides, organic solvents, or any other material deemed harmful to the network workers, the sewerage network, or to the environment. Wastewater should also be free from insecticides and radioactive materials. Article 15 sets specifications, upper limits and level of treatment for the re-use of wastewater for irrigation purposes. Article 17 prohibits any form of dilution of industrial wastewater as an alternative to the appropriate treatment. Article 21 allows for a 10% increase of BOD and TSS above limits for a maximum period of six month, provided that other constituents comply with set specifications.

The regulations implementing these laws are independent of each other in terms of regulated streams, inspection, and enforcement entities. These are shown in Table X However, all these laws, refer to the laboratories of the MoHP as the analytical body for measurements of wastewater parameters. An important regulatory connection between these laws, as well as other environmental laws, is the environmental register required by law 4 of 1994. The register includes all information concerning a facility's discharges over a 1-year period. Historical information must be kept for 10 years. The EEAA is mandated to do inspection and independent analysis of these registers. Nevertheless, MoHP also carries out compliance monitoring and only its laboratory results are considered to be official.

Regulations for wastewater discharge to different water bodies, according to Law 4/1994, Law 48/1982, and Law 93/1962.

Law	Subject of Law (related to wastewater)	Issues Regulated by the Law and Methods of Regulation	Responsible Entity
4/1994	Discharge of Liquid Wastes to Marine Waters	- Prohibition of untreated (in violation of this law) wastewater discharge to marine waters, either directly or indirectly, intentionally or unintentionally. - Banned discharge of wastewater containing non-degradable polluting substances.	Egyptian General Authority for Shore Protection, in coordination with EEAA.
		- Perform periodic analysis for samples of the treated wastewater, from establishments permitted to discharge to marine waters, and in case of violations, it gives 1 month for compliance. If not completed, disposal will be stopped, license will be revoked without prejudice, and/or penalties as mentioned in this law imposed.	MOHP Laboratories. In case of violation, EEAA is notified and begins administrative procedures.
48/1982	Discharge of Liquid Wastes to the Nile and Waterways	- Prohibition of wastewater discharge to the Nile and waterways, even if in compliance with the specifications of this law, unless a license is acquired.	Ministry of Irrigation. In coordination with the MOHP
		- Perform periodic analysis for samples of the treated wastewater from establishments licensed to discharge into waterways, in case of violations without immediate danger, 3 months to comply are allowed. If renovations are not completed, discharge will be stopped, and/or license will be withdrawn without prejudice to the penalties given in the law. In case of violations with immediate danger, the establishment will be notified to remove the causes of harm immediately. If they are not removed, the license will be withdrawn and discharge stopped OR the Ministry of Irrigation will undertake this at his expense.	MOHP Laboratories. In case of violation, the Ministry of Irrigation is notified to begin administrative procedures.
93/1962 (and amendments)	Discharge of Wastewater to the Public Sewer System	- Prohibition of wastewater discharge to the public sewer system, which is in compliance with the specifications of this law, unless a license is acquired. Otherwise, the discharge is stopped by administrative procedures.	Ministry of Housing, in cooperation with the sanitary drainage authorities.
		- Perform periodic analyses for samples of the treated wastewater from establishments licensed to discharge to public sewer systems, and in case of violation, 6-months are give to bring the discharge into compliance. If the work is not completed, license will be withdrawn and/or the grace period may be extended. In case of immediate danger, the discharge is stopped.	MOHP Laboratories. In case of violation, the Ministry of Housing and the sanitary drainage authorities are to be notified to take administrative procedures.

Limits for pollutants in wastewater vary depending on the type of receiving water body and related law. The parameters that should be monitored and / or inspected are BOD, COD, pH, temperature, residual chlorine, TSS, TDS, oil & grease. Table X presents the permissible limits

for discharges to the different recipients (Sea, Nile, Canals, Agriculture drains, and Public sewer) according to the different relevant laws. Spent lube oil has a negative impact on water and soil and therefore its disposal should be monitored inspected. A record should be kept for this purpose.

Maximum effluent concentrations

Parameter (mg/1 unless otherwise noted)	Law 4/94: Discharge Coastal water	Environment Law 93/62 Discharge to Sewer System (as Decree 44/2000)	Law 48/82: Discharge into :			
			Underground Reservoir & Nile Branches/Canals	Nile (Main Stream)	Municipal drain	Industrial drain
BOD (5day,20 deg.)	60	<600	20	30	60	60
COD	100	<1100	30	40	80	100
pH (Grease)	6-9	6-9.5	6-9	6-9	6-9	6-9
Oil & Grease	15	<100	5	5	10	10
Temperature (°C.)	10>avg. temp of receiving body	<43	35	35	35	35
TSS	60	<800	30	30	50	50
Settable Solids	-	<10	-	20	-	-
TDS	2000	-	800	1200	2000	2000
Chlorine	-	<10	1	1	-	-

Public water sources

According to Law 27 of 1978 on the protection of public water sources for drinking and domestic purposes, any source distributing potable and non-potable water for a given price, or even free of charge, is regarded as a public water source (Article1). Creating a public water source, or making a water connection from any public water source, before obtaining permission from the relevant authority (determined by the Minister of Housing and Public Utilities) is strictly prohibited (Article 2). In addition, the use of a water source that has been deemed unfit by the competent local unit's health department is prohibited

Biodiversity

The main law for protecting wildlife and natural habitats is Law number 102 of 1983 concerning Natural Protectorates. The law was created to allow the establishment of "Natural Protectorates" to protect areas of special natural attractions, natural landscape, natural habitats and wildlife. The Prime Ministerial Decree 1067 of 1983 designates the Egyptian Environmental Affairs Agency (EEAA) as the authorized administrative body charged with the implementation of law 102 of 1983.

According to Law 102 of 1983, a Natural Protectorate is defined by article 1 of the law as:

"Any area of Land, or coastal or inland water characterized by flora, fauna, and natural features having cultural, scientific, touristic or aesthetic value".

The Law preserves such areas by prohibiting activities susceptible to harm the environment of designated natural protectorates (article 2), either within the protectorate, or even within the surrounding area (article 3). Failure to fulfil these provisions result at a fine ranging from five hundred to five thousand Egyptian Pounds and/or up to a year of imprisonment (article 7). In case of recidivism, the fine will be increased to three thousand to ten thousand Egyptian Pounds and/or a year of imprisonment at least. In addition, remediation costs will be on the violator's expenses, and equipments subject of the violation will be confiscated by the authorities.

In addition, the Agricultural Law 53 of 1966, which is the main legislation protecting wildlife and especially birds. The Law and its executive regulations which provide lists of legally protected wildlife species will be the main legal reference for identifying the significance of potential impact of the project on wildlife.

International treaties

Egypt has signed and ratified a number of international conventions that commit the country to conservation of environmental resources. The following is a list of conventions that are somewhat relevant to this project:

- International Plant Protection Convention (Rome 1951)
- African Convention On the Conservation Of Nature and Natural Resources (Algeria 1968)
- Convention on Wetlands of International Importance especially as Water Fowl Habitat (Ramsar, 2 February 1971)
- UNESCO Convention For The Protection Of the World Cultural And Natural Heritage (Paris, 16 November 1972)
- Convention on International Trade In Endangered Species Of Wild Fauna And Flora (CITES) (Washington 1973)
- Convention of the Conservation Of Migratory Species Of Wild Animals (Bonn, 1979)
- International Tropical Timber (Geneva 1983)
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal (1989)
- Convention on biological diversity (Rio de Janeiro 1992).
- United Nations convention to combat desertification in those countries experiencing serious drought and/or desertification, particularly in Africa (Paris 1994).

ANNEX 2 NOISE MEASUREMENTS

Location 1

Day	Hour	Measured Parameters (db)								
		L_{EQ}	L_{MAX}	TWA	SEL	CNEL	L_{01}	L_{10}	L_{50}	L_{90}
9th of April 2010	**15:00**	63.2	79.9	36.6	81.2	63.2	76.4	63.2	57.1	54.7
	16:00	63.5	77.7	36.8	81.4	63.5	73.6	65.0	60.9	57.8
	17:00	49.6	58.5	22.9	67.5	49.6	56.1	50.9	48.5	47.1
	18:00	50.2	58.2	26.7	71.3	50.5	56.2	52.1	49.6	48.2
	19:00	72.1	78.4	45.3	89.9	77.1	77.7	75.5	70.7	65.4
	20:00	69.4	76.0	42.6	87.2	74.4	75.4	73.2	65.9	63.3
	21:00	73.0	80.8	46.2	90.8	78.0	80.2	77.7	68.1	57.6
	22:00	49.6	59.6	22.8	67.4	59.6	58.1	52.8	47.3	47.0
	23:00	48.6	50.8	21.8	66.4	58.6	50.2	49.6	48.4	47.0
10th of April 2010	**0:00**	63.5	80.7	36.7	81.3	73.5	78.2	57.5	47.1	46.8
	1:00	47.4	52.4	20.7	65.2	57.4	51.8	49.6	46.1	45.5
	2:00	45.9	50.2	19.1	63.7	55.9	48.6	46.4	45.5	45.1
	3:00	59.0	75.9	32.3	76.9	69.0	73.3	54.7	49.6	49.3
	4:00	46.6	47.9	19.9	64.5	56.6	47.7	47.3	46.4	45.8
	5:00	49.1	56.7	22.4	66.9	59.1	54.6	50.6	48.0	47.1
	6:00	48.6	54.7	21.8	66.4	58.6	52.8	49.7	48.0	47.1
	7:00	50.3	54.3	23.5	68.1	50.3	52.7	50.9	50.1	49.1
	8:00	51.8	54.4	25.0	69.6	51.8	54.0	53.2	51.6	49.6
	9:00	51.6	56.3	24.8	69.4	51.6	55.7	53.7	50.9	48.8
	10:00	58.6	61.0	31.9	76.5	58.6	60.4	59.6	58.3	57.6
	11:00	61.8	67.4	35.1	79.7	61.8	66.0	64.2	60.9	59.6

Definitions:

L_{EQ} : The true equivalent sound level measured over the 1-minute run time

L_{MAX} : Maximum SPL (Sound Pressure Level); Highest SPL measured over a 1-minute time interval

TWA : Time weighted average; The constant SPL over an 8-hour interval that would produce the same exposure to sound as an exposure measured over a run time sampling interval (Rtime).

SEL : Sound Exposure Level; The continuous SPL lasting one-second that would deliver the same sound exposure as an accumulated exposure determined over a sampling interval (RTime)

CNEL : Community Noise Exposure Level. The accumulated exposure to sound measured in a 24-hour sampling interval and artificially boosted during certain hours

L_{01} : Sound level exceeded 1% of the time

L_{10} : Sound level exceeded 10% of the time

L_{50} : Sound level exceeded 50% of the time

L_{90} : Sound level exceeded 90% of the time

Location 2

Day	Hour	Measured Parameters (db)								
		L_{EQ}	L_{MAX}	TWA	SEL	CNEL	L_{01}	L_{10}	L_{50}	L_{90}
April 10 2010	**12:00**	61.6	67.1	35.9	80.5	61.6	65.8	63	61.1	59.8
	13:00	61.8	65	36.3	80.8	61.8	64.6	63.6	61.3	59.6
	14:00	64.1	71.6	38.5	83.1	64.1	69.1	65.6	63.4	61.8
	15:00	63.1	68.6	36.5	81	63.1	67.9	66.4	61.8	61.3
	16:00	65.4	66.7	35.1	79.7	65.4	66.5	66.3	65.2	64.2
	17:00	59.3	60.2	32.6	77.2	59.3	59.9	59.69	59.1	58.8
	18:00	61	74.9	34.3	78.9	61	72.6	60.5	56.6	56.1
	19:00	53.9	60.1	27.2	71.8	58.9	59	56.3	52.5	50.7
	20:00	56.8	61.6	30.1	74.7	61.8	60.6	59.2	55.9	53.3
	21:00	58.6	67.5	31.8	76.4	63.6	67	61.9	55.4	52.1
	22:00	54.1	60.2	27.3	71.9	64.1	59.4	57.3	52.6	48.9
	23:00	63.1	80	36.3	80.9	73.1	77.5	58	51.5	50.8
April 11 2010	**0:00**	57.1	68.8	30.4	75	67.1	67.8	58.6	52.6	50.4
	1:00	50.1	53.4	23.3	67.9	60.1	52.9	51.8	49.4	48.1
	2:00	56.2	63.6	29.4	74	66.2	61.5	57	56	54
	3:00	48.6	51.8	21.8	66.4	58.6	51.6	49.7	48.1	47.4
	4:00	49.4	59.5	22.8	67.4	59.4	57.1	49.7	48.1	47.7
	5:00	48.4	53.7	21.8	66.3	58.4	52.7	51	47.6	45.7
	6:00	53	61.5	26.2	70.8	63	61	54.8	51	49.4
	7:00	56.7	69.4	29.9	74.5	56.7	67.1	56.3	54.9	52.8
	8:00	54.9	66.4	28.1	72.7	54.9	64.2	55.5	53.3	51.8
	9:00	58.1	62.5	31.3	75.9	58.1	61.6	60.5	57.4	55.3
	10:00	60.3	70.1	33.5	78.1	60.3	67.8	61.6	58.8	57.8
	11:00	70.5	86.4	43.7	88.3	70.5	84.3	70.5	62.7	60.5

Location 3

Day	Hour	Measured Parameters (db)								
		L_{EQ}	L_{MAX}	TWA	SEL	CNEL	L_{01}	L_{10}	L_{50}	L_{90}
April 11 2010	**12:00**	64.9	70.1	38.1	82.7	64.9	69.6	67.9	63.8	60.5
	13:00	65.5	73	38.8	83.4	65.5	72.1	68.8	63.4	58.7
	14:00	61.4	70.2	35.5	80.1	61.4	69	64.6	59.2	57.5
	15:00	66.4	77.6	42.9	87.5	66.4	76.1	71.4	59.1	56.1
	16:00	70.4	79.6	43.6	88.2	70.4	78.8	74.3	64	57.2
	17:00	59.4	67.1	32.9	77.5	59.4	65.2	59.9	59.1	56.6
	18:00	67.6	81.8	40.9	85.5	67.6	79.4	70.2	63.4	58
	19:00	58.7	65.9	32	76.6	63.7	65.5	61.9	56.9	53.2
	20:00	68.5	70.9	41.7	86.3	73.5	70.6	70	68.5	65.9
	21:00	53.7	58	27.1	71.7	58.7	57.3	54.6	53.4	52.6
	22:00	53.9	59.2	27.2	71.8	63.9	57.8	54.3	53.6	53.2
	23:00	52.3	55.4	25.5	70.1	62.3	54.8	53.8	52.6	44.2
April 12 2010	**0:00**	49.9	51.7	23.2	67.8	59.9	51.4	50.9	50.1	48.4
	1:00	52.5	55.2	25.7	70.3	62.5	54.4	53	52.2	51.9
	2:00	55.8	57.5	30.6	75.2	65.8	57.3	57	54.9	54.3
	3:00	51.1	61.9	24.3	68.9	61.1	61.2	50.5	49.2	48.2
	4:00	51	56.3	24.2	68.8	61	54.7	51.8	50.5	50
	5:00	51.6	53.9	24.8	69.3	61.6	52.8	52	51.4	50.8
	6:00	49.4	51.9	22.7	67.3	59.4	51.2	50.1	49.2	48.6
	7:00	49.4	51.7	22.7	67.3	49.4	51.5	50	49.4	48.3
	8:00	56.5	63.4	29.7	74.3	56.5	62.2	58.8	55.3	53.8
	9:00	51.4	56.4	24.6	69.2	51.4	54.8	53	51	48.7
	10:00	56.8	60.3	30	74.6	56.8	58.8	57.1	56.7	56.3
	11:00	51	57.4	24.3	68.9	51	54.8	52.2	50.7	48.9

ANNEX 3 LIST OF PLANT AND ANIMAL SPECIES RECORDED IN THE STUDY AREA

Wild perennial and annual plant species recorded in desert areas

Perennials	Annuals
Ephedra alata	*Mesembranthemum forsskalei*
Haloxylon salicornicum	*Matthiola livida*
Heliotropium digynum	*Erodium pulverulentum*
Pancratium sickenbergeri	
Panicum turgidum	
Pituranthas turtuosus	
Centaurea aegyptiaca	
Anabasis setifera	
Thymus capitatus	
Retama raetam	
Zilla spinosa	
Reseda sp.	
Farsetia sp.	
Echinops spinosus	
Farsetia aegyptia	

Dominant hydrophytes in the waterways in the Cairo region

Submerged species	**Emergent species**
Ceratophyllum demersum	*Cyperus alopercuroides*
Elodea canadensis	*C. articulatus*
Myriophyllum specatum	*C. difformis*
Potamogeton crispus	*C. papyrus*
P. pectinatus	*C. schimperianus*
Ruppia Maritima	*Echinochloa stagnina*
Floating species	*Juncus subulatus*
Azolla filiculoides	*Leersia hexandra*
Eichhornia crassipes	*Leptochloa fusca*
Lemna gibba	*Paspalum distichum*
Ludwigia stolonifera	*Persicaria salicifolia*
Nymphaea caerulea	*P. senegalensis*
N. lous	*Phragmites australis*
Pistia stratiotes	*Pycreus mundtii*
Potamogeton nodosus	*Saccharum spontaneum subsp. Aegypticatum*
Vossia cuspidata	*Scirpus litoralis*
	S. maritimus
	S. trigueter
	Typha domingensis

List of bird recorded in the study area with breeding status of each species.
MB= migrant breeder, RB= resident breeder, PV= passage visitor,
WV= winter visitor. The parentheses indicate that the status is variable or irregular

Order	Family	Species	Breeding status
Falconiformes	Falconidae	*Falco concolor*	MB, (WV)
		Falco tinnunculus	RB, PV
		Falco biarmicus	RB, PV
	Accipitridae	*Elanus caeruleus*	RB, (WV)
Charadriiformes	Charadriidae	*Vanellus spinosus*	RB, PV
	Burhinidae	*Burhinus oedicnemus*	RB, PV, WV
		Burhinus senegalensis	RB
Ciconiiformes	Ardeidae	*Bubulcus ibis*	RB
Pteroclidiformes	Pteroclididae	*Pterocles senegallus*	RB
		Pterocles coronatus	RB
		Pterocles lichtensteinii	RB
Columbiformes	Columbidae	*Streptopelia senegalensis*	RB
		Columba levia	RB
		Streptopelia turtur	RB, PV
Strigiformes	Strigidae	*Bubo bubo*	RB
		Athene noctua	RB
	Tytonidae	*Tyto alba*	RB
Coraciformes	Meropidae	*Merops apiaster*	PV
		Merops orientalis	RB
		Merops superciliosus	MB, PV
	Cerylidae	*Ceryle rudis*	RB
Passeriformes	Passeridae	*Passer domesticus*	RB
	Alaudidae	*Ammomanes cinctures*	RB
		Ammomanes deserti	RB
		Galerida cristata	RB
		Alaemon alaudipes	RB
	Hirundinidae	*Ptyonoprogne obsoleta*	RB
	Acrocephalidae	*Hippolais pallida*	RB, PV, (WV)
	Pycnonotidae	*Pycnonotus barbatus*	RB
	Fringillidae	*Carduelis carduelis*	RB, PV, (WV)
	Turdidae	*Oenanthe lugens*	RB, (WV)
		Oenanthe monacha	RB
		Oenanthe leucopyga	RB
	Sylviidae	*Scotocerca inquieta*	RB
		Passer domesticus	RB
	Corvidae	*Corvus ruficollis*	RB
		Corvus corone	RB
	Cisticolidae	*Prinia gracilis*	RB
8	**21**	**37**	

List of the mammals recorded from the study area.

Order	Family	Species
Insectivora	Erinacidae	*Hemiechinus auritus*
Chiroptera	Pteropodidae	*Rousettus aegyptiacus*
	Rhinopomatidae	*Rhinopoma hardwickei*
	Vespertiliontidae	*Pipistrellus kuhlii*
Lagomorpha	Leporidae	*Lepus capensis*
Rodentia	Cricetidae	*Gerbillus gerbillus*
		Dipodillus dasyurus
		Dipodillus henleyi
		Meriones crassus
		Psammomys obesus
		Sekeetamys calurus
	Muridae	*Rattus rattus*
		Mus muscullus
		Arvicanthis niloticus
		Acomys russatus
		Acomys cahirinus
	Dipodidae	*Jaculus jaculus*
Carnivora	Canidae	*Vulpes vulpes*
		V. rueppelli
		Canis lupaster
	Felidae	*Felis sylvestris*
		Felis chaus
Artiodactyla	Bovidae	*Capra nubiana*
		Gazella dorcas
6	**11**	**24**

In addition to this wild fauna, a variety of domestic animals are kept by the local farmers, such as sheep, goats, cows and buffalos, poultry, horses, donkeys, dogs, etc…

Reptiles recorded from the study area.

Lizards	
Family	**Species**
Agamidae	*Trapelus flavimaculatus*
	Trapelus pallida
Gekkonidae	*Certopodion scaber*
	Hemidactylus turcicus
	Ptyodactylus hasselquistii
	Stenodactylus sthenodactylus
	Tarentola annularis
	Tropiocolotes steudneri
Lacertidae	*Acanthodactylus boskianus*
	Acanthodactylus scutellatus
	Mesalina guttulata
	Mesalina rubropunctata
Scincidae	*Chalcides ocellatus*
	Sphenops sepsoides
	Mabuya quinquetaeniata
	Scincus scincus
Chamaeleontidae	*Chamaeleo chamaeleon*
Snakes	
Family	**Species**
Colubridae	*Coluber rogersi*
	Psammophis schokari
	Malpolon moilensis
	Spalerosophis diadema
	Telescopus dhara
Viperidae	*Cerastes cerastes*
	Cerastes vipera
	Echis carinatus
	Echis coloratus
Elapidae	*Naja haje*
10	**31**

List of Amphibians in the study area

Family	**Species**
Bufonidae	*Bufo regularis regularis*
	Bufo viridis viridis
Ranidae	*Ptychadena mascareniensis*
	Rana ridibunda
2	**4**

Freshwater fish in the study area

Family	**Species**
Bagridae	*Bagrus bajad*
	Bagrus docmak
Centropomidae	*Lates niloticus*
Cichlidae	*Haplochromis loati*
	Haplochromis wingatii
	Hemichromis bimaculatus
	Oreochromis aureus
	Oreochromis niloticus niloticus
	Tilapia zillii
Clariidae	*Clarias anguillaris*
Cyprinidae	*Labeo niloticus*
Mochokidae	*Synodontis schall*
Mormyridae	*Petrocephalus bane bane*
7	**13**

Interviewed local community leaders

تم عمل عشرة لقاءات مع القيادات الطبيعية بالمنطقة وهم :

1. الحاج / مجدى خطاب
العمل التطوعى :عضو مجلس الشعب مرشح فئات من سنة 1990 الى الان
العمل الاساسى : رجل اعمال فهو رئيس مجلس ادارة شركة الطارق وشركة الهرم الاكبر للسياحة وشركة ممقاولات لمشروعات القرى السياحية وصاحب بازارات (بازار فيلة) ولديه مزرعة بطريق مصر اسكندرية
عنوان المنزل : شارع ترعة المنصورية (ابو الهول السياحى)فوق بازار فيله
موبايل : 0129001387

2. الشيخ / سيد مناع
العمل التطوعى :رئيس الجمعية الشرعية بنزلة السمان _ ورجل داعية
العمل الاساسى : صاحب محلات سياحية بالغردقة
تليفون الجمعية : 37719695
موبايل : 0105255681

3. الاستاذ / نبيل سعداوى خطاب
العمل التطوعى : قيادة طبيعية يخدم المنطقة بالمساعدة فى استخراج قرارات علاج على نفقة الدولة باللجوء لاولاد عمومته من اعضاء مجلس الشعب والشورى
يخدم الشباب باقامة دورات كرة القدم (سابقا)
العمل الاساسى : مرشد سياحى
عنوان المنزل : شارع امون بنزلة السمان
موبايل : 0185255383

4. سحر خطاب
العمل التطوعى :
- امين وحدة بالحزب الوطنى
- امينة المرأة على مستوى دائرة الهرم
- عضو مجلس محلى محافظة (الجيزة)
- صاحبة جمعية الغد والمستقبل

العمل الاساسى : كانت مدرسة ثم استقالت
تليفون المنزل : 33852546
تليفون الجمعية : 33889324
موبايل : 0101711193

5. الحاج / عبد الناصر الجبرى
العمل التطوعى : عضو مجلس شعب (مرشح عمال) وله خدمة مواطنين

عنوان المنزل : 18 ش ابو الهول السياحى امام كبابجى الاهرام (براغيتو)
تليفون المنزل : 33858396
موبايل : 0112625111
مكتب خدمة المواطنين : 37420747 المواعيد من 8 – 10 مساء

6. علام عاشور
العمل التطوعى :
- يجمع امضاءات اصحاب الاسطبلات او البازارات لتقديم الشكاوى لجميع المستويات وارسال تلغرافات , ويتم بحث وحل اغلب المشاكل
- عضو برابطة الخيالة

عنوان المنزل : 32 ش جمال عبد الناصر
موبايل : 0121672187

7. أ / يوسف هنداوى خطاب
العمل التطوعى :
- عضو مجلس محلى محافظة الجيزة منذ 1990 الى الآن
- رئيس لجنة السياحة بالمجلس المحلى منذ 2001 الى الآن
- مرشح الحزب الوطنى لمجلس الشورى للدورة الجديدة
- كان رئيس لجنة العشوائيات بالمجلس المحلى على مستوى محافظة الجيزة

تليفون المنزل : 38505532
موبايل : 0123276932

8. أ / عبدالله رحومة حطاب
العمل التطوعى : عضو مجلس الشورى وله مكتب خدمه مواطنين
العمل الاساسى : كان صاحب محلات وبازارات
عنوان المنزل : شارع زغلول متفرع من شارع الهرم مشعل – الهرم (شرق ترعة المنصورية)
موبايل : 0122220343

9. الحاج / محمد يوسف فايد
العمل التطوعى : عضو مجلس شعبى محلى مدينة الجيزة
رئيس لجنة السياحة بالمجلس على مستوى المدينة
العمل الاساسى : صاحب محلات لبيع الروائح الشرقية والبردى واسطبلات خيل
عنوان المنزل : 22 ش سيد جابر مع زين العابدين
موبايل : 0141484276

10. أ / على جودة الشاعر
العمل التطوعى :
- رئيس لجنة السياحة بالحزب الوطنى من 2004 – 2006
- مستشار المجلس المحلى لمحافظة الجيزة (مستشار سياحى وعضو هيئة تنشيط السياحة بالجيزة)
- رئيس جمعية مستقبل شباب الجيزة بنزلة السمان

العمل الاساسى : محامى على المعاش

كان محاضرا بكلية السياحة والفنادق جامعة حلوان لمدة 25 سنة
يملك الان مجموعات شركات بلو سكاى وهى شركة رقم (2) فى السجل التجارى على مستوى مصر وشركة اى كان بميدان التحرير امام المتحف المصرى

عنوان المنزل : ا ش السمان الوسطانى بميدان الحقية
تليفون المنزل : 33850649
موبايل : 0105701800

Participants in a sample focus group meeting

حلقة نقاشـية لأهالي نزلة السمان

التاريخ : يوم الأحد 2010/2/21 الساعة 8,30 إلى الساعة 10,45 مساءً
المكان : دوار عائلة خطاب (دوار مغبون) أمام دكان الحاج خُبزه ، وعمرو الرفا بشارع نزلة السمان الوسطاني

م	الاســـم	السن	النوع	التعليم	مدة الإقامة بالمنطقة	العنوان	المهنـة
1	محسن محمد السعدي	53	ذكر	معهد اتحاد الموسيقي	أبا عن جد	5 ش سراج الدين من ش سيدي حمد السمان	أمين نشاطات التجارية والصناعية
2	نبيل مهدي أحمد المنجيلفي	35	ذكر	دبلوم تجارة	أبا عن جد	16 ش أمون	عضو في الحزب الوطني بدون عمل
3	إسلام أبو العلا خطاب	29	ذكر	دبلوم زراعة	أبا عن جد	ش عماد الدين من ش أبو الهول السياحي	أمين شباب السمان عضو هيئة مكتب جمال مبارك وأمين تنظيم المهندس أحمد عز سابقا
4	محمد ناصرة حمدي	23	ذكر	بكالوريوس نظم معلومات	أبا عن جد	23 ش نزلة السمان	مساعد أمين الشباب بالحزب الوطني

5	جهلان محمد حسين	62	ذكر	أمي	32 سنة	29، 31 ش عمر بن الخطاب وشارع الهرم الرئيسي	غفير عمارة
6	صبري غنيم	45	ذكر	دبلوم تجارة	أبا عن جد	ش نزلة السمان	أمن عمال
7	عمرو أحمد سيد	27	ذكر	دبلوم تجارة	مولد بالمنطقة	ش نزلة السمان	رفـا
8	رأفت محمد إسماعيل	41	ذكر	يقرأ ويكتب	مولود بالمنطقة	ش جوهر القائد	عامل في المركز الصحي

Public scoping meeting advertisement

Ahram Daily Newspaper on April 7, 2010

دعوة عامة

لجلسة المناقشة العلنية لدراسة تقييم الاثر البيئى
لمشروع خفض منسوب المياه الجوفية بهضبة الهرم

تدعو شركة مجموعة البيئة والتنمية السادة المواطنين المعنيين لحضور ندوة
لمناقشة دراسة تقييم الاثر البيئى لمشروع خفض منسوب المياه الجوفية بهضبة
الاهرام الممول من الوكالة الامريكية للتنمية الدولية بمنحة رقم ٢٦٣٠٢٧٠

وذلك بقاعة الخليفة بفندق ميناهاوس بالجيزة فى الساعة
الحادية عشرة صباح الأحد ١١ ابريل ٢٠١٠

Scoping session agenda

From 11: 00 – 11:15	Opening remarks by Dr. S.A El Aziz Head of Ancient Egyptian Antiquities Sector Supreme Council of Antiquities
From 11:15 – 11:45	Scoping Presentation by Dr. M. Saleh, EA Team Leader AECOM/EDG
From 11:45 – 13:00	Discussion
From 13:00 – 13:30	Conclusion and Recommendations
From 13:30 – 14:00	Tea Break

Project facts sheet

USAID | EGYPT FROM THE AMERICAN PEOPLE

Pyramids Plateau
Groundwater Lowering Activity

منطقة أبو الهول وما حولها بحوالي متر واختفاء المياه السطحية من كل المناطق المتأثرة حول ابو الهول .

واستكمالا لجهود المجلس الأعلى للآثار لحماية المنشآت الأثرية والسياحية الهامة قام المجلس الأعلى للآثار بالتعاون مع الوكالة الأمريكية للتنمية الدولية USAID بتكليف شركة AECOM الأمريكية بالتعاون مع جماعة المهندسين الاستشاريين ECG بعمل دراسة عن مشكلة المياه الجوفية بمنطقة أبو الهول واقتراح الحلول المناسبة لها.

وتقوم شركة AECOM / ECG بعمل عدة اقتراحات لتخفيض منسوب المياه الجوفية بالمنطقة إلى مستوى آمن لا يؤثر على جميع الآثار بمنطقة هضبة الهرم وبما لا يؤثر على جميع المنشآت الحديثة والأثرية بالمنطقة.

ومن بين الحلول المقترحة تنفيذ مجموعة من خطوط المواسير المثقبة محاطة بفلتر من الزلط ومحاطة بنسيج يسمح بمرور المياه دون مرور حبيبات التربة (Filter Fabric) وعلى أعماق تسمح بتخفيض مستوى المياه الجوفية للمستوى المطلوب ثم تجميع المياه في بيارة تجميع ثم ضخها بواسطة طلمبات إلى ترعة المنصورية .

والجدير بالذكر أن الأعمال الإنشائية للمشروع سوف تكون جميعها داخل المنطقة الأثرية فيما عدا خط الطرد الواصل من محطة الضخ إلى ترعة المنصورية والذي سوف يكون على عمق لا يتجاوز المترين وسوف يتم تنفيذه بحيث لا يعوق الحركة السياحية للمنطقة.

وتجدر الإشارة إلى أن المجلس الأعلى للآثار أكد على الشركة المصممة للمشروع AECOM / ECG أن تكون الحلول المقترحة آمنه تماماً على المنشآت الأثرية وجميع المباني الأخرى بالمنطقة وأن يتم التنفيذ على مراحل وبطريقة لا تؤثر على الحركة السياحية بالمنطقة وأيضاً على الحياة اليومية ومصالح المواطنين بالمناطق المجاورة للمشروع.

CAPW NOPWASD AECOM ECG EDG

ANNEX 6 LIST OF STAKEHOLDERS INVITED TO PUBLIC CONSULTATION SESSION

List of invitees to scoping session

- Egyptian Environmental Affairs Agency
- Ministry of Water Resources and Irrigation
- Ministry of Agriculture
- National Organization for Potable Water And Sanitary Drainage (NOPWASD)
- Local People Council
- Shoura and People Assembly
- Faculty of Engineering, Cairo University
- Faculty of Antiquities, Cairo University
- Ministry of Transportation
- Non Governmental Commissions Caring of Antiquities Protection
- Non Governmental Commissions Caring of Antiquities Protection
- Non Governmental Commissions in Nazlet El Samman

➢ **Public leaders**

- Mr. Magdy Khatab, Member of People Assembly
- Mr. Abd el Naser El Gabry, Member of People Assembly
- Mr. Nabeel S. Khatab
- Mrs. Sahar Khatab, Women Secretary, El Hezb El Watany
- Mr. Allam Ashour
- Mr. Yousef I. Khatab, Member of Local People Assembly
- Mr. Mohamed Y. Fayed , Member of Giza City Council
- Mr. Sayed Manaa, Head of El Gamayia El Sharayia
- Dr. Aly G. El Shaer, Local People Council Consultant
- Dr. Hamdy el Sisey, Deputy Head of Giza City Council
- Mr. Mabrouk Hendawy Khattab
- Mr. Gamal Ahmed Amer
- Mr. Mohamed A. Fayed
- Mr. Mohamed Hassan Khatab, Counselor

➢ **Non-governmental commissions**

- El Gamayia El Sharayia
- Gamayet Mostakabl Shbab El Giza
- Gamayet El Ghad wa El Mostakabl

List of participants in the scoping session

no.	Name	Affiliation
1	Sahar khattab	Member of Local Council, Giza
2	Sawsn Ebrahim Fahmy	Supervisor, Al Haram Development Projects, Giza Governorate
3	Reem Ahmed Abu El Saod	Ministry of water Resources
4	Mamdoh Abu Sreea Gab Allah	Ataff Manager & Magdy Khattab; People's Assembly Member
5	Amany Wiliam Uwakim	NOPWWASD
6	Noha Fouad El Maraghi	NOPWWASD, Secondary Cities
7	Shabaan Ahmed Abd el Gawad	SCA
8	Osama El Sheemy	SCA
9	Magdy Khatab	People's Assembly Member
10	Kamal Wahid Ahmed	Chief Inspector, Pyramids Antiquities District, SCA
11	Mohamed El Sayed Ismail Sheha	Inspector, Pyramids Antiquities District, SCA
12	Waad Allah Mohamed Abu El Ella	Director General , Engineering Directorate, SCA
13	Dr. Mahmod Hassan Afifi	Director General, Cairo and Giza Antiquities Sector, SCA
14	Essam Mohamed Shehab	Director of the Secretary General's technical Office, SCA
15	Safwat Mahros Mohamed Mahraan	Member of Local Council, Giza
16	Mahmod Rabea Mohamed	Ministry of water Resources & irrigation
17	Sayed Mohamed El Sayed	Director General, Al Haram Utilizes, Giza Governortate
23	Hamid El Welias	Member of Local Council, Giza
24	Kother Ismail	Housewife
25	Kamel Hassan Abdallah	Farmer
26	Zen El Abideen Ali Sayed Ali	Research Scientist, Ain Shams University
27	Rashad Anis Sabry	Ministry of Housing
28	Niveen Mohamed Mostafa El Maghraby	Ahram Engineering Directorate, SCA
29	Tarek Abu Basha	Jeweler
30	Mervat Mahmod El Sadawi	Environmental Officer, CID Pharmaceuticals
31	Farida Saleh Hafez	Housewife
32	Khiry Abd Elsalam Ali	Local labor leader
33	Magdy Ahmed Ebrahim	Teacher, local public school
34	Khaled Abdel Raoof Mohamed	Teacher, local public school
35	Ebrahim Mohamed El Sayed El Sisi	Secretary general, Local Unit of El-Sis Village
36	Dr. Hussien Mostafa	Architect
37	DR. Maher taha El nmr	Professor of architecture
38	Abd El Baki Hamed Abd Elbaki	Civil Servant
39	Reham Yossif Ahmed	Journalist
40	Dr. Mohamed Gamal	Professor, Suez Canal University
41	Dr. Akram Mohamed Fekry Ahmed	Ministry of Irrigation and Water Resources
42	Sahah Edris Radwan	Ministry of Health

43	Mohamed Abdel El nasser	Tour Guide
44	Dawlt Ahmed Abdel Moaty	Journalist
45	Abde aty Sayed Khataab	Owner of a local perfumes shop
47	Soaad Saadh	Development expert
48	Ali Ebrahim Naser Mahmod	Accountant
49	Mohamed Seadawy Naser	Local merchant
50	Mohamed Montasser Khataab	Businessman
51	Tarek Mohamed Shehta Ahmed	Businessman
52	Hazim Tawfik Khataab	Accountant
53	Mahmod Sayed El qmaty	Ministry of Education
54	Nashaat Mahmod Mohssen	Public relations
55	Mohamed El Hossieny Barakat	Journalist
56	Ali El Shaaer	Chairman, Youth Future Association, Giza
57	Ashraf Ismail Shash	Head of Haram local Council
58	Ahmed Hassan El Masry	Retired local politician
59	Bader Mahdy Anany Khataab	Oil industry expert
60	Saber Mohamed Elsayed Khataab	Hotel employee
61	Mohsen El Saadi Khataab	Owner, audio-visual studio
62	Sami Zaky Karim Khataab	Teacher
63	Zaky Karim Ali Khataab	Retired army officer
64	Yossif Khataab	Member of Local Council ,Giza
65	Alaa El Hefnawi	Engineer
66	Dr. Samir Latif	Ministry of Housing
67	Mohamed Wahid Hamed Mahmod	Student
68	Mohamed Abdel Fattah Mohamed	Student
69	Elsayed Shamatta Abdel Baki	Retired Police Officer
70	Abdel Sallam Tolba	Accountant
71	Khalifa Saleh Khalifa	Businessman
72	Mohamed Nader Abdel Wahaab	Advisor, SCA
73	Amr Gamaal Amer	Tour operator
74	Yehia Abdel Latif El Shaaer	Tour operator
75	Ramzy Kamel Farag	Journalist
76	Dr . Amira Abdo Mikeal	Journalist
77	Essam Habib Labib	Businessman
78	Eslaam Abu El Ellaa Hendawi	Businessman
79	Ahmed Mohamed Mahmod Khataab	Tour guide
82	Mabrouk Nour El Din Hendawy Khattab	Oil engineer
83	Maher Mohamed Othman	Engineer
84	Eng. Tarek Fathy Abdel Mawla	Engineer
86	Dr. Abdel Hameed	Physician

يجب اتباع نظام المواسير المثقبة.

وقد بدأت تظهر مياه جوفية امام منطقة ابو الهول.

عرض ملخص (د/مصطفى صالح)

يجب وضع خطة للحد من الاضرار.

فى البداية سنعرف البيئة وهى كل مايحيط بالانسان من هواء وماء وتربة.

ان مشروع تخفيض منسوب المياه الجوفية بمنطقة الاهرام هو تمويل من المعونة الامريكية.

الخطوات:

1. تحديد مكونات المشروع.
2. تحديد الاثار المراد ترميمها و تبعيد الاثار السليمة حتى لا تتضرر.

كما يجب التشاور مع الجهات المعنية وهذا يعنى التشاور مع المحيطين بهذه المنطقة ويتم التشاورعلى مرحلتين:

1. التشاور مع المواطنين وخاصة اهالى منطقة نزلة السمان.
2. عمل جلسات تشاور لتقييم المشروع والتعامل مع هذه الاثار والحد من خطورة هذه المياه.

وينقسم المشروع الى 3 فصول:

1. الموقع الجغرافى: وخاصة منطقى ابو الهول حيث انها اكثر المناطق انخفاضا. ولكن لا يوجد حيوانات مهددة بالانقراض.
2. الخواص الطبيعية: أ) جودة الهواء فقد تم تحليل الهواء ووجدنا ان نوعية الهواء اقل من الحد المسموح للقانون ومثله مثل هواء القاهرة .

ب)المياه ووجد انها تتعدى نسب التلوث.

ج)الضوضاء.

ومن اهم المناطق هى نزلة السمان حيث انها منطقى حضرية و تجارية وسياحية.

3. وصف المشروع: ان نسبة المياه الجوفية الموجودة بالمنطقة قد ارتفعت بشكل اضر بالاثار المصرية ومن اهم المناطق التى كانت تشكل المياه الجوفية خطورة عليها هى الاقصر والهرم وابو الهول.

الحل السريع:

1. هو عمل مشروع عاجل لتقليل المياه فى منطقة ابو الهول وسحبها.
2. ان يكلف المجلس الاعلى للاثار عدة اماكن للعمل مع خبراء الهيئة.
3. فى بداية العمل يجب دراسة كمية المياه التى يجب ان يتم سحبها.
4. يجب عمل انابيب مثقبة وهذه الانابيب ستعمل على سحب المياه وضخها على منطقة ترعة المنصورية.

كما انه يوجد اكثر من حل :

1. زيادة عدد الابار الرأسية.
2. عمل مواسير افقية.
3. عمل ابار رأسية ومواسير افقية وضخ المياه لمنطقة ترعة المنصورية.

التاثيرات البيئيه المتوقعة خلال مرحلة الانشاء:

الاثار الايجابية: أ. سيحدث تنشيط بسيط للحالة الاقتصادية لمنطقة نزلة السمان.

ب.الحد من تدهور المنطقة الاثرية.

ج. تحقيق التزام مصر تجاه حماية اثارها.

د. تحسين الخدمات السياحية.

ه. تحسين الصورة الجمالية للمنطقة.

و.الحد من تكاثر الباعوض والناموس.

الاثار السلبية: أ. ارتفاع مستوى الضوضاء وازدحام شارع ابو الهول.

ب. نقل مواد البناء له خطورة على صحة الاهالى.

خطة تخفيف الاضرار:

1. خلال مرحلة الانشاء: يجب ان توقع عقود مع مهندسين انشاء ويتم الاتفاق على شروط مثل: أ. ان يقتصر العمل على ساعات النهار فقط.

   ب. الحد من انتشار الاتربة.

   ج. الامتناع عن اشغال الطريق.

   د. وضع جدول زمنى للمشروع.

   ه. وضع خطة لادارة حركة المرور.

   و. ضمان وجود ممرات امنة للعبور.

   ز. الالتزام بمعايير السلامة.

   ويجب اتباع هذه البنود والالتزام بها.

2. خلال مرحلة التشغيل: يجب التزام الجهات الحكومية بمراقبة المياه التى يتم تصريفها على ترعة المنصورية.

الاراء والمشاورات:

أ. أ/مجدى ابو طالب خطاب: ارى انه من الممكن ان يكون الحفر فى المنطقة الشرقية بدلا من شارع ابوالهول كما يجب ان نتعاون للحفاظ على اثارنا وخاصة منطقة ابوالهول والاهرامات.

ب. د/على الشاعر: انضم ايضا لراى أ/ مجدى وهو الحفر فى المنطقة الشرقية بدلا من شارع ابوالهول السياحى. كما يجب ان نعلم ان نزلة السمان هى وادى للمياه الجوفية وعمقها 4000 متر. كما يجب علينا تنمية البشر والحد من الضرر.

ت. اللواء/اشرف شاش: انضم ايضا لراى أ/مجدى ود/على وهذا للتخفيف من الاشرار التى ستنتج عن الحفر فى شارع ابوالهول.

ث. مهندس/وكيل ربيع: ما هو البديل عندما تكون نسبة الاملاح بها عالية وتؤثر على المياه الجوفية هل يجوز تجميع المياه والاستفادة منها؟ كما انه لا يجوز الحفر فى شارع ابوالهول حيث انه المخرج الوحيد.

ج. أ/محمد منتصر خطاب: نريد ان نعرف تأثير سحب المياه على العقارات ايضا وهل الشفط سيكون ف منطقة ابو الهول فقط او من منطقة نزلة السمان ايضا؟

ح. نريد ان نعرف على اى اساس تم منع البناء فى منطقة نزلة السمان فيجب ان نخاف على مصلحة اهالى نزلة السمان مثل خوفنا على الاثار.

خ. هذه المياه ليست مياه جوفية ولكنها مياه سطحية ونزلت الى الارض ولكنها ليست نابعة من الارض.

د. المياه التى سيتم سحبها بها 90% تلوث حيث انها من عدة مصادر مثل صرف صحى وغيره.

ذ. أ/يحيى الشاعر: هيئة الاثار قالت ان ذهه المياه ناتجة عن الشاليهات التى كانت موجودة فوق هضبة الهرم لذا قاموا بهدم هذه الشاليهات ومنعوا البناء فى نزلة السمان واقاموا سور فاصل بين نزلة السمان ومنطقة الاهالى فلماذا لم يقوموا بهدم المبانى الخاصة بالهيئة؟

ر. أ/محسن السعدى: ارى انه من الممكن انه بدل الحفر فى شارع ابوالهول ان نقوم بتصريف هذه المياه فى اول بلاعة قريبة من المنطقة بدل الحفر وتعطيل الطرق. حيث ان هذه المياه عندما تصرف على ترعة المنصورية ستضر بالزراعة ومياه الشرب.

ز. هناك فقد ثقة بين هيئة الاثار وبين الاهالى.

س. ما تاثير شفط المياه على المنطقة المحيطة؟ وهل المياه الجوفية الموجودة بالمنطقة عميقة ام سطحية؟ وهل الابار التى ستحفر ستكون عميقة ام سطحية؟

ش. ان المشروع سينفذ يطريقة تحمى المياه الجوفية والسكان بالاضافة لابوالهول.

ما هو مصدر المياه؟

مستوى المياه ارتفع فى مصر كلها بنسبة 15 متر خلال الـ20 سنة الاخيرة، كما ان حقل منطقة ابوالهول كان يخرج 30 الف كم من المياه الجوفية وبعد وقف الحقل اثر ذلك على زيادة نسبة المياه.

من الممكن محاولة الاستفادة من المياه فى استصلاح اراضى جديدة.

المشروع لن يؤثر على البيوت فقد عمل مشروعان فى البر الغربى والشرقى ولم يحدث شئ للبيوت.

هل سيكون هناك شغل وحفر خارج المنطقة؟

لا. كل الشغل سيكون داخل المنطقة.

<u>الخلاصة:</u>

سنجد بديل لشارع ابوالهول الرئيسى.

لا يوجد تاثير من المشروع على المبانى.

كما نريد وعد بان الغاز الطبيعى سيدخل على نزلة السمان ودخول الكهرباء ايضا للمناطق التى لا يوجد بها كهرباء.

<u>د/احمد جنيدى:</u>

كل الشغل سيكون بالمنطقة الاثرية فقط اى ان الشغل الخارجى سيكون على الطرد فقط اذن لا لايوجد تاثير سلبى على المنطقة المحيطة ونزلة السمان او الاهالى وسيكون هناك خط يسحب المياه من منطقة الشغل على ترعة المنصورية.

ما هو الحل طويل المدى لمشكلة المياه الجوفية؟

لا يوجد مصدر واحد للمياه الجوفية وعندنا مشكلة فى زيادة منسوب المياه الجوفية فى مصر، كان هناك ما يسمى بحقل الاهرام فكان هذا الحقل يسحب كمية مياه ولكن غلق هذا الحقل عن طريق انسداد الابار بالتدريج ادى الى ان مشكلة زيادة المياه الجوفية بدأت فى الظهور، كما انه لا يوجد حل طويل المدى ولكن هناك حل لخفض المياه بمنطقة ابوالهول للحد من التاثير السلبى على هذه المنطقة الاثرية ومحاولة الحفاظ عليها. كما اننا سنحاول تخفيض المياه لمسافة متران فقط وليس لمسافة 100 متر.

هل لا يوجد فكرة لنقل ابوالهول لمسافة ما حتى نبعده تماما عن خطر المياه الجوفية؟

سنفكر فى الموضوع مثلما حدث فى معبد ابوسمبل.

هل يوجد محطة معالجة للمياه الجوفية قبل ألقاؤها فى ترعة المنصورية؟

لو وجدنا ان المياه تحتاج لمعالجة ستعالج قبل وصولها للترعة.

يجب ان تحل المشكلة من اساسها وهذا عن طريق معالجة المواسير القديمة المتهالكة حيث انها تؤدى الى اضرار سلبية على الاهالى وتؤدى الى فشل كلوى.

يوجد دراسة حالية للتسريبات الاتية من الجيزة ونزلة السمان.

يجب الحفاظ عل المنطقة المحيطة بابوالهول والاهرامات.

خط الصرف: طريق جامع الناصر هو اقصر طريق ولكن عند اختيارنا للطريق الاخر للحفاظ على الاثر.

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