Japan International Cooperation Agency

The Arab Republic of Egypt
Giza Governorate, Giza City

No. 01

# BASIC DESIGN STUDY REPORT ON THE PROJECT FOR THE WATER SUPPLY AND SEWER SYSTEM UPGRADING IN MONIB, GIZA CITY IN THE ARAB REPUBLIC OF EGYPT (PHASE 2)

DECEMBER, 1992

YACHIYO ENGINEERING CO., LTD.

Japan International Cooperation Agency

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## PREFACE

In response to a request from the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct a basic design study on the Project for the Water Supply and Sewer System Upgrading in Monib, Giza City (Phase 2) and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Egypt a study team headed by Mr. Shinichi MORI, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs and constituted by members of Yachiyo Engineering Co., Ltd., from June 1st to June 30th, 1992.

The team held discussions with the officials concerned of the Government of Egypt, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Egypt in order to discuss a draft report and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Arab Republic of Egypt for their close cooperation extended to the teams.

December, 1992

Kensuke Yanagiya
President
Japan International Cooperation Agency

December, 1992

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

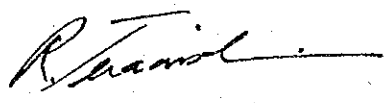
We are pleased to submit to you the basic design study report on the Project for the Water Supply and Sewer System Upgrading in Monib, Giza City (Phase 2) in the Arab Republic of Egypt.

This study has been made by Yachiyo Engineering Co., Ltd., based on a contract with JICA, from May 29th to December 19th, 1992. Throughout the study, we have taken into full consideration of the present situation in Egypt, and have planned the most appropriate project in the scheme of Japan's grant aid.

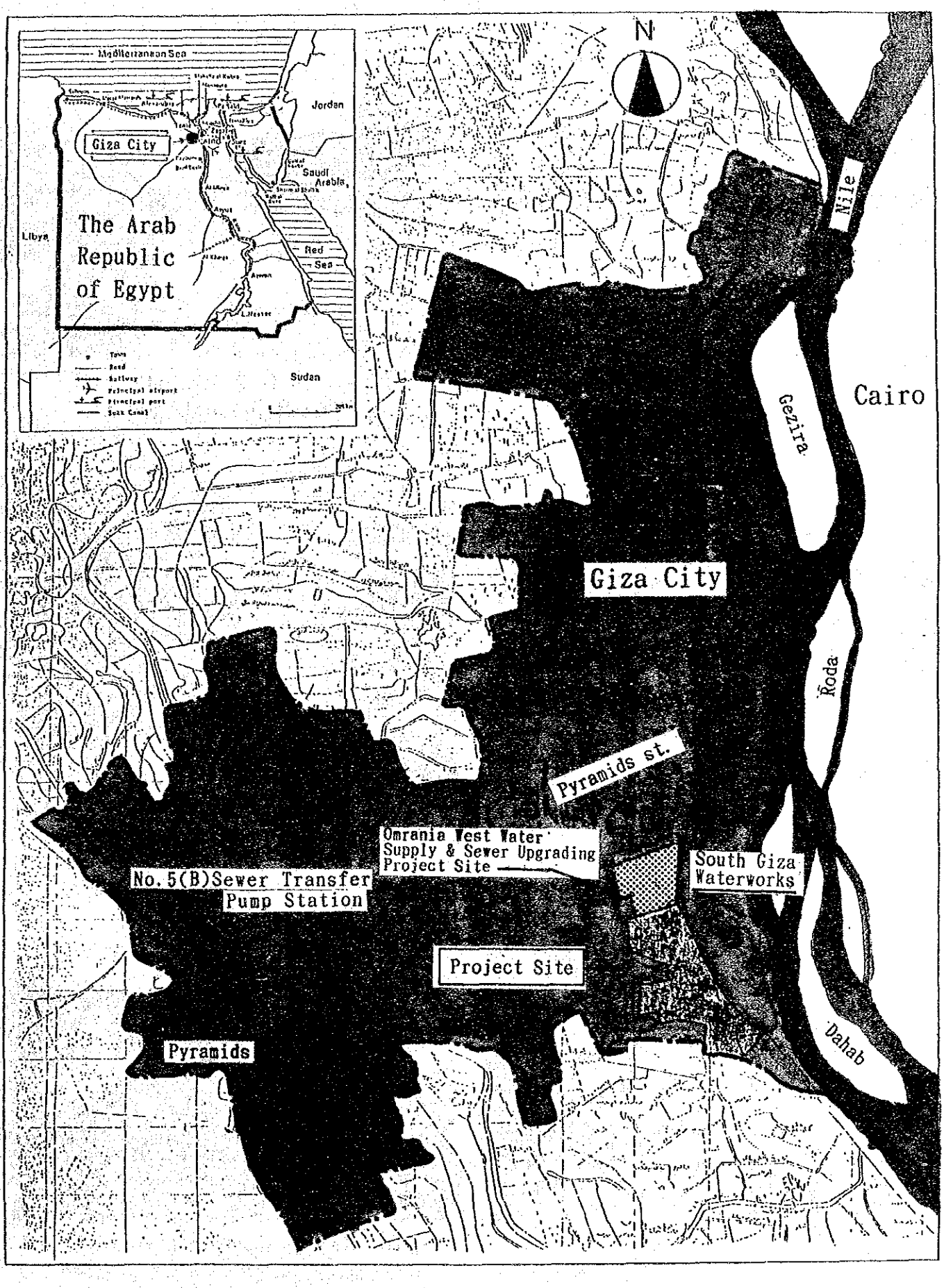
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, Ministry of Health and Welfare, Ministry of Construction, Kobe City Government, Kawasaki City Government and Embassy of the Arab Republic of Egypt in Japan. We also wish to express our deep gratitude to the officials concerned of Giza City, JICA Egypt Office, Embassy of Japan in Egypt for their close cooperation and assistance during our study.

At last, we hope that this report will be effectively used for the promotion of the project.

Very truly yours,



Project Manager, Ryosuke Teranishi
Basic design study team on the Project for
the Water Supply and Sewer System Upgrading
in Monib, Giza City (Phase 2)
Yachiyo Engineering Co., Ltd.



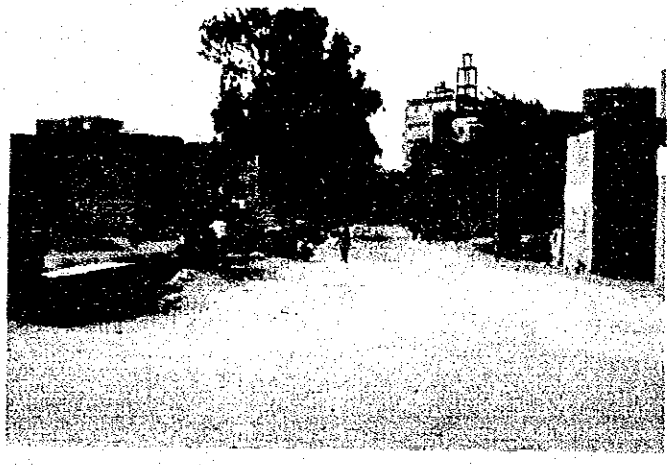

Location of Giza City and Project Site

# General Conditions of Project Area

El Kasabgy Street
(Zomor Canal on the left)

Konayssah Canal Street

Monib Street
(Sewage overflow onto street)

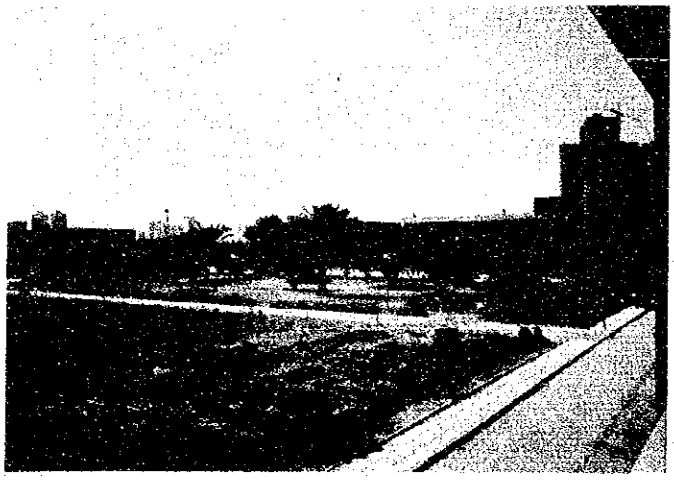


Terra Nirsa Street

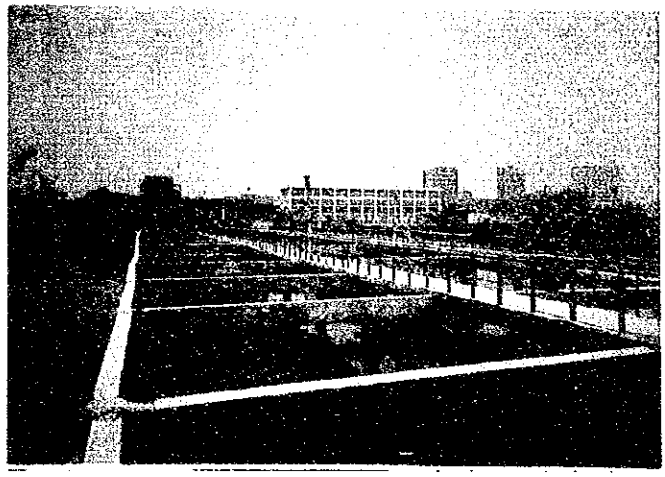
Local inhabitants fetching water from
the communal tap along the Zomor Canal

Gamal Abdel Nasser Street
(Busy shopping area in Monib District)

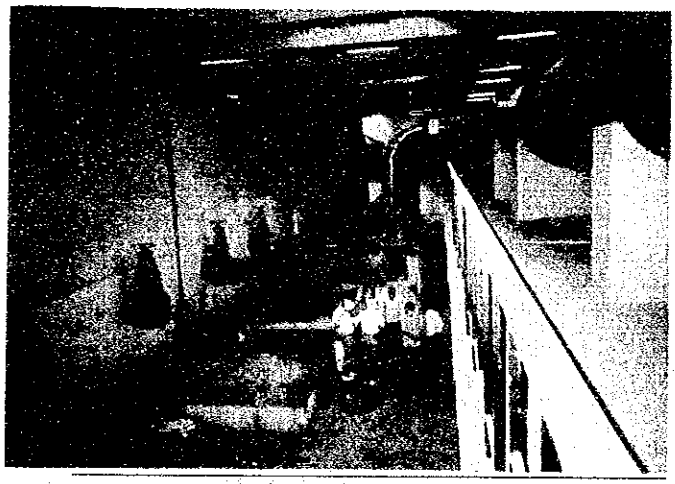
# South Giza Waterworks



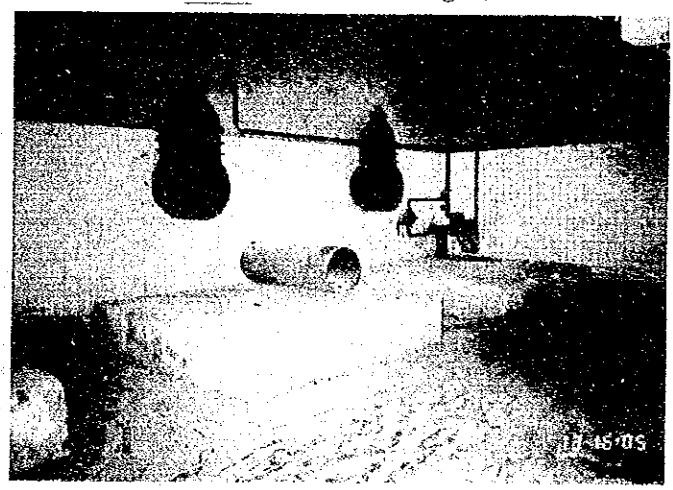
General view of upgrading project site



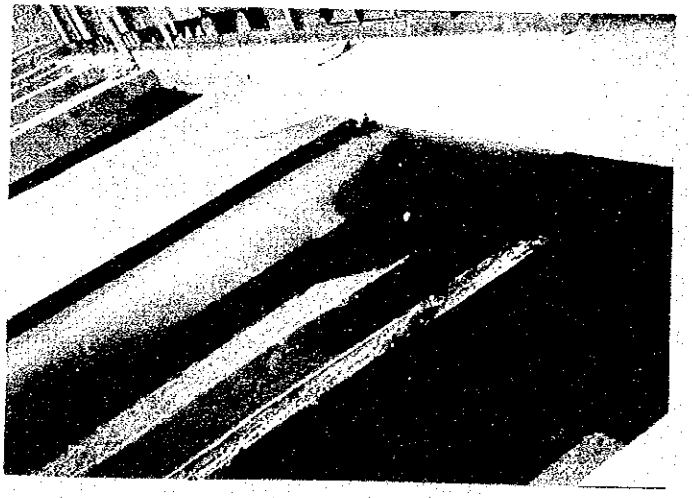
South Giza Waterworks seen from raw intake point: existing intake pump station (left) and intake pump station for 6th October Waterworks (right)



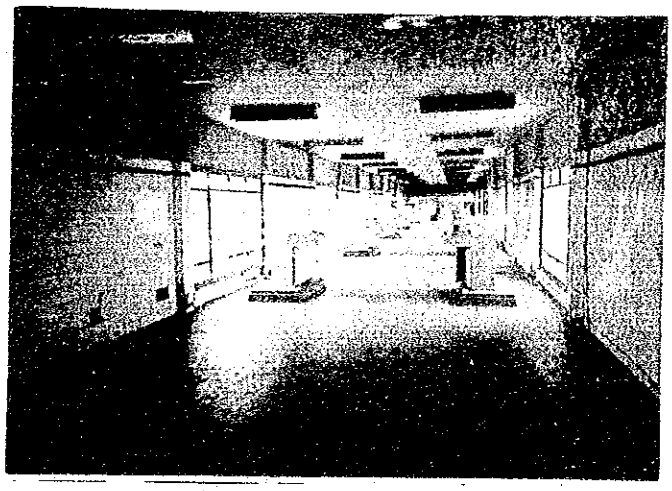
Inside of pumping station for 6th October Waterworks (intake pump room)



Space for intake pump to be installed under the Project

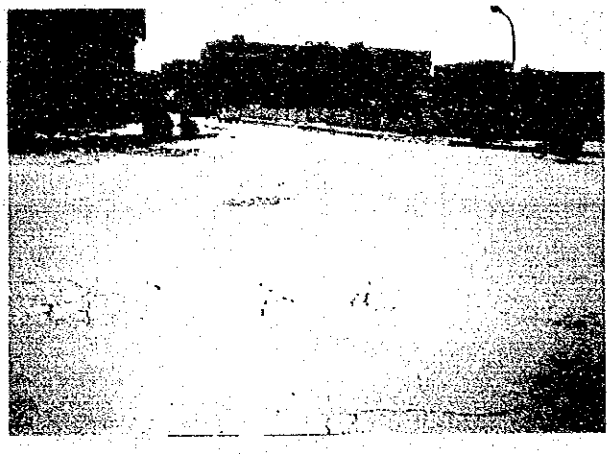


Existing rapid sand filters



Control room of existing rapid sand filters

# Water Supply Trunk Line Route



Connection point between planned trunk line and existing trunk line

6th October Street

Railway line crossing point

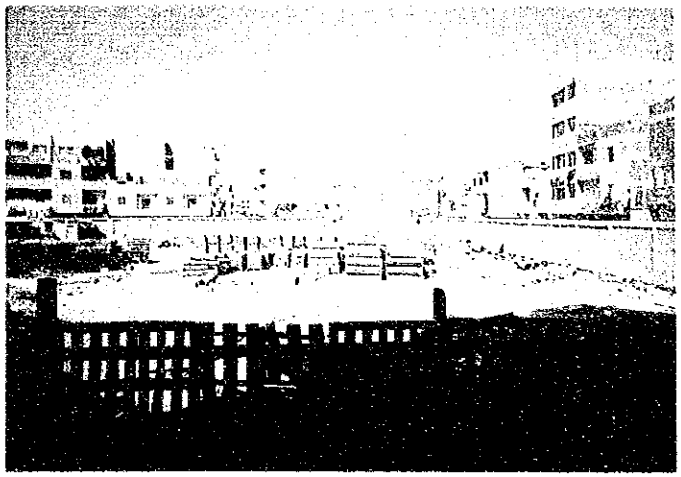
Sadi Amar Street

Canal Crossing Point

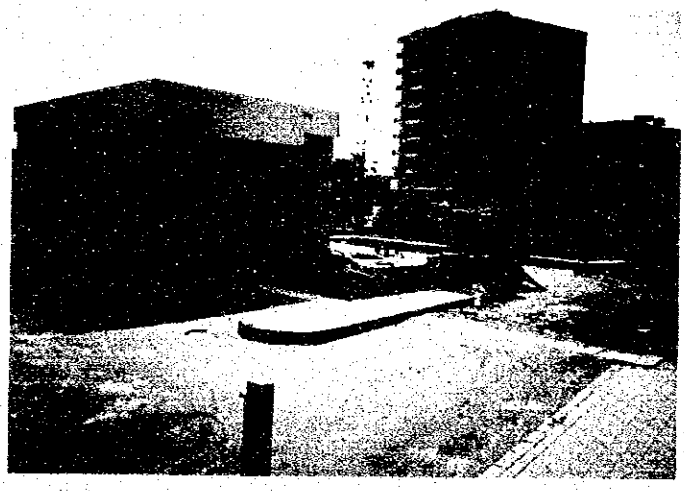
Konayssah Canal Street

# Sewer Transfer Pump Station No. 5 (B)

Sewer Transfer Pump Station No. 5 (B)
Construction Site

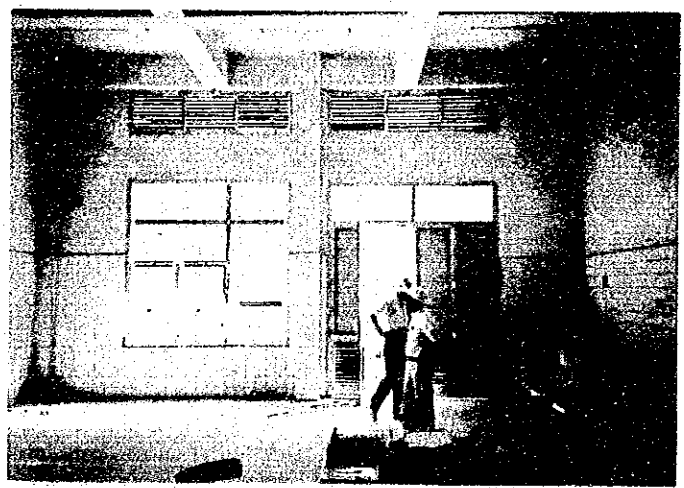


Sewer Transfer Pump Station No. 5 (B)
Construction Site

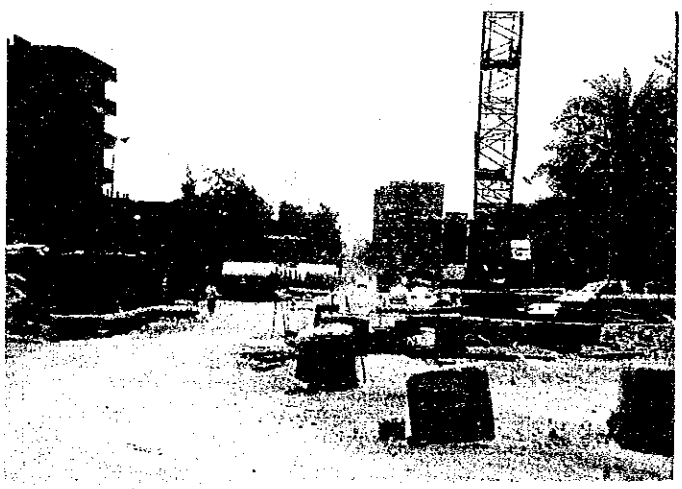


Sewer Transfer Pump Station No. 5 (A)
(operation to commence by end of 1992)

Sewer Transfer Pump Station No. 5 (A) building (left) and sub-station/emergency power generation facility (right). The wooden fence on the right marks the boundary between the No. 5 (A) and No. 5 (B) stations



Inside of sub-station/emergency power generation facility



Sewer trunk line construction site of USAID which will become the downstream of Sewer Transfer Pump Station No. 5 (B) (near Sewer Transfer Pump Station No. 5 (B) entrance)

# SUMMARY

## SUMMARY

The Arab Republic of Egypt has a vast land area of some 1 million $km^2$ (2.7 times larger than the land area of Japan). However, cultivable land accounts for a mere 2.9% of the total area and is almost totally confined to the Nile Delta and the narrow strips of green belt on both banks of the Nile. The overwhelming majority of the population (June, 1992 estimate: 58 million) live in these areas, resulting in an extremely high population density. The GDP per capita is estimated to be approximately 480 US dollars (1991).

The Government of Egypt has prepared the Long-Term Perspective Plan covering the 20 year period from 1983 to 2002 with three main targets for national development. These targets are (1) consolidation of the national economic strength, (2) improvement of the public infrastructure and (3) balanced distribution of the population. In the Second Five-year Plan (1987/88-1991/92) and Third Five-year Plan (1992/93-1996/97), the priority in infrastructure development is given to an increased water supply capacity in urban areas from 8.6 million $m^3$/day (1986/87) to 12.4 million $m^3$/day.

Egypt's central political and economic functions are conducted in a wide area called the Greater Cairo Region which consists of Cairo, Giza and part of the Governorate of Qalyubiya. The population of the Greater Cairo Region has been rapidly expanding since the 1960's due to large inward migration caused by a series of 4 Middle Eastern wars and the inflow of local people seeking employment, reaching some 13.21 million in 1989. The construction of basic infrastructure such as water supply and sewer facilities and roads has failed to keep pace with the rapid population increase and local life and industrial activities have been severely affected by the over-population.

The provision of basic infrastructure in Giza City, located in the Governorate of Giza, lags behind Cairo which is situated on the opposite side of the Nile. In Monib District in Giza City in particular where many low income families live (estimated population of some 133,000 in 1990 in an area of 185ha, resulting in a population density of 718/ha), the provision of basic infrastructure is almost non-existent as shown by the water service ratio of approximately 5% and the average water supply volume of 10-20 litres/person/day and the lack of a sewer system due to the omission of Monib District from urban development programmes.

Under these circumstances, the Government of Egypt has prepared 2 main urban development plans for the Greater Cairo Region, i.e., the Greater Cairo Region Long Range Urban Development Scheme and the Greater Cairo Region Transportation Master Plan Study, aiming at the balanced distribution of the population and the improvement of the transportation

network. With regard to water supply service improvement, master plans have been prepared for Cairo and Giza City with US and German (then West German) assistance respectively. In the case of sewer service improvement, the Greater Cairo Wastewater Master Plan has been prepared with US and British assistance. The Government of Egypt hopes to achieve the step-by-step improvement of the water supply and sewer services in accordance with these plans. In fact, the Greater Cairo East Bank Project and the Greater Cairo Wastewater Project (for the west bank) are currently in progress with British and US assistance respectively, both of which are in line with the Master Plan. These projects, however, are concerned with lowerstream facilities and the improvement of upperstream facilities has been left to Egypt's own efforts.

Unfortunately, the implementation of various projects with its own funds is very difficult for the Government of Egypt due to the extensive investment required for such facilities, Egypt's worsening fiscal conditions and the low profitability of such services. Therefore, the Government of Egypt has been obliged to request the provision of foreign assistance including Japan.

In response to such requests, the Government of Japan decided to provide grant aid for the Project for Omrania West Water Supply and Sewer Upgrading, Giza City in 1988 and this project was completed in March, 1991. In November, 1991, the Government of Japan conducted the Basic Design Study for the Project for Water Supply and Sewer System Upgrading in Monib, Giza City (Phase 1 Project), consisting of the construction of water supply and sewer trunk lines and the provision of construction materials for water supply and sewer branch lines. The Project Site of the Phase 1 Project, i.e., Monib District, is the same as that of the Phase 2 Project.

In the case of the Phase 1 Project, it is expected that the water supply routes to both inhabitants and public facilities in the Project Site will be established and that local living conditions will be improved by means of an improved water distribution network with the result of increasing the current water consumption of 10-20 litres/person/day to some 70 litres/person/day. Nevertheless, as the water supply capacity of the existing waterworks in Giza City can only meet some 70% of the required volume, falling short of the target 140 litres/person/day level planned by water supply master plans, the Government of Egypt has prepared the South Giza Waterworks Expansion Plan (design water supply volume: 35,000$m^3$/day) as part of the overall extension plan for the said waterworks (design water supply volume: 200,000$m^3$/day) to secure the necessary water supply level for the Project Site (as planned by the master plans) and has also prepared the Water Supply Trunk Line Construction Plan to guarantee a reliable, steady supply of water.

With regard to improvement of the sewer system, since the sewage volume will be increased and exceed the transfer capacity of the existing sewer transfer pump station due to the increase of water supply volume after the completion of the South Giza Waterworks Expansion Plan, the construction of a new pumping station is necessary to establish appropriate drainage routes for the swift flow of sewage to wastewater treatment plants. Consequently, the Government of Egypt has prepared a plan to construct Sewer Transfer Pump Station No. 5 (B).

The Government of Egypt subsequently made a request to Japan for the provision of grant aid for the construction of the facilities mentioned above as components of the Project for Water Supply and Sewer System Upgrading in Monib, Giza City (Phase 2) (hereinafter refered to as "the Project"). In response to this request, the Government of Japan decided to conduct the Basic Design Study, and the Japan International Cooperation Agency (JICA) sent the Basic Design Study Team to Egypt for the period between June 1st and June 30th, 1992 and again between October 19th and October 30th, 1992 to explain the contents of the Draft Final Report to the Egyptian side.

It was confirmed that the Project Site is suffering from poor living and sanitation conditions due to a chronic water supply shortage and the poor drainage of sewage, etc., because of the long delay in the construction of water supply and sewer facilities despite the area's importance for development as part of the Greater Cairo Region. As a result, the urgent implementation of the Project with a subject area of 185ha and a design population of 247,000 (target year: 2010) was judged necessary. It was further confirmed that there is no foreign assistance programme for the facilities to be constructed under the Project and that the requested size of the facilities [① water service facilities: construction of new water supply facilities at South Giza Waterworks (design water supply capacity of 35,000$m^3$/day) and the construction of a water supply trunk line (1,200mm in diameter and some 2.3km long) and ② sewer facilities: construction of Sewer Transfer Pump Station No. 5 (B) (design pumping volume: 1,650 litres/sec × 3 pumps)] is compatible with the master plans prepared with US, UK and German assistance. Together with the positive prospect of the Project combining the new facilities with the water supply and sewer networks to be constructed under the Phase 1 Project to improve the water supply and sewer services over a wide area, the contents of the Egyptian request were judged appropriate.

In preparing the South Giza Waterworks Expansion Plan and the Sewer Transfer Pump Station No. 5 (B) Construction Plan for the Project, the compatibility of the new facilities with those of the Phase 1 Project has been taken into consideration. The construction methods and sites have been selected to avoid any damage or disruption to the existing facilities while using the latter to the advantage of the Project. In the case of the Water Supply Trunk Line Construction Plan, special consideration has been given to construction work at sections crossing the railway line

and major trunk roads and also to connection with the existing water supply trunk line to minimise the possible disruptive effects on local life and industrial activities.

All the plans have been designed to facilitate the maximum use of local equipment, materials and manpower to contribute to the promotion of Egyptian industries, the vitalisation of the local economy and the creation of employment opportunities.

The Project is outlined below.

Outline of the Project

| | Item | Work Size |
|---|---|---|
| Construction of Water Supply Facilities | South Giza Waterworks Expansion | Design water supply capacity: max. 35,000m$^3$/day<br>Water source: the Nile<br>Specifications:<br>Intake pump (1 set for operation)<br>Flocculation basin (horizontal-vertical combination circulation method)<br>Coagulation basin (sloping horizontal sedimentation method)<br>Rapid sand filtration<br>Distribution pumps (2 sets operation, 1 set stand-by) |
| | Water Supply Trunk Line | - Diameter: 1,200mm<br>- Total length: approx. 2.3km<br>- Type of pipe: ductile cast iron pipe |
| Construction of Sewer Facilities | Sewer Transfer Pump Station No. 5 (B) | Design pumping volume: 1,650 litres/sec/pump × 3 pumps (2 sets operation, 1 set stand-by)<br>Specifications: screw pump<br>(The building will have space for the installation of an additional pump by 2010) |

The organization with overall responsibility for the Project is Giza Governorate while Giza City is the implementation body. The facilities constructed under the Project will be handed over to Giza City upon their completion and the assets, i.e., facilities, and the operation and maintenance responsibility for such assets will then be immediately assigned to either GCWSA (some 14,000 employees as of 1991) or GOSD (some 11,000 employees as of 1989).

Although both GCWSA and GOSD have sufficient manpower, equipment and technical strength to properly maintain the new facilities, the financial balance is currently in the red due to the interest payment of foreign and domestic debts, necessitating central government subsidies and National Investment Bank loans. In order to improve the financial situation, the Government of Egypt plans to increase the water charge by some 230% from its present level by 1995 to secure the necessary funds for the operation and maintenance of the water supply facilities. Government efforts to improve the financial situation also include a planned increase of the share of the sewer service in the water service revenue from the current 10% to approximately 30%.

The estimated annual revenue from the new water supply facilities based on the increased water tariff is approximately 5.75 million LE (¥220 million), of which some 1 million LE (¥39 million) will be allocated to GCWSA and some 1.38 million LE (¥54 million) to GOSD as budget for operation and maintenance. As the estimated annual running cost of the new facilities is some 900,000 LE (¥35 million) for the water supply facilities and some 930,000 LE (¥36 million) for the sewer facilities (both of which are lower than the expected budgetary allocation), no financial problems are anticipated in regard to the running of the new facilities. Nevertheless, it is important that Giza City ensure proper management and operation arrangements for the new facilities at the time of their transfer to GCWSA and GOSD in view of their efficient use over a long period of time.

The main components of the work to be undertaken by the Egyptian side are the removal of the existing sewer channel and trees, etc., from the construction site at South Giza Waterworks and the installation of outdoor lighting and the construction of premise roads for Sewer Transfer Pump Station No. 5 (B). The estimated cost to be borne by the Egyptian side is some 380,000 LE (¥14.8 million based on the exchange rate of 1LE=¥39 as of July, 1992). The period required to complete the Project, if implemented, is as follows.

33 months (from the appointment of the Contractor to the completion of the construction work)

The Egyptian side is required to secure by a preset date all construction sites, including a temporary yard site and work roads, which are within the scope of the work to be undertaken by the Egyptian side and to communicate and coordinate with related ministries, agencies and organizations in Egypt to smoothly implement the Project in cooperation with the Japanese side.

The direct effects of the Project through the construction of various facilities will include a stable supply of drinking water at a maximum rate of 140 litres/person/day and the sanitary discharge of sewage of upto 190 litres/person/day to the public sewage system.

The implementation of the Project following the Phase 1 Project is expected to achieve various positive effects, including the liberalisation of the inhabitants of Monib District (estimated number of beneficiaries: 155,000 in the project completion year of 1996 and 247,000 in the target year of 2010) from poor, unsanitary living conditions, liberalisation of women and children from the hard work of water transportation, improved living and health conditions and the promotion of urban development programmes, etc., greatly contributing to the stabilisation and improvement of life in the Project Site. The implementation of the Project with grant aid provided by the Government of Japan is, therefore, both highly significant and appropriate.

## CONTENTS

## TABLES AND FIGURES

[TABLES]

[FIGURES]

## ABBREVIATIONS

| | |
|---|---|
| AD | Datum Level at Alexandria |
| CWO | Organization for the Execution of the Greater Cairo Wastewater Project |
| E/N | Exchange of Notes |
| GCWSA | Greater Cairo Water Supply Authority |
| GDP | Gross Domestic Product |
| GNP | Gross National Product |
| GOSD | Greater Cairo General Organization for Sanitary Drainage |
| ha | hectare |
| ISO | International Organization for Standardization |
| JICA | Japan International Cooperation Agency |
| JIS | Japan Industrial Standard |
| LE | Egyptian Pound |
| NOPWASD | National Organization for Potable Water and Sanitary Drainage |
| O & M | Operation and Maintenance |
| OJT | On the Job Training |
| USAID | United States Agency for International Development |

## Definitions of Certain Technical Terms Used

The technical terms in this report are defined as follows.

Water Supply Facilities

| | | |
|---|---|---|
| Water Supply Trunk Line (diameter: 800mm or more) | : | water trunk line to supply water from a waterworks to an area of consumption and not directly connected to households |
| Water Supply Branch Line (diameter: 300mm-600mm) | : | water supply line branching from the trunk line to supply water to an area of consumption and not directly connected to households |
| Water Supply Branch Line (diameter: less than 300mm) | : | water supply line branching from the main branch line (diameter: 300mm-600mm) to supply water to households |

Sewer Facilities

| | | |
|---|---|---|
| Sewer Trunk Line (diameter: 1,200mm or more) | : | trunk line to forward sewage collected from an area of discharge to the lowerstream and not directly connected to households |
| Sewer Branch Line (diameter: 300mm-600mm) | : | sewer line to forward sewage collected from an area of discharge to the sewer trunk line and not directly connected to households |
| Sewer Branch Line (diameter: less than 300mm) | : | sewer line to discharge sewage from households to the sewer main branch line (diameter: 300mm-600mm) |

# CHAPTER 1 INTRODUCTION

The Government of the Arab Republic of Egypt (hereinafter referred to as the Government of Egypt) considers the establishment of a self-sufficient economy, improvement of the public infrastructure and the appropriate distribution of the population to be the three main priority targets under the Long-Term Perspective Plan covering the 20 year period from 1983 to 2002 and has been working particularly hard to improve the public infrastructure. The target adopted by the Second Five-year Plan (1987/88-1991/92) to expand the urban water supply capacity from 8.6 million $m^3$/day (figure for 1986/87) to 12.4 million $m^3$/day has been inherited by the current Third Five-year Plan (1992/93-1996/97) as part of the overall attempt to improve the public infrastructure.

In Giza City in Giza Governorate, located on the opposite bank of the Nile to Cairo, improvement of the public infrastructure has been greatly delayed compared to Cairo. The poor public infrastructure is particularly noticeable in Monib District (population of some 133,000) as it is outside the designated area for urban development. With regard to the prospect of improving the public infrastructure in Giza City, a master plan for water supply improvement has been prepared with the assistance of Germany (former West Germany) and a master plan to improve the sewer system in Greater Cairo, prepared with the assistance of the US, UK and other countries, includes Giza City.

While trying to improve the water supply and sewer systems in Giza City step-by-step in accordance with these master plans, the Government of Egypt has been forced to request the provision of financial assistance by donor countries, including Japan, because of the difficulty of raising funds due to the low profitability of the projects and also because of the shortage of its own project funds.

In response to such requests, the Government of Japan provided grant aid for the Project for Omrania West Water Supply and Sewer Upgrading, Giza City from 1988 to 1991, followed by the Basic Design Study on the Project for Water Supply and Sewer System Upgrading in Monib, Giza City (Phase 1) (hereinafter referred to as the Phase 1 Project) in November, 1991.

The planned water supply improvement under the Phase 1 Project is the establishment of water supply routes to both inhabitants and public facilities in the Project Area by means of an improved water distribution network with the result of increasing the current water supply volume of 10-20 litres/person/day to some 70 litres/person/day. Nevertheless, as the water supply capacity of the existing waterworks in Giza City can only meet some 70% of the required supply volume, achievement of the target supply volume of 140 litres/person/day is

impossible. Facing this water supply shortage, the Government of Egypt has prepared the South Giza Waterworks Expansion Plan to increase the design water supply volume by 35,000m$^3$/day to secure the necessary level of water supply to the Project Area and has also prepared the Water Supply Trunk Line Construction Plan to guarantee a stable supply of water.

With regard to improvement of the sewer system, since the sewage volume will be increased and exceed the transfer capacity of the existing sewer transfer pump station due to the increase of water supply volume after the completion of the South Giza Waterworks Expansion Plan, construction of a new pumping station is necessary to establish appropriate drainage routes for the swift flow of sewerage to wastewater treatment plants. Consequently, the Government of Egypt has prepared the plan to construct the Sewer Transfer Pump Station No. 5 (B).

The Government of Egypt subsequently made a request to Japan for the provision of grant aid for the construction for the plans mentioned above as components of the Project for Water Supply and Sewer System Upgrading in Monib, Giza City (Phase 2) (hereinafter referred to as the Project). In response to this request, the Government of Japan decided to conduct the Basic Design Study, and the Japan International Cooperation Agency (JICA) sent the Basic Design Study Team headed by Mr. Shinichi Mori of the Grant Aid Cooperation Section, Economic Cooperation Bureau, Ministry of Foreign Affairs to Egypt for the period between June 1st and June 30th, 1992. A list of the Study Team members and the field survey schedule are given in Appendix 1 and Appendix 2 of this report respectively.

The objectives of the Basic Design Study were to obtain a correct understanding of both the background and contents of the proposed plans for Monib District, i.e., (1) the South Giza Waterworks Expansion Plan, (2) Sewer Transfer Pump Station No. 5 (B) Construction Plan and (3) Water Supply Trunk Line Construction Plan, and to study the present conditions of the proposed construction sites/routes and the capability of a likely plan implementation body, etc., in order to accurately determine the possible effects of the Project and its suitability as a grant aid project financed by the Government of Japan.

The Study Team visited related organizations in Egypt, including Giza City, Greater Cairo Water Supply Authority (GCWSA), the Greater Cairo General Organization for Sanitary Drainage (GOSD), etc., to explain the objectives of the study and to discuss the general conditions of water supply and sewer services in Egypt as well as Giza City. The Study Team also discussed the contents of the original request with the Egyptian side, reconfirming the background and objectives, etc., of the plans. Furthermore, it was confirmed that these plans are essential to supplement the master plan for the improvement of water supply and sewer services in Giza City. The Minutes of Discussions (M/D) (see Appendix 4) were concluded on June 22nd, 1992 based on the results of the discussions and studies on both the reconfirmed

# CHAPTER 1

# INTRODUCTION

background and contents of the request. A list of those interviewed in Egypt is given in Appendix 3.

Following the signing of the M/D, the Study Team continued to collect and analyse data and information, to consult with officials of the related organizations and to conduct a series of field surveys. The Field Report was subsequently submitted to Giza City and other related organizations on June 24th, 1992 to confirm the basic technical issues for the basic design of the new project with the Egyptian side (Appendix 5).

Upon its return to Japan, the Study Team prepared the Basic Design Study Draft Final Report for the Project for Water Supply and Sewer System Upgrading in Monib, Giza City (Phase 2), taking into consideration the current conditions of water supply and sewer systems in Egypt, current conditions of project sites, relationship between the Project and master plans and the propriety, contents and scale of the grant aid. JICA then sent the Draft Final Explanatory Team to Egypt headed by Ms. Chiho Muramatsu of the Grant Aid Cooperation Section, Economic Cooperation Bureau, Ministry of Foreign Affairs for the period between October 24th and November 4th, 1992 to explain the contents of the Draft Final Report to the Egyptian side. Having received approval of the contents of the said Draft Report, the Basic Design Study Report has now been finalised. A list of the team members, field survey schedule and M/D for the Draft Final Explanatory Team are given in Appendices 1, 2 and 4 respectively.

# CHAPTER 2

# BACKGROUND OF THE PROJECT

# CHAPTER 2 BACKGROUND OF THE PROJECT

## 2.1 Background of the Project

### 2.1.1 Outline of Water Supply Service

#### (1) National Outlook of Water Supply Service

Egypt's relatively high average annual population growth rate of some 2.7% is causing overcrowding in urban areas, including Giza City. Consolidation of the public infrastructure designed to cope with such population growth has, however, been much delayed over the years due to a series of 4 Middle Eastern wars.

According to national statistics, the national average rate of households served by water supply was 73.1% in 1986 but the service was under full capacity due to general deterioration and the lack of adequate maintenance of service facilities, including the service pipe network and waterworks. The deterioration and inadequate capacity of the waterworks mean that they cannot possibly meet the water demand, resulting in a serious water supply shortage. The water service ratio in Egypt as of 1986 is shown in Table 2-1.

Table 2-1 Water Service Ratio in Egypt

| Area | Ratio of Households Served by Water Supply |
|---|---|
| Nationwide | 73.1% |
| Urban Areas (Average) | 92.4% |
| Rural Areas (Average) | 55.9% |

Source: National Statistics, 1986

The Government of Egypt plans to alleviate the serious water supply shortage by increasing the water supply capacity in urban areas from 8.6 million $m^3$/day to 12.4 million $m^3$/day in its Second Five-year Plan as part of its emphasis on the consolidation of the public infrastructure. In order to achieve this target, the Government of Egypt has divided the national water supply service into 3 services areas, i.e., Greater Cairo Region, Alexandria and other areas, and a body responsible for the improvement of the water supply service has been established in each area under the jurisdiction of the Ministry of Reconstruction, New Communities, Housing and Utilities (hereinafter

referred to as the Ministry of Reconstruction). Projects aiming at achieving this goal include the Alexandria Water Supply Improvement Project assisted by the Government of Italy and the Greater Cairo Water Supply Improvement Project assisted by the Government of Japan, etc. Some projects are already underway.

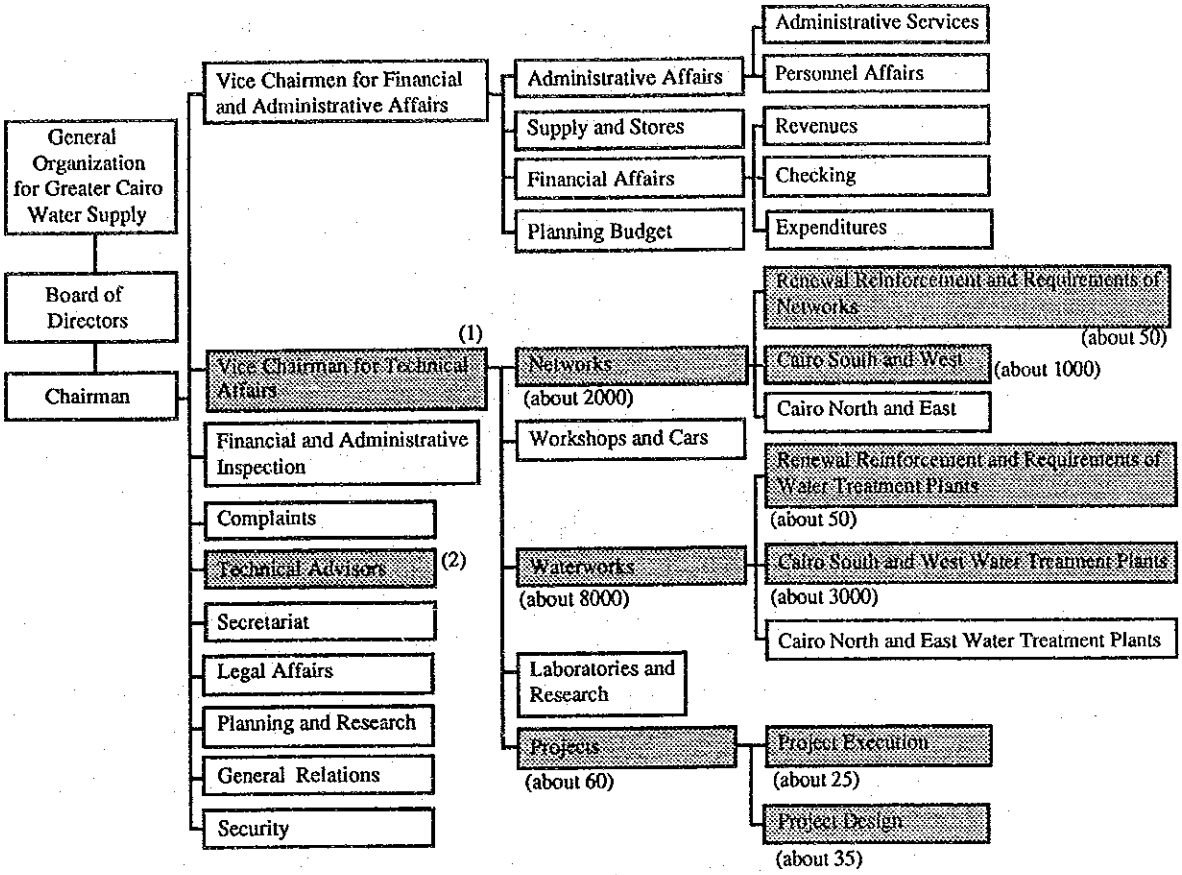
The body responsible for the water supply service in the Greater Cairo Region where Giza City is located is the Greater Cairo Water Service Authority (GCWSA) while the National Organization for Potable Water and Sanitary Drainage (NOPWASD) is responsible for water supply and sewer services in all areas in Egypt except the Greater Cairo Region and Alexandria.

NOPWASD employs some 1,000 people for the planning, construction and maintenance of water supply and sewer services and has been actively rehabilitating and constructing water supply facilities, mainly in terms of improving the water supply capacity of waterworks in accordance with the policy set by the Second Five-year Plan.

(2) Outline of Water Supply Service in Greater Cairo Region

1) Related Administrative Organizations

The planning, operation and maintenance of the water supply service in the Greater Cairo Region, including Monib District, Giza City, i.e., the Project Site, are conducted by GCWSA which was established to succeed the Greater Cairo Water Supply Company by a Presidential Decree in 1968. As described earlier in 2.1.1 (1), GCWSA is under the jurisdiction of the Ministry of Reconstruction and as shown in Fig. 2-1 its Board of Directors operate the service together with some 14,000 employees (1991). The Project is mainly handled by technical advisers of the Network Section, Waterworks Section and Projects Section with coordination by the Vice-Chairman for Technical Affairs.




Notes : 1) Shadowed sections are those which will be involved in the implementation of the Project.
2) The total number of GCWSA employees is 13,735 as of December, 1991.
3) Figures in brackets indicate the number of employees in sections which will be involved in the implementation of the Project.

Source : GCWSA

Fig. 2-1 Organization of GCWSA

2) Water Supply Situation

GCWSA has a service area of 380km$^2$ (December, 1991) in the Greater Cairo Region and its aggregate service line length is some 5,000km with a design service population of approximately 12 million. GCWSA claims that the total daily water supply capacity of all waterworks in the Greater Cairo Region is some 3.5 million m$^3$ with a service ratio of approximately 85%. In Monib District, however, GCWSA has so far installed several public taps where the water supply to individual households is virtually non-existent.

To improve the situation, GCWSA prepared the master plan in 1979 for water supply improvement in the Greater Cairo Region with the technical cooperation of the US which became the basis for all water supply improvement plans/projects in subsequent years. The planned improvement of the water supply network in the Greater Cairo Region is shown in Fig. 2-2.

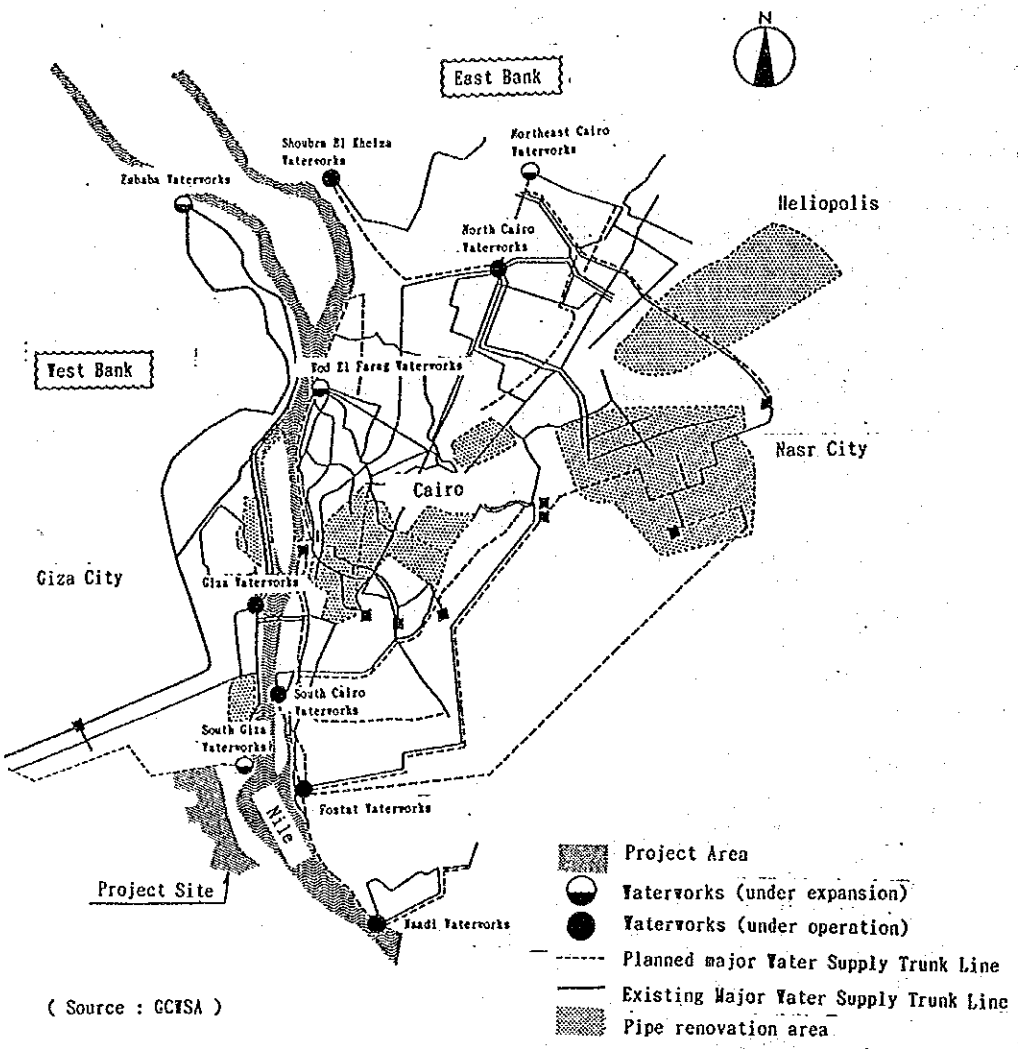



Fig. 2-2 Water Supply Improvement Plans for Greater Cairo Region

The total daily water supply capacity of all waterworks is approximately 3.5 million $m^3$ and 4 waterworks, i.e. Embaba, Giza, South Giza and El Ahram (Wellfield) are currently operating in Giza City. The historical increase of the water supply capacity and the planned increase in the future for each waterworks are shown in Table 2-2 while the planned water supply volume, including the 35,000$m^3$/day of the new water supply facility at South Giza Waterworks by the Project (assumed year of completion: 1996), and the required supply volume in Giza City are shown in Fig. 2-3.

Table 2-2 Water Supply Capacity of Waterworks in Greater Cairo Region: Past, Present and Future

(Unit: $m^3$/day)

| Waterworks | 1986 | 1987 | 1991 | 1996 | 2010 |
|---|---|---|---|---|---|
| Embaba | 115,000 | 300,000 | 345,200 | 345,200 | 745,000 |
| Giza | 143,000 | 120,000 | 125,300 | 125,300 | 122,500 |
| South Giza | 226,000 | 140,000 | 220,400 | 255,400 | 400,000 |
| El Ahram (Wellfield) | 30,000 | 30,000 | 29,200 | 29,200 | 60,000 |
| Total | 514,000 | 590,000 | 720,100 | 755,100 | 1,327,500 |

Source: GCWSA

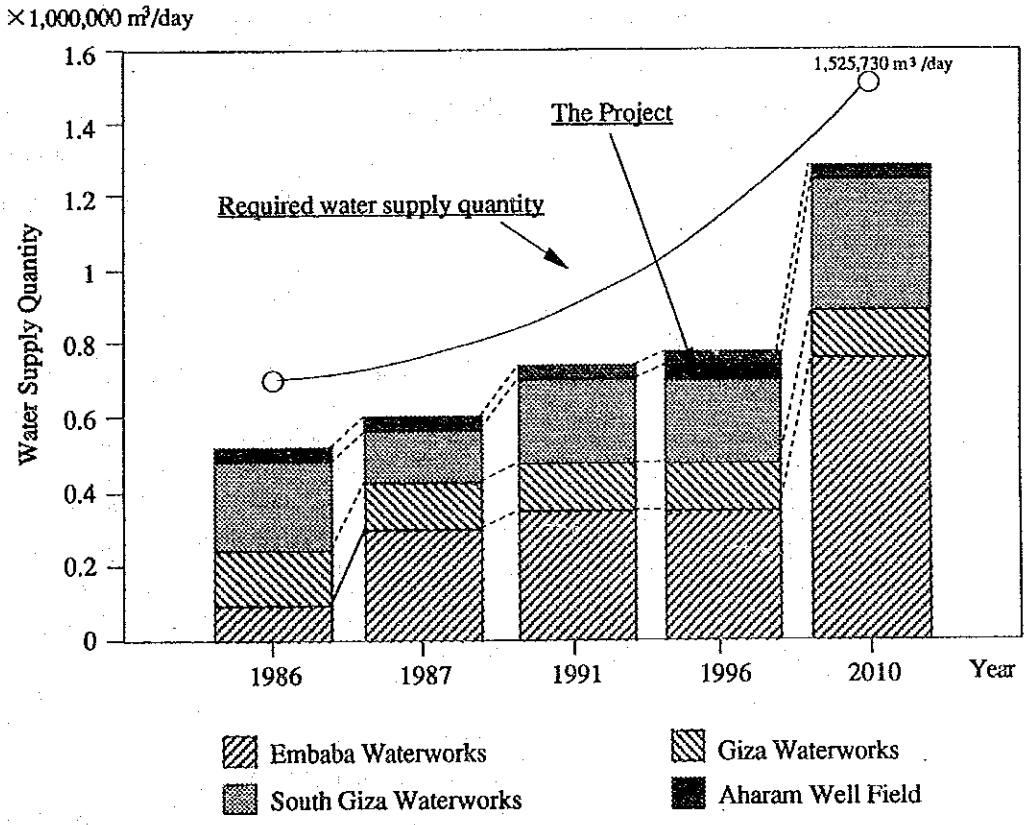



Fig. 2-3 Planned Water Supply Volume and Required Water Supply Volume in Giza City

As shown in Table 2-2, an expansion programme has been in progress at the Embaba Waterworks since 1986 to increase the supply capacity. Nevertheless, the overall water supply capacity shows only a minor increase due to the deterioration of the performance of other waterworks. The supply capacity is currently some 70% of the required capacity (Fig. 2-3), indicating that the poor water supply capacity is the cause of the chronic water shortage in the Greater Cairo Region.

All waterworks are forced to conduct overload operation to meet the demand and this is particularly noticeable in the case of South Giza Waterworks which serves the Project Site. The present working water production is some 220,000m$^3$/day, a +60% overload against the design capacity of 140,000m$^3$/day, necessitating the urgent construction of a new facility as well as the expansion and/or repair of the present facilities. In order to improve the situation, GCWSA has set an improvement target yet of 2010 for Giza City in accordance with the master plan prepared with German assistance and has been implementing the necessary work. The actual household water supply performance in 1986 and the target level in 2010 are given in Table 2-3.

In the table, the water supply (consumption) per capita for the high (income) class and the middle (income) class in 2010 has been set lower than the present level to ensure fair water distribution in the light of the chronic shortage of potable water. In order to achieve fair distribution, it is planned to increase the water tariff for high class facilities and households with a high level of water consumption by a much higher rate than others as shown in Table 2-4.

Table 2-3 Household Water Supply Performance and Target Level in Giza City

| Income Class | Supply Volume (litres/person/day) | | Service Population (× 1,000 person) | | Supply Volume (m$^3$/day) | |
|---|---|---|---|---|---|---|
| | Performance in 1986 (incl. of some 23% leakage) | Target in 2010 (incl. of some 14% leakage) | Actual Figure in 1986 | Target in 2010 | Performance in 1986 | Target in 2010 |
| High Class | 390 | 250 | 240.3 (9.6%) | 327.2 (10.2%) | 93,717 | 81,800 |
| Middle Class | 225 | 160 | 401.0 (16.0%) | 559.7 (17.4%) | 90,225 | 89,552 |
| Low Class | 95 | 120 | 761.5 (28.6%) | 2,012.3 (62.7%) | 68,067 | 241,476 |
| Communal Taps | 20 | 20 | 179.2 (7.2%) | 41.1 (1.3%) | 3,584 | 822 |
| Unserved Area | 0 | 0 | 967.0 (38.6%) | 270.0 (8.4%) | 0 | 0 |
| Total | | | 2,504 0 (100%) | 3,210.3 (100%) | 255,593 | 413,650 |

Source: Water Supply Improvement Master Plan for Giza City (1987)

3) Financial Situation of GCWSA and Water Tariffs

The financial situation of GCWSA has been worsening in recent years, particularly because of a rapid increase in expenditure which increased by some 130% in 1989/90 on the previous year. The expenditure in 1989/90 was some 495 million LE. The main reason for this increase was the interest repayment of foreign loans

and debt, accounting for some 16% (67 million LE) of the total expenditure in 1989/90.

To improve the situation, GCWSA is currently implementing the Water Tariff Structural Readjustment Plan with the assistance of the USAID and plans to increase the current charges by 10-30% for domestic use, service use and commercial use and by 35-100% for other uses from fiscal 1992/93. The increase of GCWSA's income by some 150% through the introduction of the new tariff system is expected to result in some 40 million LE, contributing to the improvement of the current financial situation of GCWSA. The Government of Egypt plans to introduce a phased increase of the water charge within 3 years to fundamentally improve the financial situation of the water supply service. Table 2-4 shows the current and planned water tariffs.

Table 2-4 Present Water Tariff and Proposed Increases

| Kind of use | Fiscal Year | | Rate of Increase (%) |
|---|---|---|---|
| | 1991/92 | 1992/93 | |
| 1. Domestic Use | | | |
| - Upto $30m^3$ | 0.085 | 0.10 | 18 |
| - Excess of $30m^3$ | 0.10 | 0.13 | 30 |
| - Building works | 0.25 | 0.28 | 12 |
| 2. Services Use | | | |
| - Religious Buildings, Bakeries, etc. | 0.075 | 0.08 | 7 |
| - Sporting Clubs | 0.10 | 0.13 | 30 |
| 3. Companies and Commercial Shops | | | |
| - Small Factories, etc. | 0.18 | 0.23 | 28 |
| - Big Factories | 0.25 | 0.31 | 24 |
| 4. Production and Investment Use (1st class hotel & restaurant, tourist facility, etc.) | 0.35 | 0.55 | 57 |
| 5. Raw Water | 0.06 | 0.08 | 33 |
| 6. Portable Water for nondomestic use | | | |
| - Government Factories | 0.18 | 0.20 | 11 |
| - Government Agencies | 0.10 | 0.20 | 100 |
| 7. Filtered Water | 0.08 | 0.10 | 25 |
| 8. Monthly fixed rate for houses built by governorate | | | |
| - 1 Room | 0.75 | 1.00 | 33 |
| - 2 Rooms | 0.90 | 1.25 | 39 |
| - 3 Rooms | 1.20 | 1.50 | 25 |
| - More than 3 Rooms | 1.50 | 2.00 | 33 |

Source: GCWSA

### 2.1.2 Outline of Sewer Service

#### (1) National Outlook of Sewer Service

Improvement of the sewer service in Egypt, as in the case of the water supply service discussed in 2.1.1, was almost ignored until 1980 because of the lack of funds to consolidate the public infrastructure, in turn caused by a series of Middle Eastern wars, despite the intensified population concentration in urban areas. Most of the sewer facilities today are operating at over capacity, forced by the inflow of sewage of which the volume far exceeds the design capacity of the wastewater treatment plants.

Many cities, in fact, lack an adequate sewer network or wastewater treatment plants. The sewage from households is consequently drained to cesspits, causing poor living and sanitary conditions in the form of groundwater pollution and the overflow of sewage onto roads due to the inadequate drainage system of these cesspits.

The Government of Egypt invested some 456 billion yen in the sewer service sector during the First Five-year Plan period (commencing in fiscal 1981/82) to improve the situation. Further investment of 138 billion yen is planned in the Second Five-year Plan period (commencing in fiscal 1987/88) to improve the national average sewer service ratio from the current 25% to 85%.

While the said investment has improved the sewer facilities in the Greater Cairo Region, Alexandria and other urban centers, the promotion of the relevant projects has necessitated foreign aid because (1) the rate of population growth has exceeded the speed of sewer service improvement and (2) sewer system improvement is an expensive undertaking, etc.

As in the case of the water supply service, the sewer service is also divided into 3 areas (Greater Cairo Region, Alexandria and other areas) which have their own organization responsible for the provision of the sewer service.

The construction of main lowerstream sewer facilities in the Greater Cairo Region is being implemented with US and British assistance, supervised by the Organization for the Execution of the Greater Cairo Wastewater Project (CWO). Upperstream facilities have been planned and are under construction by the Greater Cairo General Organization for Sanitary Drainage (GOSD) which is responsible for the operation and maintenance of all sewer facilities in the Greater Cairo Region, including those completed by CWO. In areas other than the Greater Cairo Region and Alexandria, NOPWASD (see 2.2.1-(1)) is responsible for the sewer service in addition to the water supply service.

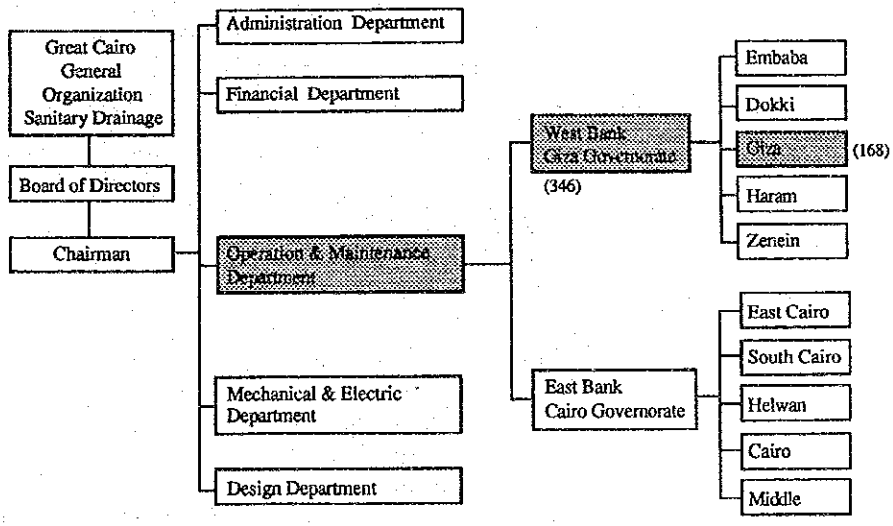
At present, NOPWASD is implementing as many as 46 projects for the improvement of sewer systems and/or the construction of wastewater treatment plants in accordance with the targets set by the Second Five-year Plan with the assistance of Italy, France and Australia, etc. The number of projects increases to 76 when small-scale projects are included.

(2) Outline of Sewer Service in Project Site

1) Related Administrative Organizations

A Presidential Decree in 1981 divided the responsibility for the sewer service in the Greater Cairo Region, including the Project Site, which was formerly borne by the National organization for Sanitary Drainage whose operation and maintenance responsibility for sewer facilities covered all Egypt, between the newly created CWO and GOSD with the former responsible for the construction and supervision of main lowerstream facilities and the latter responsible for the operation and maintenance of all sewer facilities in the Greater Cairo Region (see 2.1.3-(1)).

As in the case of GCWSA, GOSD is under the jurisdiction of the Ministry of Reconstruction and is run by the Board of Directors. It employs some 11,000 people (1989) and its organization is shown in Fig. 2-4. As Fig. 2-4 shows, the West Bank Giza Governorate Section of the Operation and Maintenance Department will have responsibility for the implementation of the Project.




Notes : 1) Shadowed sections are those which will be involved in the implementation of the Project.
2) The total number of GOSD employees is 10,950 as of October, 1989.
3) Figures in brackets indicate the number of employees in sections which will be involved in the implementation of the Project.

Source : GOSD

Fig. 2-4 Organization of GOSD

2) Sewer Service Situation

Most of the existing sewer facilities in the Greater Cairo Region were laid more than 30 years ago and the general deterioration and inadequate capacity have reduced the efficiency of the sewer service, necessitating the urgent upgrading of the facilities as well as the overall efficiency.

While GOSD claims a sewer service ratio in the Greater Cairo Region of some 70%, the drainage capacity of the existing sewer network is only some 50% of the required level. The overflow of sewage onto roads and the contamination of groundwater by sewage from the cesspits used in areas without the sewer service have resulted in a deterioration of the general environment and of sanitary conditions in particular. The sewer service network in the Greater Cairo Region is shown in Fig. 2-5.

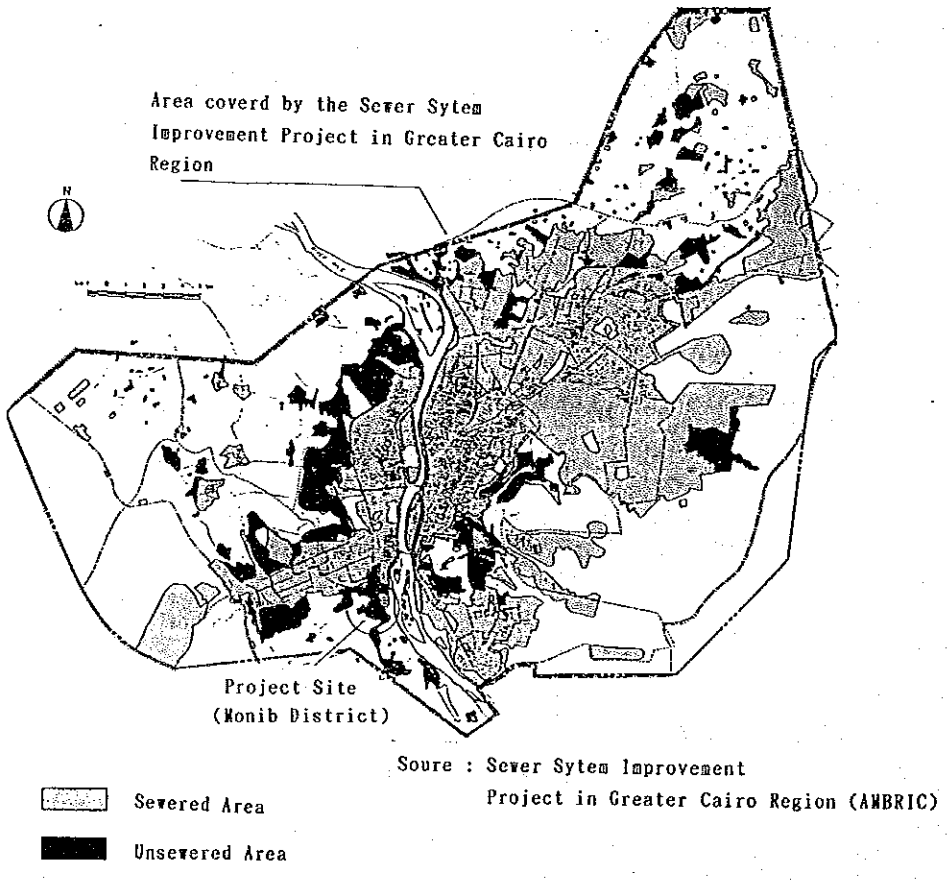
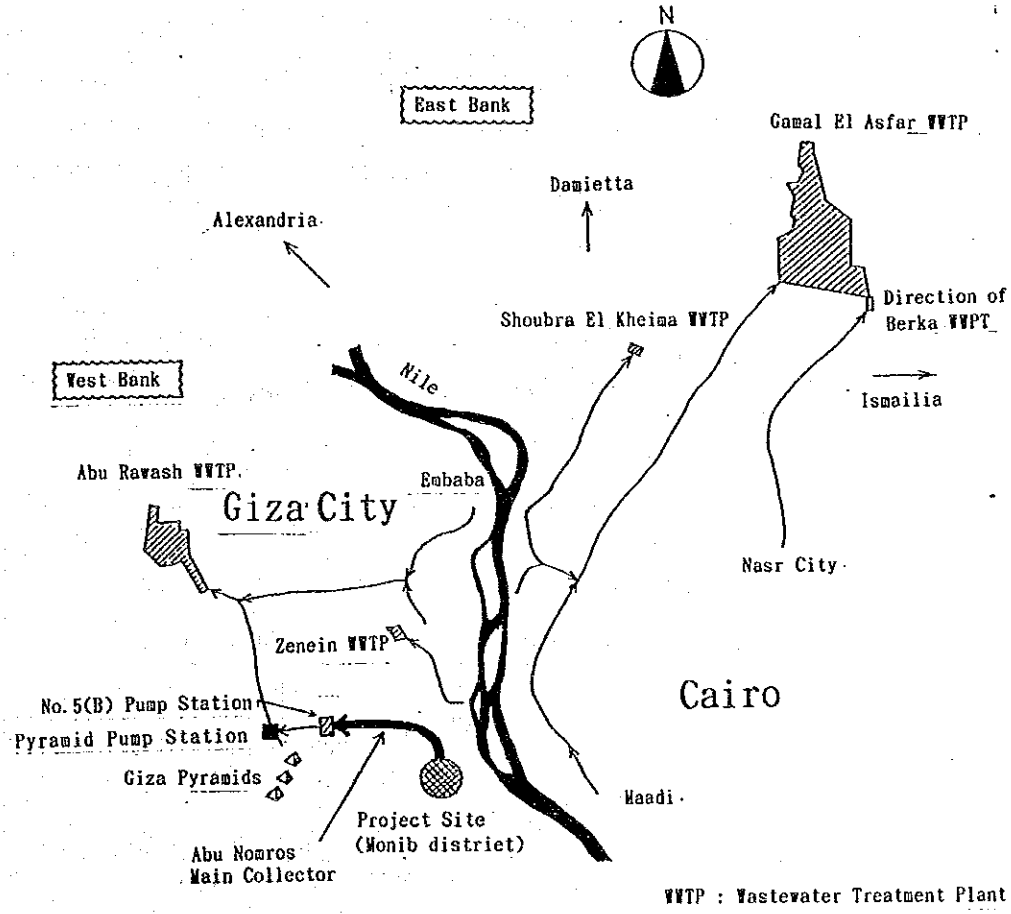



Fig. 2-5 Sewer Service in Greater Cairo Region

The Government of Egypt has responded to the situation by dividing the Greater Cairo Region into the West Bank and East Bank areas and has been implementing projects to improve and expand the wastewater treatment plants and sewer trunk lines, etc. with the assistance of the US, Britain and others. Fig. 2-6 shows the main projects being implemented by CWO in the Greater Cairo Region (some sections have been completed and the newly constructed facilities which have been handed over to GOSD are currently in operation) and the location of the Project Site. The Master Plan to improve the sewer system in the Greater Cairo Region is given in Appendix 8.




( Source : Greater Cairo Wastewater Project )

Fig. 2-6 Sewer System Improvement Projects in Greater Cairo Region and Location of Project Site

Monib District (Project Site) is located on the West Bank of the Nile where the only operating wastewater treatment plant is located at Zenein. The treatment capacity of Zenein Wastewater Treatment Plant of some 300,000m$^3$/day covers only 50% of the drainage and the plant is forced to operate at an overload.

In order to improve the situation, the Government of Egypt commissioned a British consultant in 1978 to prepare the Greater Cairo Wastewater Master Plan and subsequently requested AMBRIC, a joint project organization of 4 consultants in the US and Britain, to review and update the Master Plan in 1981. Based on this revised Master Plan, projects have since been implemented with US assistance in the West Bank area and by British and Italian assistance in the East Bank area.

The estimated service population and drainage volume upto the target year (2010) of the revised Master Plan are given in Table 2-5. Compared to the East Bank area, the service population of the West Bank area is expected to sharply increase to reflect the recent population increase (a 370% increase in 20 years), necessitating the urgent improvement of the sewer network. Table 2-6 shows the estimated population growth and the design sewer service population in the Greater Cairo Region while Table 2-7 shows the design service area, population density and design population in the target year (2010).

Table 2-5 Design Service Population and Design Sewage Drainage Volume in Greater Cairo Region

| | Item | | 1990 | 2000 | 2010 |
|---|---|---|---|---|---|
| East Bank | Design Population | (million) | 7.430 | 9.821 | 11.449 |
| | Sewer Service Ratio | (%) | 85.0 | 86.4 | 92.6 |
| | Design Service Population | (million) | 6.33 | 8.49 | 10.64 |
| | Design Sewage Discharge | (1,000 $m^3$/day) | 1,816 | 2,551 | 3,332 |
| | Biological Oxygen Demand (BOD) | (tons/day) | 589 | 794 | 1,012 |
| | Suspended Solids (SS) | tons/day) | 650 | 876 | 1,118 |
| West Bank | Design Population | (million) | 3.359 | 5.032 | 7.357 |
| | Sewer Service Ratio | (%) | 57.4 | 85.2 | 97.6 |
| | Design Service Population | (million) | 1.93 | 4.29 | 7.18 |
| | Design Sewage Discharge | (1,000 $m^3$/day) | 472 | 1,173 | 2,139 |
| | Biological Oxygen Demand (BOD) | (tons/day) | 168 | 375 | 626 |
| | Suspended Solids (SS) | (tons/day) | 184 | 410 | 694 |

Note: Design Service Population = Design Population x Sewer Service Ratio
Source: Revised Greater Cairo Wastewater Master Plan

Table 2-6 Estimated Population Size and Design Sewer Service Population in Greater Cairo Region

(Unit: 1,000)

| | | 1990 | 2000 | 2010 |
|---|---|---|---|---|
| Design Population | East Bank | 7,430 (2.9) | 9,821 (2.8) | 11,449 (1.5) |
| | West Bank | 3,359 (4.9) | 5,032 (4.1) | 7,357 (3.9) |
| Total | | 10,789 | 14,853 | 18,806 |
| Population Outside Service Area | | 1,774 | 2,204 | 2,277 |
| Greater Cairo Region Total | | 12,563 (3.5) | 17,057 (3.9) | 21,083 (2.4) |

Note: Figures in brackets are the annual population growth rate.
Source: Revised Greater Cairo Wastewater Master Plan

Table 2-7 Design Service Area, Population Density and Design Population in Target Year (2010)

| | 1990 | | | | 2010 | | | | Maximum Estimate | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Design Service Area (ha) | Service Area Coverage Ratio (%) | Population Density (persons/ha) | Design Population (1,000) | Design Service Area (ha) | Service Area Coverage Ratio (%) | Population Density (persons/ha) | Design Population (1,000) | Design Service Area (ha) | Service Area Coverage Ratio (%) | Population Density (persons/ha) | Design Population (1,000) |
| East Bank | 15,580 | 69 | 476 | 7,412 | 22,610 | 100 | 505 | 11,417 | 22,610 | 100 | 727 | 14,392 |
| West Bank | 5,609 | 59 | 591 | 3,314 | 9,549 | 100 | 765 | 7,306 | 9,549 | 100 | 1,044 | 9,969 |
| Total | 21,189 | 66 | 506 | 10,726 | 32,158 | 100 | 582 | 18,723 | 32,158 | 100 | 821 | 26,408 |

Source: Revised Greater Cairo Wastewater Master Plan

According to the plan for the West Bank area where the construction of the No. 5 (B) Pumping Station is envisaged by the Project, sewage beyond the capacity of Zenein Wastewater Treatment Plant will be forwarded to Abu Rawash Wastewater Treatment Plant, the construction of which is currently in progress with US assistance in the northwestern part of Giza Governorate, via a trunk line passing through the Boulac Pumping Station and also via another trunk line passing through the Pyramid Pumping Station. The plan also includes the use of the treated water for afforestation projects in the desert. The design treatment capacity of Abu Rawash Wastewater Treatment Plant is one million $m^3$/day in 2000 which will further increase to 2.3 million $m^3$/day by 2010.

In addition to the construction of Abu Rawash Wastewater Treatment Plant, USAID is also providing assistance for the improvement of the so-called lowerstream facilities, including the construction of pumping stations and sewer

trunk lines, leaving the general improvement of the upperstream facilities to the own efforts of the Government of Egypt.

GOSD plans the construction of the Abu Nomros main collector and Sewer Transfer Pump Station No. 5 (B) to improve the sewer service in southern Giza, including the Project Site, in view of the efficient operation of the facilities to be constructed by USAID.

Although the planned completion of the Abu Nomros main collector by GOSD is June, 1993, construction work has not yet started in sections where the technical requirements are beyond the present levels of local technologies because (1) the pipe laying depth is too deep, (2) the soil is too soft and the groundwater level is too high and (3) the construction area is too small and the traffic volume is too large, etc. The work section for which Japanese assistance (Phase 1 Project) has been requested by the Government of Egypt (approximately 1.8km) is this kind of difficult section, requiring the use of advanced technologies. Excluding this section, the Egyptian side has so far completed some 60% of the planned work.

3) Financial Situation of GOSD

The sewer line construction cost is met by central government appropriation and financial assistance provided by foreign countries. 10% of the collected water charge is allocated for sewer line operation and maintenance purposes but is far below the actual expenditure of GOSD. The funding shortfall is met by the central government which finds it difficult to provide the full amount required due to its own tight financial situation. GOSD is currently implementing the System Management Plan with US assistance to review the financial system and other aspects of the organization. Table 2-8 shows the main items for which the necessity for improvement is pointed out by the Plan.

Table 2-8 Planned Organizational Improvement of GOSD

| No. | Improvement Item |
|---|---|
| ① | Legal basis or authority to operate autonomously |
| ② | Manageable organization structure |
| ③ | Adequate facilities to provide services |
| ④ | Sufficient number of qualified and experienced staff |
| ⑤ | Comprehensive training programme |
| ⑥ | Appropriate types and quantities of equipment, tools and consumables |
| ⑦ | Appropriate fund raising system to meet requirements |

Source: GOSD System Management Plan

Among the items listed in Table 2-8, an appropriate funding raising system to meet the requirements is particularly stressed to improve the financial strength of GOSD and 3 measures are pointed out for urgent implementation, i.e., (1) an improved budgeting system for GOSD, (2) an improved water charge system to reflect the wastewater flow discharge and (3) a review of the present water charge system.

As in the case of the water charge referred to in 2.1.1-(2)-3), the Government of Egypt also plans to increase the sewer service charge rate from the present 10% of the water charge to approximately 30% to fundamentally improve the financial situation of the sewer service.

### 2.1.3 Outline of Related Plans

#### (1) National Development Plans

Egypt's current long-term development plan is the Long-Term Perspective Plan which covers the 20 year period from 1983 to 2002 as described in Chapter 1. Table 2-9 shows the basic national development objectives of this Plan.

Table 2-9 Objectives of Long-Term Perspective Plan

| No. | Objectives |
|---|---|
| ① | Establishment of a self-reliant economic system |
| ② | Consolidation of basic infrastructure |
| ③ | Appropriate distribution of population |

Source: Current Egyptian Society and Economy, Associationfor Promotion of International Cooperation in Japan

In order to set concrete targets in line with the objectives listed in Table 2-9, the Government of Egypt prepares and implements 5-year plans. In both the First (1982/83-1986/87) and Second (1987/88-1991/92) Five-year Plans, the highest priority was given to the improvement of the living standard and the increased production capacity of the Egyptian economy by means of improving the public infrastructure and strengthening the energy and construction sectors.

With the completion of the Second Five-year Plan in June, 1992, the Third Five-year Plan (1992/93-1996/97) is on the way to implementation and has already been approved by the Egyptian Parliament. While the Third Five-year Plan basically inherits the main objectives of the Second Five-year Plan, its actual implementation will be led by the private sector rather than the public sector. The announced strategies and targets

upto the present under this novel concept for plan implementation are shown in Table 2-10.

Table 2-10 Strategies and Targets of Third Five-year Plan

| | Item | Description |
|---|---|---|
| Strategies | ① Industrial Development Strategy | import substitution, domestic production of productive goods, provision of subsidies, vitalisation of the public sector, introduction of appropriate technologies, creation of a new agency responsible for the acceptance of technologies |
| | ② Management Strategy | provision of export targets for state corporations, provision of loans, renewal of such top management as members of boards of directors, improved quality control capability and production capacity, salaried employment, preparation of management plans |
| | ③ Marketing Strategy | improved product quality, improved competitiveness, export finance, PR for export promotion measures, active encouragement of inward investment by foreign companies |
| Targets | ① GDP Growth Rate | fiscal 1992 target (July, 1992-June, 1993): 4.0% (131 billion LE)<br>fiscal 1993 onwards: 5.1% (average) |
| | ② Population Plan | present population (July, 1992): 580 million (including 2.1 million living abroad)<br>final year (1996/97) target: 650 million (to contain the annual growth rate to 2.3%) |
| | ③ Workforce (Increased Employment) | present workforce: 13.9 million (5.3 million in state/public sector)<br>final year (1996/97) target: 24.5 million |
| | ④ Investment | total amount (5 years): 154 billion LE<br>private sector: 89.5 billion LE (58%) |

In the water supply and sewer service sector, the improvement targets and policies adopted by the Second Five-year Plan have been inherited by the Third Five-year Plan. The targets and policies of the Second Five-year Plan are given in Table 2-11 and Table 2-12 respectively.

Sewer system improvement under the Project, i.e., the Sewer Transfer Pump Station No. 5 (B) Construction Plan, is included in the list of projects to be implemented under the Third Five-year Plan. Similarly, water supply system improvement under the Project (the South Giza Waterworks Expansion Plan and Water Supply Trunk Line Construction Plan) are compatible with the targets set by the Second Five-year Plan.

Table 2-11 Improvement Targets for Water Supply and Sewer Services Under Second Five-year Plan

| Service | Targets |
|---|---|
| Water Supply | Increase of potable water from 8.6 million $m^3$/day to 12.4 million $m^3$/day at the end of the plan (including improved capacity in Greater Cairo Region from 3.4 million $m^3$/day to 5.3 million $m^3$/day) |
| Sewers | Wastewater drainage capacities must be increased to meet the potable water production expansion |

Source: Second Five-year Plan

Table 2-12 Policies for Water Supply and Sewer Service Sectors Under Second Five-year Plan

| No. | Policy | Relevance | |
|---|---|---|---|
| | | Water Supply | Sewers |
| ① | Conservation of water use, restriction of losses and study of the application of progressive pricing to water consumption | ○ | – |
| ② | Upgrading of the manufacture of plumbing fixtures to ensure their conformation to international standards | ○ | ○ |
| ③ | To make the greatest possible use of non-traditional methods to supply potable water to areas lacking potable water by use of artesian wells where possible and portable filtration stations | ○ | – |
| ④ | Coordination and integration of water and sewage projects in accordance with urban plans | ○ | ○ |
| ⑤ | Supply of trained manpower for water and sewage utilities | ○ | ○ |

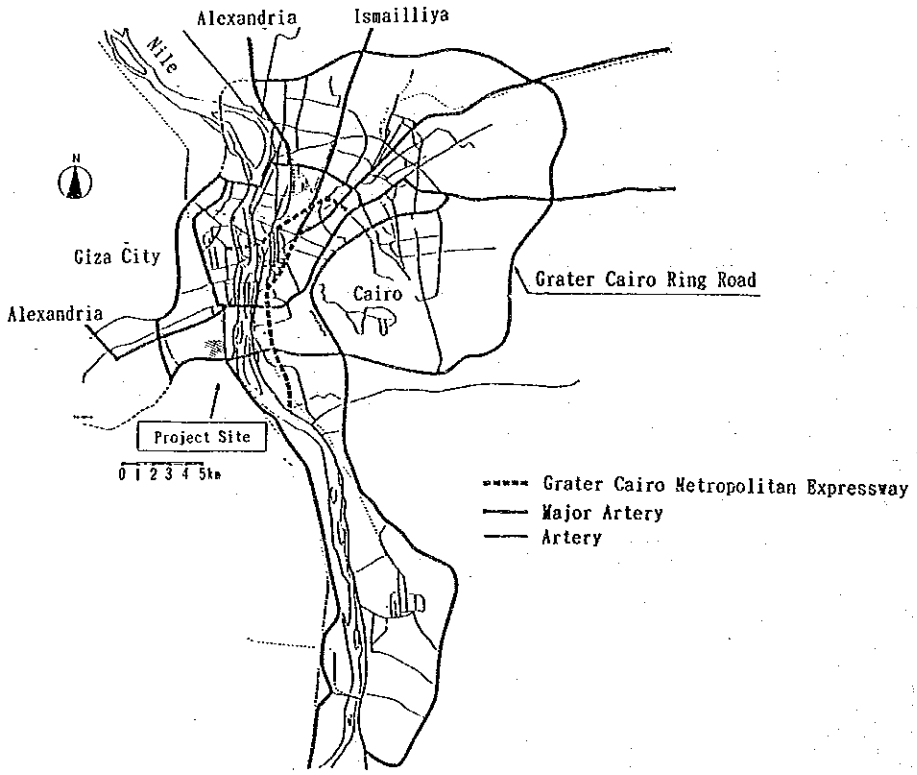
Source: Second Five-year Plan

(2) Regional Development Plans

There are 2 main urban development plans with a target yet of 2000 for the Greater Cairo Region, i.e., the Greater Cairo Region Long Range Urban Development Scheme and the Greater Cairo Region Transportation Master Plan Study. The former was prepared in 1982 with the main objectives being the appropriate distribution of the population and improvement of the transportation network. The latter was prepared between 1987 and 1989 with Japanese technical cooperation as part of the former and proposed the construction of a ring road connecting the main areas of the Greater Cairo

Region as a priority project to consolidate the public infrastructure in order to support economic development in the Region.

Monib District is included in the proposed route for the ring road and is expected to show much development in the future. Fig. 2-7 shows the proposed route for the Greater Cairo Region Ring Road.




( Source : Grater Cairo Region Transportation Masterplan Study )

Fig. 2-7 Proposed Route for Greater Cairo Region Ring Road to be Completed by 2000

(3) Development Plans in Water Supply and Sewer Service Sectors

1) Outline of Water Supply Development Plans and Status of the Project

As described in 2.1.1-(2), several water supply development plans for the Greater Cairo Region, including Giza City in which the Project Site is located, have been prepared over the years with foreign assistance and some plans are indeed underway. Table 2-13 shows the planned completion date of these plans, the subject areas and assisting countries.

Table 2-13 List of Water Supply Improvement Plans for Greater Cairo Region

| Year of Planning Completion | Subject Area | Assisting Country | Description |
|---|---|---|---|
| 1979 | Greater Cairo Region | U.S. | Master plan for water supply improvement in Greater Cairo Region and basis for all future plans, including the Project (for Monib District) |
| 1980 | Cairo and Part of Giza | Japan | Water supply improvement for Cairo and part of Giza City in 3 phases. First 2 phases completed with Japanese assistance |
| 1987 | Giza | Germany | Water supply improvement master plan for Giza City based on Master Plan in 1979 (Study of water supply in Giza City) |
| 1990 | Cairo | U.S. | Water supply improvement master plan for Cairo based on Master Plan in 1979 |

Source: Greater Cairo Region Transportation Master Plan Study

Water supply improvement in Giza City is being conducted in accordance with the relevant master plan prepared by Germany and the Project will be part of this master plan as shown in Fig. 2-8.

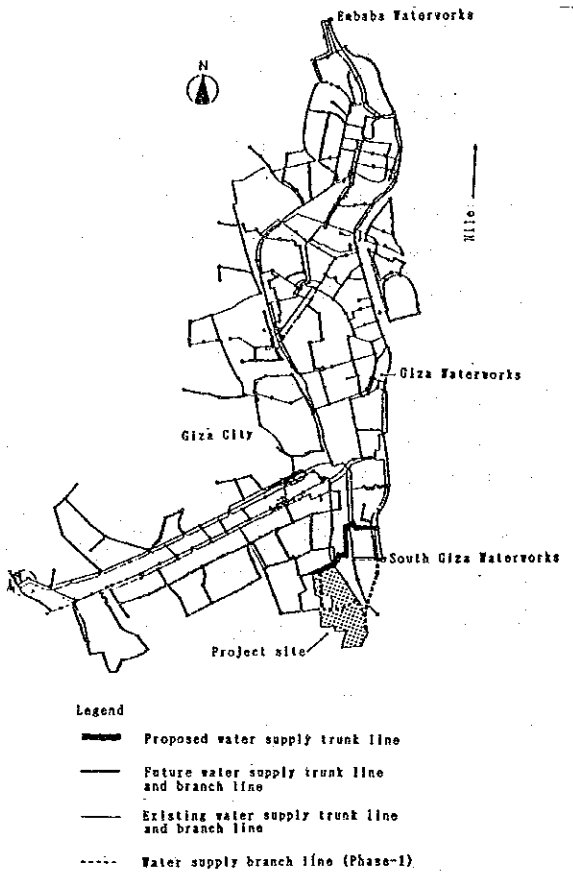



Fig. 2-8 Giza Water Supply Improvement Master Plan and the Project

2) Outline of Sewer Development Plans and Status of the Project

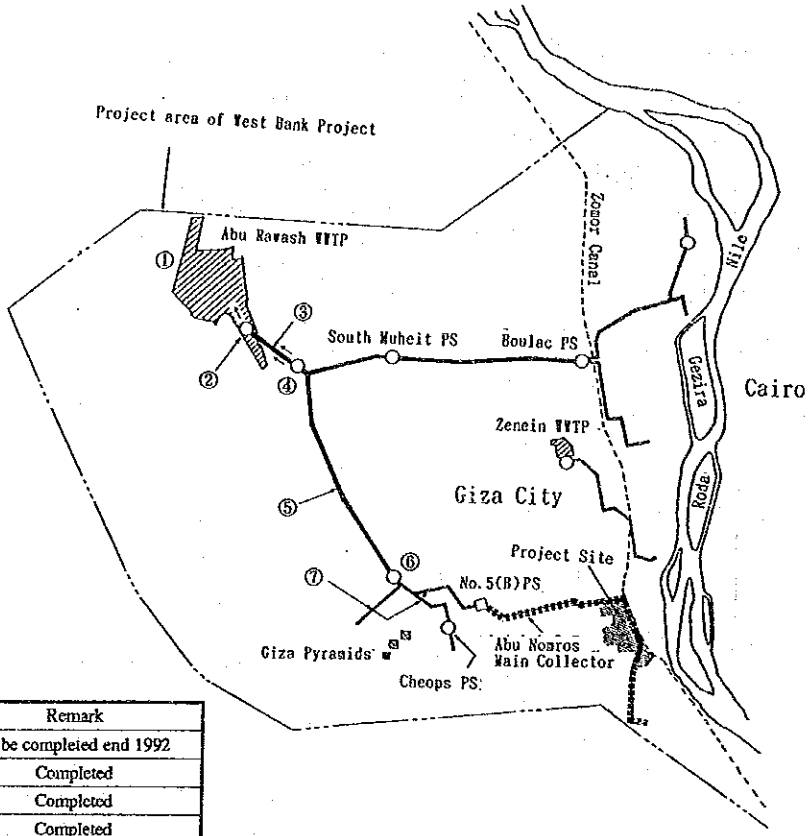
The history of sewer improvement planning for the Greater Cairo Region commenced with the preparation of the Greater Cairo Wastewater Master Plan by a British consultant in 1978 using the Arab Fund for Economic and Social Development. Later, a joint venture formed by 4 consultants from the US and Britain revised the said Master Plan in 1981 with the financial assistance of these 2 countries. Sewer improvement projects are currently being implemented in the East Bank area of the Nile, i.e., Cairo side, with British and Italian assistance and in the West Bank area, i.e., Giza side, with US assistance in line with the objectives set by the Revised Master Plan. Table 2-14 shows the history of sewer improvements projects for the Greater Cairo Region.

Table 2-14 History of Sewer Improvement Projects for Greater Cairo Region

| Year of Planning Completion | Subject Area | Assisting Country | Description |
|---|---|---|---|
| 1978 | Greater Cairo | British | Greater Cairo Wastewater Master Plan prepared by a British consultant using the Arab Fund for Economic and Social Development |
| 1981 | ditto | U.S. and British | Revised Master Plan prepared by a joint venture (AMBRIC) formed by 4 consultants from the U.S. and Britain in cooperation with an Egyptian consultant |
| 1983 | ditto | ditto | Greater Cairo Region Sewer Improvement Project started with the rehabilitation of existing facilities |
| 1984 | ditto (East Bank Area) | British | Greater Cairo East Bank Project started with British assistance (to be completed by the end of 1994) |
| 1985 | ditto (West Bank Area) | U.S. | Greater Cairo Wastewater Project (for west bank of the Nile) started with U.S. assistance (to be completed by mid-1994) |

Source: Greater Cairo Wastewater Master, Review Statement

The Project Site is part of Giza City on the west bank of the Nile and is included in the subject area of the US-assisted Greater Cairo Wastewater Project. Although this project aims at the construction of main lowerstream facilities, such as wastewater treatment plants, sewer trunk lines and pumping stations, it does not include sewer improvement in southern Giza, including Monib District. Nevertheless, Monib District is part of the sewer service area of the project and sewage in Monib District is taken into consideration in the design capacities of the above lowerstream facilities. Fig. 2-9 shows the relationship between the Greater Cairo Wastewater Project and the Project and also the construction schedule of the former.




| | Project | Remark |
|---|---|---|
| ① | Abu Rawash WWTP | to be completed end 1992 |
| ② | Inlet Pump Station | Completed |
| ③ | Boulac - Abu Rawash culvert | Completed |
| ④ | Junction Pump Station | Completed |
| ⑤ | Pyramids culvert | Completed |
| ⑥ | Pyramids Pump Station | Completed |
| ⑦ | Pyramids collector | to be completed by March 1993 |

Fig. 2-9 Greater Cairo Wastewater Project and Project

## 2.2 Outline of the Request

### 2.2.1 Background of the Request

Giza City in Giza Governorate is located on the opposite bank of the Nile to Cairo. The public infrastructure of the city is much poorer than that of Cairo. Monib District which currently has a population of some 133,000 is particularly poor in terms of the provision of public infrastructure as the area has not been included in urban development plans.

Although a master plan for water supply improvement in Giza City has been prepared with (West) German assistance, implementation has hardly commenced due to the lack of funds.

In the sewer service sector, the Revised Greater Cairo Wastewater Master Plan covering the Giza City area has been prepared by US and British consultants. In accordance with this Master Plan, the construction of main lowerstream facilities (wastewater treatment plants, sewer trunk lines and main pumping stations) is in progress under the Greater Cairo Wastewater Project with grant aid provided by USAID. However, improvement of the upperstream facilities has been left to the own efforts of the Government of Egypt.

While the Government of Egypt aims at achieving the gradual improvement of the water supply and sewer services in Giza City in accordance with these plans, it has been obliged to make requests to foreign governments, including the Government of Japan, for the provision of financial assistance due to the lack of its own funds. In response to such request, the Government of Japan provided grant aid cooperation for the Project for Omrania West Water Supply and Sewer Upgrading from 1988 to 1991 in the neighbouring area of Monib District and then conducted the Basic Design Study for the Phase 1 Project in June, 1992.

The planned water supply improvement under the Phase 1 Project is the establishment of water supply routes to both inhabitants and public facilities in the Project Site by means of an improved water distribution network with the result of increasing the current water supply volume of 10-20 litres/person/day to some 70 litres/person/day. Nevertheless, as the water supply capacity of the existing waterworks in Giza City can only meet some 70% of the required supply volume, achievement of the target supply volume of 140 litres/person/day is impossible. Facing this water supply shortage, the Government of Egypt has prepared South Giza Waterworks Upgrading Plan to increase the design water supply volume by 35,000$m^3$/day to secure the necessary level of water supply to the Project Site and has also prepared the Water Supply Trunk Link Construction Plan to guarantee a stable supply of water.

With regard to improvement of the sewer system, as the implementation of South Giza Waterworks Upgrading Plan means an increased volume of sewage generated in the Project Site beyond the transfer capacity of the existing sewage pumping stations, the construction of a new pumping station is necessary to establish appropriate drainage routes for the swift flow of sewage to wastewater treatment plants. Consequently, the Government of Egypt has prepared the plan to construct the Sewer Transfer Pump Station No. 5 (B).

The Government of Egypt has subsequently made a request to Japan for the provision of grant aid for the construction of the facilities mentioned above as part of the Project for Water Supply and Sewer System Upgrading in Monib, Giza City (Phase 2).

### 2.2.2 Contents of the Request

The contents of the Egyptian request for the Project, confirmed through discussions with the Egyptian side, are shown in Table 2-15 (also see Appendix 4).

Table 2-15 Contents of Egyptian Request

| Requested Item | Description |
|---|---|
| (Water Supply Facilities) | |
| ① Expansion of South Giza Waterworks | design water supply capacity: 35,000m³/day (max.) |
| ② Construction of Water Supply Trunk Line | diameter: 1,200mm and approx. 2.4km in length |
| (Sewer Facilities) | |
| ③ Construction of Sewer Transfer Pump Station No. 5 (B) | design pumping volume: 1,650 litres/sec./pump × 3 pumps (building plan incorporates space to allow the installation of an additional pump in the future) |
| (Others) | |
| ④ Services necessary for construction mentioned in ① ~ ③ and for detailed design thereof | 1 lot |

## 2.3 Outline of Project Site

### 2.3.1 Location and Socioeconomic Conditions of Project Site

#### (1) Location

Monib District, i.e., the Project Site, is located in south Giza and is immediately to the south of Omrania West where a project to improve the water supply and sewer facilities was completed with Japanese grant aid in March, 1991. A trunk road connecting Cairo to the Pyramids runs a few kilometres to the north of the Project Site. With Cairo on the opposite side of the Nile being a distance of only some 10km, the Project Site forms part of the Greater Cairo Region.

The Project consists of South Giza Waterworks Upgrading Plan, the Sewer Tranfer Pump Station No. 5 (B) Construction Plan and the Water Supply Trunk Line

Construction Plan, all of which will serve the Project Site. The relative locations of the Construction Sites of the Project to Monib District are shown on the Project Location Map and also described in Table 2-16 below.

Table 2-16 Relative Locations of Construction Sites of the Project to Monib District

| Construction Site | Relative Location to Monib District |
|---|---|
| South Giza Waterworks | Located along the west bank of the Nile some 1.3km east of the northern end of Monib District. The Nile in front of the site is divided into 2 streams by Dahabu Island. |
| Sewer Tranfer Pump Station No. 5 (B) | Located some 3.5km west of the northern end of Monib District near the Pyramids some 5.5km distance from the Nile. |
| Water Supply Trunk Line Route | Links the northern end of Monib District and South Giza Waterworks |

(2) Socioeconomic Conditions

The Project Site is a newly emerging residential area with a population which has been rapidly increasing in recent years to take advantage of the facts that the distance to central Giza is as short as some 4km and that the commuting time to Cairo will be drastically reduced with the completion of the ring road, the construction of which is currently in progress (see 2.1.3-(2)).

The prominent industry is commerce, mainly retailing. The Project Site is currently best described as a residential-cum-commercial area with no large factories. The residential area in Monib District is divided into 4 blocks by main roads. The sprawl of housing areas in the Project Site in the last 20 years is shown in Fig. 2-10.

Of these 4 blocks, an increasing concentration of housing is particularly noticeable in Block A in the north of the Project Site bordering Omrania West and Block C which is at the centre of the Project Site and which is a commercial area with many retail shops. Much of the housing in these 2 blocks, in fact, consists of 6-10 storey buildings, resulting in a particularly high population density. In comparison, the speed of housing development is rather slow in Blocks B and D although the number of houses has been steadily increasing in both blocks in the last 20 years. Table 2-17 gives the characteristics of each block.

The Project Site is known among the districts of Giza for its concentration of low income families. The high population density and the slow progress of the

improvement of the public infrastructure, including water supply and sewer facilities, have contributed to the creation of inferior living conditions. The health environment of the local inhabitants is particularly poor and demands the urgent improvement of both the general living and health standards through the construction of water supply and sewer facilities, both of which are essential integral parts of the public infrastructure. Table 2-18 shows the land size, present population and estimated future population in the year 2010 of the Project Site.

Table 2-17 Characteristics of Housing in Project Site

| Block | Area | Description |
|---|---|---|
| A | North of Dr.Mohamed Fouad Sahed Street | Northernmost part of the Project Site bordering Omrania West. Housing development has been particularly progressing in the last 20 years with many high-rise (6-10 storey) apartment buildings. |
| B | Area between Mohamed Fouad Sahed Street and Terra Nirsa Street | A macaroni factory at the centre of the block is the largest factory in the Project Site and acts as the block's symbol. Housing development conducted with the construction of the factory but slow in progress compared to Block A and Block C. Much farmland still remains in the midst of the residential area. |
| C | Area between Terra Nirsa Street and Monib Street | Commercial centre of the Project Site with many new high-rise apartments together with old houses. Most buildings are 6-10 storeys high and the population density has almost reached saturation point. |
| D | South of Monib Street | Southernmost part of the Project Site with much farmland. Housing development is in progress although slower than in Block A and Block C. The remaining farmland will gradually become residential areas. |

Table 2-18 Size and Population of Project Site

| Item | Figure |
|---|---|
| Area | 185ha |
| Present Population (1990) | approx. 133,000 (population density: 718 persons/ha) |
| Estimated Future Population (2010) | approx. 247,000 (population density: 1,335 persons/ha) |

Source: Giza City

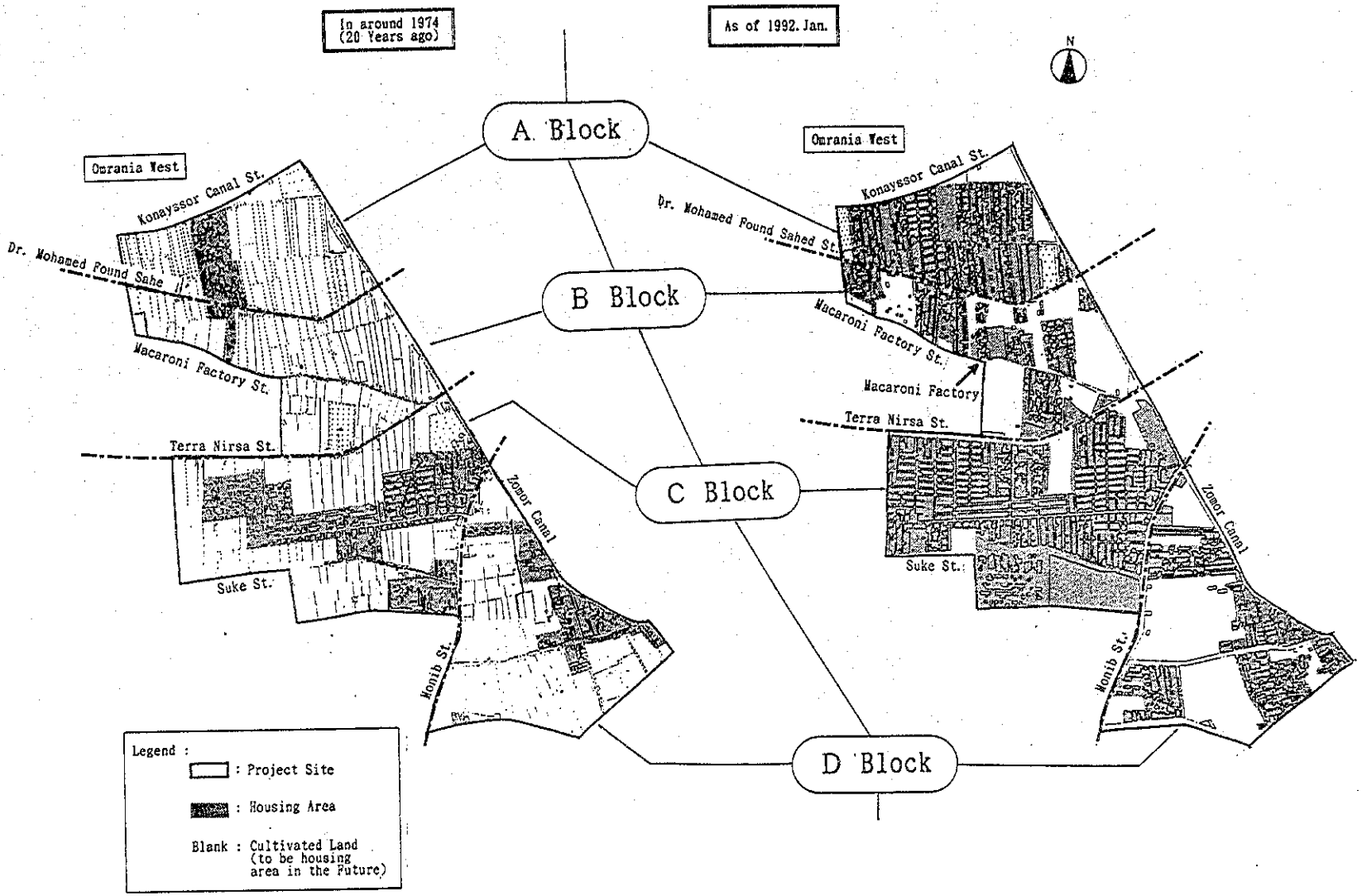



Fig. 2-10 Recent Development of Residential Areas in Project Site

### 2.3.2 Natural Conditions

#### (1) Topography and Geology

The Greater Cairo Region is situated at the southern end of the Nile Delta and is surrounded by hills of some 200m above sea-level.

Monib District and South Giza Waterworks site are located in south Giza on the west bank of the Nile and generally consist of flat land. According to existing geological survey data, shown in Table 2-19 the soil characteristics of South Giza Waterworks site are silty clay upto a depth of 6m, sand between a depth of 6m and 10m and sand with small gravels or sand between a depth of 10m and 30m, indicating the direct influence of the Nile. At the Sewer Tranfer Pump Station No. 5 (B) site which is located inland at a distance of some 5.5km from the Nile, silty clay is found upto a depth of some 7m with a sand layer beneath. The soil in Monib District is mainly silty clay or sand with few large cobble stones or gravels.

Table 2-19 Soil in Project Site

| Site | Distance from Nile | Characteristics |
|---|---|---|
| South Giza Waterworks | approx. 30 ~ 100m | upto approx.-5 ~ 6m GL : silty clay<br>-6m GL ~ -10m GL : sand<br>-10m GL ~ -17m GL : sand with small gravels<br>-17m GL ~ -30m GL : sand |
| Monib District General (including Water Supply Trunk Line Route Areas) | approx. 1 ~ 1.8km | upto -1.5m GL ~ -2.5m GL : clay containing limestone and red brick<br>-2.5m GL ~ -15m GL : intricated deposit formation of silty clay layers and sand layers |
| Sewer Tranfer Pump Station No. 5 (B) | approx. 5.5km | upto -7m GL : silty clay<br>-7m GL ~ -33m GL : sand |

#### (2) Groundwater Level

Existing survey data indicate that the groundwater level fluctuates because of changes in the water level of the Nile, seepage from the canal and wells and leakage from both the water supply and sewer networks, reaching its highest level in December and lowest level in July and August. The groundwater level in the Project Site is generally 1-3m below ground level.

(3) Weather

Statistical data for the last 20 years show that the mean annual temperature in the Greater Cairo Region is approximately 21.8°C and that the mean temperature in winter (November-March) is approximately 16°C. While the mean annual temperature in summer (May-September) is approximately 27°C, the maximum temperature may well reach 40°C-45°C with a large temperature difference between day and night.

The mean annual rainfall in areas along the Mediterranean coast is some 190mm and only a mere 25mm in the Greater Cairo Region. Rain sometimes takes the form of a localised downpour, causing damage. The humidity is very low with mean annual humidity of approximately 53%. The lowest humidity of approximately 40% is recorded in May while the highest humidity of approximately 62% is recorded in November.

Sandstorms called Hamseen occasionally sweep across the Greater Cairo Region from the west in March and April. The wind speed is an average of some 9 m/s. Mist occurs in the Greater Cairo Region on some 11 days a year, mainly in early spring and early summer.

(4) Hydrology of the Nile

1) Water Level and Discharge

The width of the Nile in the Greater Cairo Region is as wide as several hundred meters and the water level is almost constant throughout the year, controlled by the Aswan Dam in the upperstream, with a maximum annual water level fluctuation of some 2.7m. Data on the Nile's water level at South Giza Waterworks, provided by GCWSA for the Project, are given in Table 2-20.

Table 2-20 Nile's Water Level at South Giza Waterworks

| | Water Level |
|---|---|
| HWL | AD + 17.92m |
| MWL | AD + 17.21m |
| LWL | AD + 15.18m |

Note: AD = Standard tide level at Port Alexandria.
Source: GCWSA

The discharge of the Nile, i.e., the outflow from the Aswan Dam, is also constant, indicating a similar discharge level for the last 6 years (1984/85-1989/90) as shown in Table 2-21.

Table 2-21 Discharge of the Nile

(Unit: million $m^3$)

| Year | 1984/85 | 1985/86 | 1986/87 | 1987/88 | 1988/89 | 1989/90 |
|---|---|---|---|---|---|---|
| Discharge of the Nile (Outflow from Aswan Dam) | 56,300 | 55,500 | 55,300 | 52,900 | 53,300 | 54,000 |

Source: "Current Conditions of Environmental Problems in Egypt", Study Group on Egyptian Environmental Problems, JICA

2) Water Quality

According to the "Current Conditions of Environmental Problems in Egypt", a report issued by the Study Group on Egyptian Environmental Problems, JICA, the water quality of the Nile has been deteriorating in recent years because of the drainage of industrial, agricultural and domestic wastewater into the Nile. This trend was undoubtedly observed with changes in the BOD data collected during the water quality survey period from 1984 to 1986. The water quality deteriorated during this period at all the sampling sites as shown in Fig. 2-11.

The water quality test data for South Giza Waterworks for the last 5 years indicate the propagation of algae throughout the year with the average microbe count as high as 3,700-5,700 counts/ml. The turbidity value of 5-10 is also high which is further evidence of the water quality deterioration of the Nile. Changes in the microbe count of the Nile at the inlet of South Giza Waterworks are shown in Fig. 2-12 while the changes in turbidity are shown in Fig. 2-13.

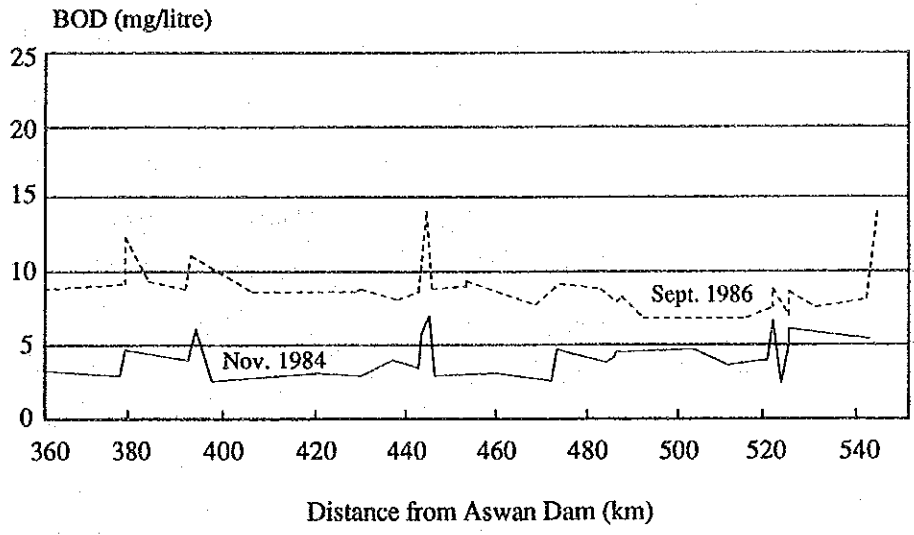



Fig. 2-11 BOD Changes in the Nile

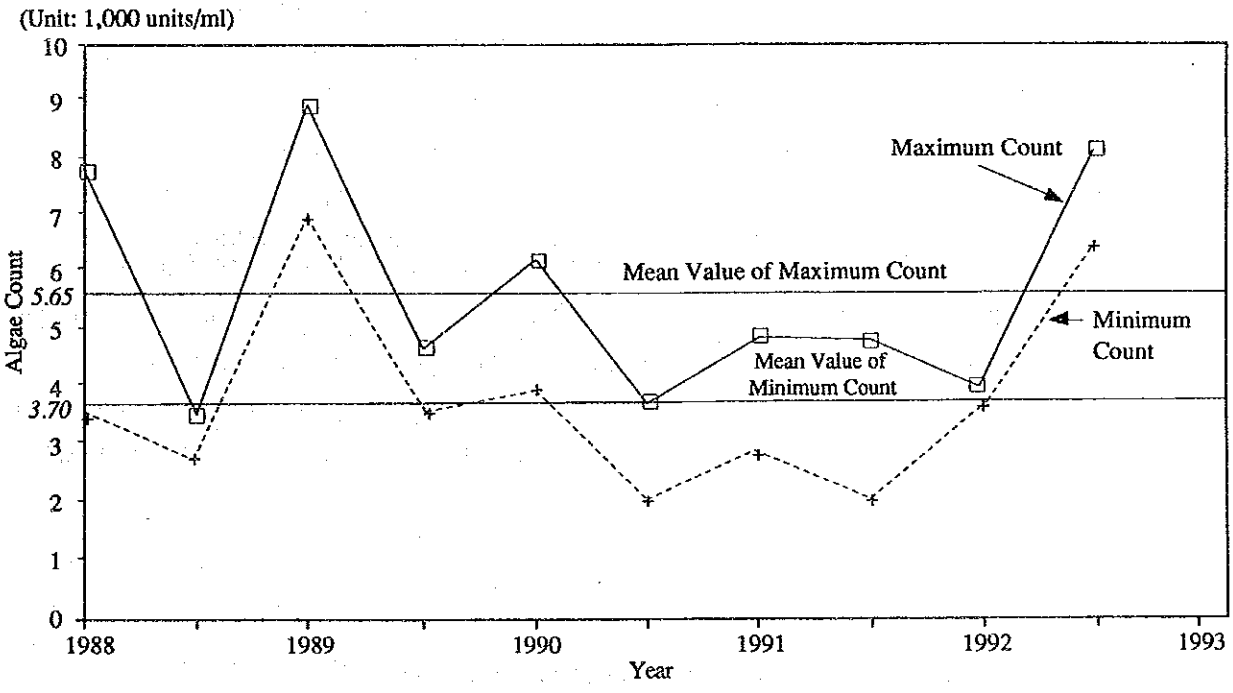



Fig. 2-12 Changes in Algae Count of the Nile at Inlet of South Giza Waterworks

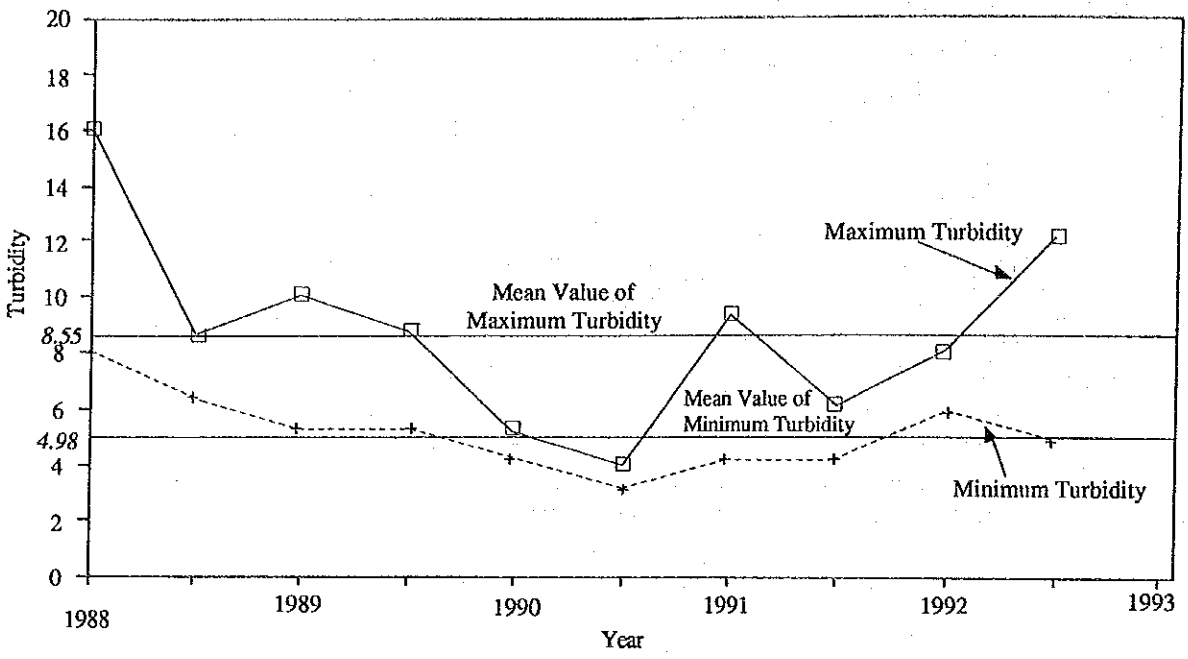



Fig. 2-13 Changes in Turbidity of the Nile at Inlet of South Giza Waterworks

### 2.3.3 Social Conditions

#### (1) Conditions of Public Infrastructure

##### 1) Ports

Port Alexandria is generally used for the unloading of construction equipment and materials from Japan. In addition to Port Alexandria, Port Suez and Port Said are also available. As Port Alexandria is a free port, many regular Japanese liners call at the port. In view of the availability of excellent unloading facilities, making a long wait for unloading unnecessary, Port Alexandria provides the convenience required for the Project.

##### 2) Roads

###### a) Roads Between Port Alexandria and Project Site

Port Alexandria is located at the western corner of the Nile Delta and 2 trunk roads, locally called Desert Road and Agriculture Road, connect the port with the Project Site. Of these 2 roads, desert road is usually used for the transportation of construction equipment and materials because of the following characteristics.

- The road width and median strip are wider than those of Agriculture Road.
- The distance is shorter by several tens of kilometres.
- The traffic volume is smaller.
- The road does not have any flyovers or bridges.
- The road has very few intersections with branch roads and seldom passes through populated areas.
- The road is well paved.
- There is little danger of people, cattle or donkeys crossing the road.

b) Roads Around Project Site

Pyramid Street and King Fisal Street, the main trunk roads in the Greater Cairo Region, run to the north of the Project Site and these trunk roads are the arteries from central Cairo to other major urban centres. Although the traffic on these roads is heavy, it runs smoothly except during the morning and evening rush hours because of the wide width of the roads (9-11m in each direction) and well maintained asphalt paving. These trunk roads and the Project Site are connected by El Kasabgy Street, El Cornesh Street, Monib Street and Osman Moharam Street, etc. Of these, El Cornesh Street, which runs from the South Giza Waterworks to the Project Site, has a width of 30m and is a particularly busy road. Traffic congestion at Monib Square where El Cornesh Street crosses the Cairo-Aswan railway line is hectic during the rush hours with buses, passenger vehicles and horse-carts vying to get through.

c) Roads in Project Site and Surrounding Areas

The locations and widths of the roads in the Project Site are given in Fig. 2-14 and Table 2-22 respectively.

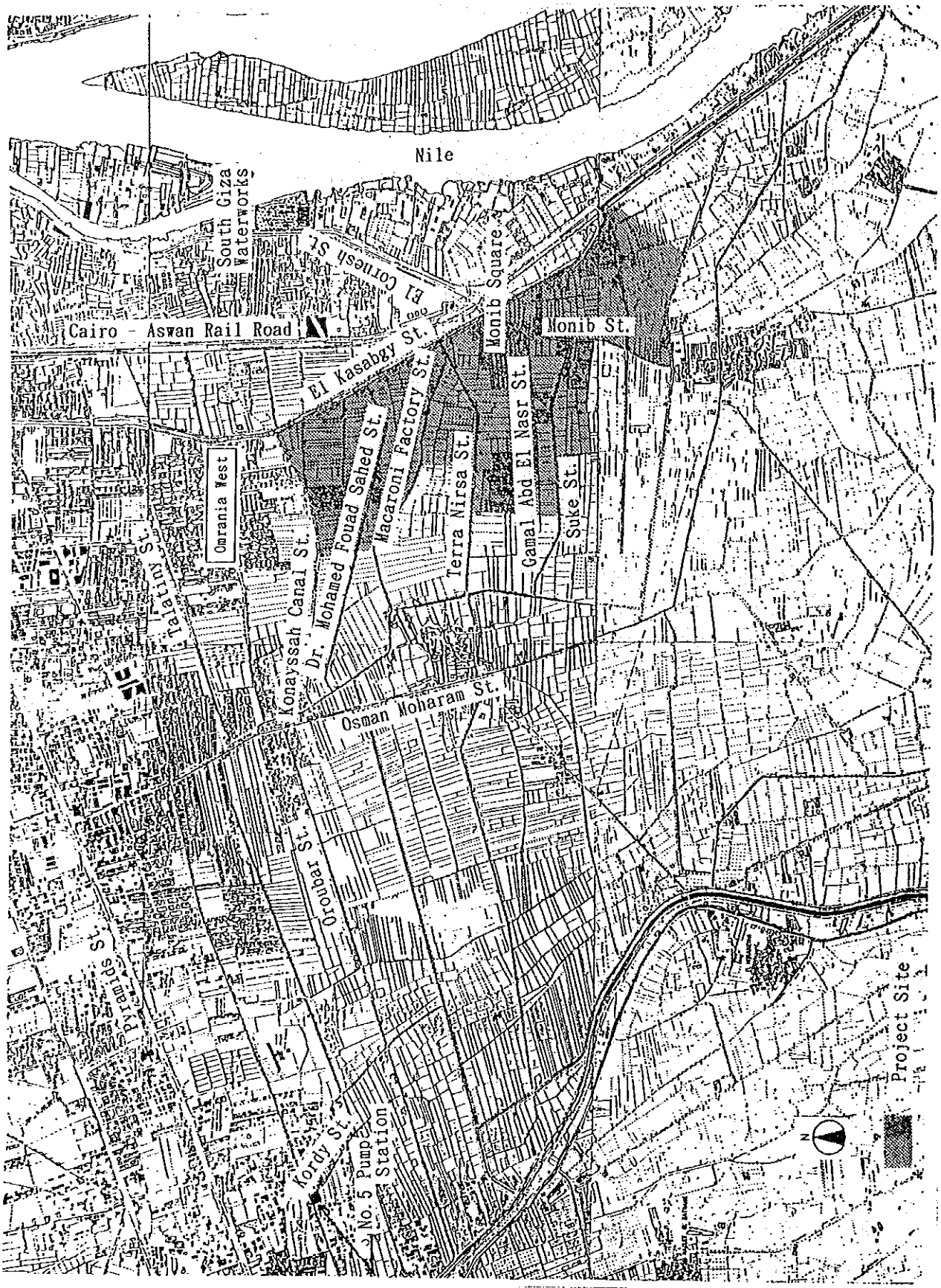



Fig. 2-14 Road Locations in Project Site

Table 2-22 Road Widths in Project Site

| Road | Width |
|---|---|
| El Cornesh Street | approx. 30m |
| Cairo-Aswan Street | approx. 26m |
| Madba Street | approx. 15m |
| 6th October Street | approx. 10m |
| Coldair Street | approx. 8m |
| Sadi Amar Street | approx. 15m |
| El Kasabgy Street | 9-12m |
| Konayssah Canal Street | approx. 12m |
| Fouad Sahed Street | 3-4m |
| Terra Nirsa Street | 8-10m |
| Suke Street | 10-15m |
| Monib Street | 15-20m |

Cairo-Aswan Street which runs north-south parallel to the Cairo-Aswan Railway line between Monib District and South Giza Waterworks is one of Egypt's major trunk roads, linking Cairo and the Aswan Region. It has a width of some 26m and has large heavy vehicle traffic consisting of lorries and buses.

El Cornesh Street which also runs north-south to the west of South Giza Waterworks has an ample road width of approximately 30m. The area between El Cornesh Street and Cairo-Aswan Street is densely populated with numerous narrow side streets of 3-4m wide running through this residential area.

3) Railways

a) The Cairo-Aswan Railway line runs north-south parallel to El Kasabgy Street to the east of the Project Site. The water supply branch line (diameter: 300-600mm) planned under the Project will be laid across this railway line which consists of double tracks (approximately 16m wide) at the planned crossing point as shown in Fig. 2-15. The track bed is slightly above the road on either side.

b) Trains are pulled by diesel engines but do not run at high speed near the Project Site. The train load appears comparable to that of Japan Railways.

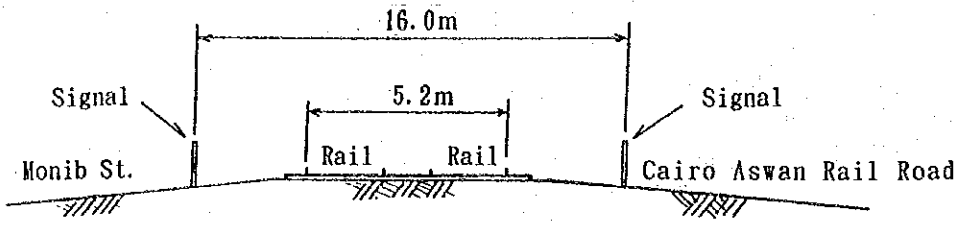



Fig. 2-15 Cross-Section of Railway Line

4) Canals

a) The Zomor Canal runs to the east of the Project Site and supplies irrigation water to farmland on the outskirts of Giza on the west bank of the Nile. The canal is the dug-in type and has hardly an man-made slope protection works on either bank.

b) The cross-section of the Zomor Canal near the Project Site is shown in Fig. 2-16. It usually dries up from mid-January to mid-February due to the lowering of the water level of the Nile, providing the opportunity for canal improvement work. The water quality is poor due to contamination by sewage and rubbish and the BOD values observed during the field survey at several sampling sites, including one near Monib Square, were generally 4-5ppm.

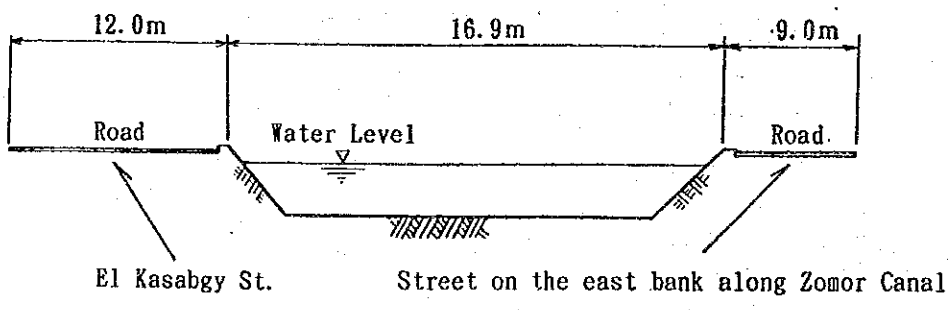



Fig. 2-16 Cross-Section of Zomor Canal

5) Power Supply and Telephone Lines

a) Power Supply Lines

There is no special high voltage transmission line exceeding 33KV in the Project Site. Instead, high voltage distribution lines of 10.5KV and low voltage distribution lines of 380-220V are directly buried below the ground to form the power supply network. These lines are usually buried under the road at a distance of some 0.8m from the end of the house. The burying depth is deeper than 80cm for high voltage cables (10.5KV) and deeper than 50cm for low voltage cables (380-220V).

There is no special protection for cables buried below ordinary roads. Conduit pipes are used at sections where cables cross trunk roads. In the case of high voltage cables recently buried, a sheet indicating the cable location may have also been buried above the cables. The types of power cables and burying methods in the Project Site are shown in Table 2-23.

Table 2-23 Power Cables in Project Site

| Type | Voltage | Cable Type | Burying Method and Depth |
|---|---|---|---|
| High Voltage | 10.5KV<br>3-phase<br>3-wire | armoured cable for direct burying | Direct Burying:<br>- standard road section<br>min. earth cover: 0.8m<br>- trunk road crossing section<br>max. earth cover: 2.0m |
| Low Voltage | 380/220V<br>3-phase<br>4-wire | as above | Direct Burying:<br>min. earth cover: 0.5m<br>max. earth cover: 2.0m |

b) Telephone Lines

Telephone lines in the Project Site are directly buried, forming an extensive network. The important trunk line is buried at a depth of approximately 2m and a width of approximately 1m along the east bank of the Zomor Canal, possibly affecting the work under the Project to construct a water supply trunk line near the crossing point of the Zomor Canal. Therefore, it will be necessary to introduce a siphon culvert or similar.

6) Hospitals

There are 3 small hospitals in the Project Site. The El Monib Special Hospital, the largest, has only some 30 beds. The hospital locations and sizes in terms of the available number of beds are given in Fig. 2-16 and Table 2-24 respectively.

Table 2-24 Hospitals in Project Site

(as of December, 1991)

| Name | Number of Beds |
|---|---|
| El Monib Hospital | about 20 |
| El Monib Special Hospital | about 30 |
| El Gamih Hospital | about 15 |

Source: Giza City

The water supply and sewer services of these hospitals are outlined below.

Water Supply Facilities

- El Monib and El Monib Special Hospitals: potable water from public taps
- El Gamih Hospital: groundwater from private wells

Sewer Facilities

- Discharge of wastewater to cesspits for ground infiltration due to absence of public sewer facilities

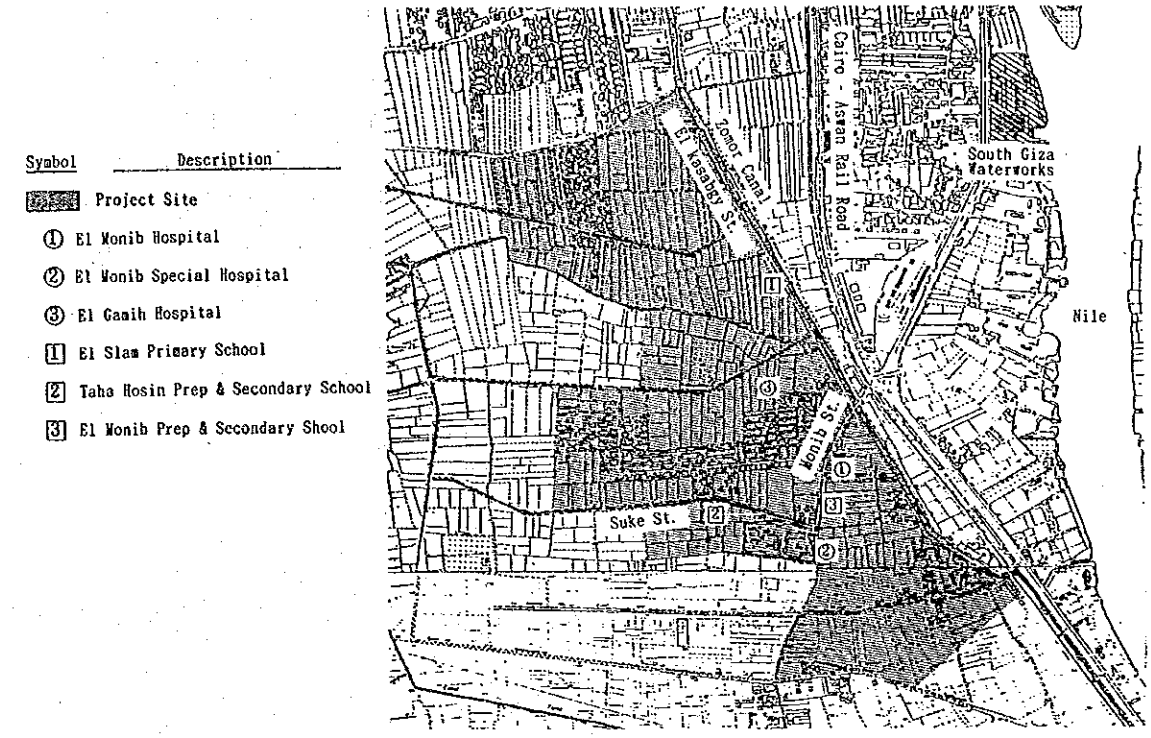
7) Schools

There is one primary school and 2 secondary schools in the Project Site, all of which are located on either El Kasabgy Street or Suke Street, the main roads in the Project Site. The school locations and number of students are given in Fig. 2-17 and Table 2-25 respectively.

Table 2-25 Schools and Number of Students in Project Site

| Name | Number of Students |
|---|---|
| El Slam Primary School | approximately 2,000 |
| Taha Hosin Prep and Secondary School | approximately 3,000 |
| El Monib Prep and Secondary School | approximately 9,000 |

Source: Giza City




( Source : Giza City )

Fig. 2-17 Locations of Hospitals and Schools in Project Site

The largest school in terms of the number of students is El Monib Secondary School with some 9,000 students which is rather disproportionately large for the population of the Project Site, suggesting that students also travel from neighbouring areas. The water supply and sewer services of these schools are outlined below.

Water Supply Facilities

- Potable water from public taps

Sewer Facilities

- Discharge of wastewater to cesspits for ground infiltration due to absence of public sewer facilities

(2) Buildings and Living Environment

Most buildings in the Project Site are 4-10 storeys high. While reinforced concrete is used for columns, beams and slabs, bricks are used for walls, suggesting inadequate resistance to vibration, external impact and deformation, etc. Based on the observation results of new buildings under construction, foundations are mat foundations which may lack adequate bearing capacity.

Local inhabitants live among sheep and chickens, etc. The illegal dumping of solid waste onto roads and empty land and the overflow of sewage from cesspits in some areas generally create poor sanitary conditions.

2.3.4 Outline of Water Supply and Sewer Services

2.3.4.1 Water Supply Facilities

The planned water supply improvement work in the Project Site will be part of the overall water supply improvement work for the west bank of the Nile as described earlier (see 2.1.1).

(1) Current Conditions of Water Supply Facilities in Project Site

At present, water supply branch lines (both large and small diameter pipes) cover part of the Project Site using South Giza Waterworks as the supply source. Only a small number of households along these existing lines receive direct water supply and account for only some 5% of the total number of households in the Project Site. Most local inhabitants obtain water from public taps, travelling water wagons and wells. The area is, therefore, suffering from a chronic domestic water shortage. The existing water supply lines in the Project Site are shown in Fig. 2-18.

The current conditions and problems of water supply facilities in the Project Site are summarised below.

1) There are no public water supply facilities in the Project Site apart from those near El Kasabgy Street and Monib Street.

2) The number of public taps along El Kasabgy Street and Monib Street is limited.

3) Some local inhabitants have wells at their own expense to draw groundwater. As these wells are rather shallow (5-6m deep), the well water tends to be contaminated by seepage water from cesspits, resulting in unsanitary conditions for those using groundwater.

4) Many local inhabitants are obliged to collect a limited volume of domestic water (10-20 litres/person/day) using buckets from public taps located far from their homes in apartment buildings (4-10 storey buildings). This heavy work is usually the duty of women and children.

5) The provision of few fire hydrants means a high risk of fire.

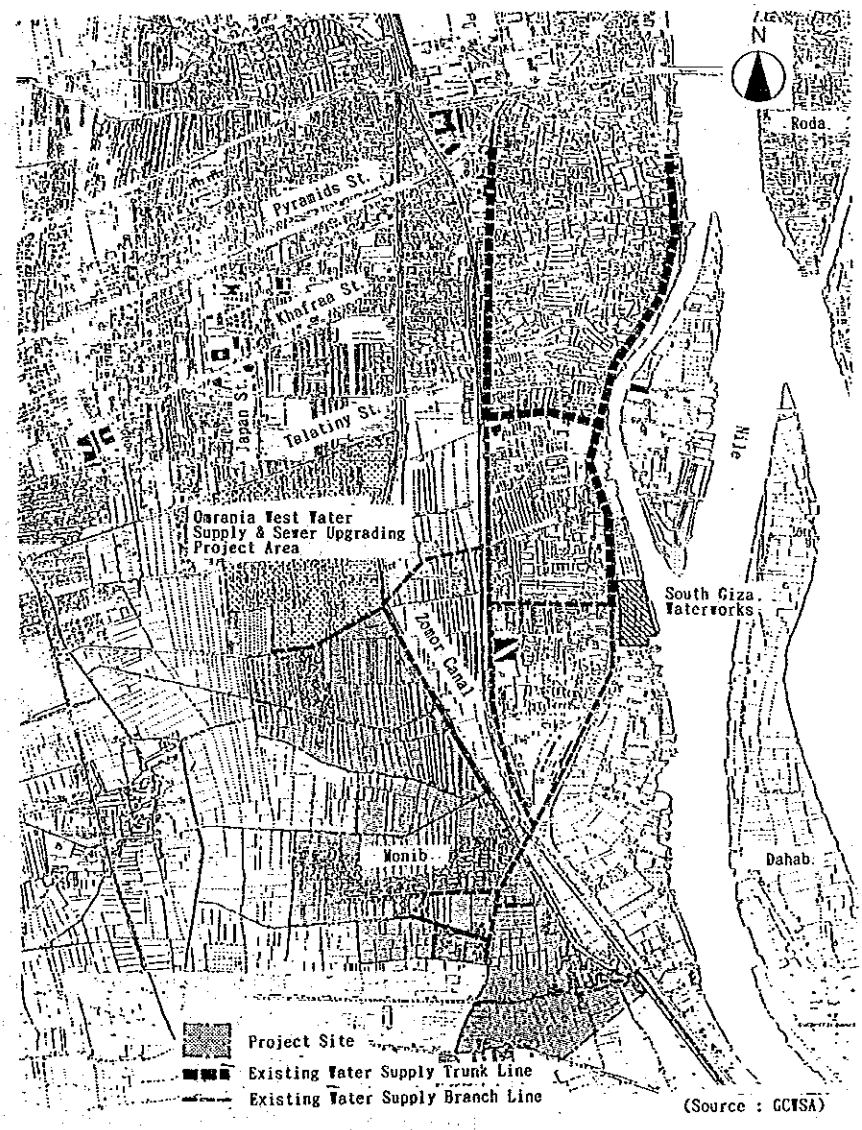



Fig. 2-18 Existing Water Supply Lines in Project Site

(2) Current Conditions of South Giza Waterworks

The existing South Giza Waterworks was constructed in 1970 with Czechoslovakian assistance. As described earlier in 2.1.1-(2)-2), while the design water supply capacity of the waterworks is 140,000$m^3$, the actual supply volume is currently 220,400$m^3$, meaning 60% overload operation.

At present, 3 waterworks and one well are operating in Giza City to supply water and South Giza Waterworks in the second largest water source next to the Embaba Waterworks (water supply volume: 345,200$m^3$/day as of 1992). The water purification process at South Giza Waterworks involves the initial intake of raw water from the Nile, transfer to the mixing basin with pre-chlorination conducted along the intake channel, mixing of the coagulant (aluminium sulphate) at the mixing basin and further distribution to the flocculation basin. Suspended solids and algae are flocculated in the relevant basin and in turn are removed at the coagulation basin. The water further flows through the rapid sand filter to remove minute flocs and undergoes the post-chlorination process at the clear water reservoir before distribution to users.

An intake pumping station to send raw water to the waterworks in 6th October City which is some 25km west to Giza City is also located on the premises of South Giza Waterworks and has been in operation since 1985. This pumping station is controlled by 6th October City and its facilities are outside the management scope of South Giza Waterworks.

South Giza Waterworks is currently facing 2 serious problems, i.e., the deterioration of facilities and overload operation. As already described earlier, South Giza Waterworks is more than 20 years old and the general deterioration of all the facilities, equipment and instruments, etc., is noticeable with many functioning below the design performance level or not functioning at all. Cracks can be observed in the structural concrete and there is serious leakage at the channel linking the coagulation basin and the rapid sand filter. Although the temporary repair of this channel has been conducted using timber, the long-term safety of the channel cannot be guaranteed. Leakage over a long period of time may corrode the reinforcing bars to damage the structural safety, necessitating the early implementation of full-scale repair work. The fact that the design water supply capacity of South Giza Waterworks falls far short of the city's water demand (see 2.1.1-(2)-2)) means that it is impossible to suspend operation for repair or rebuilding purposes. Overload operation at some 60% above the design capacity indeed prohibits such suspension without risking chaotic consequences.

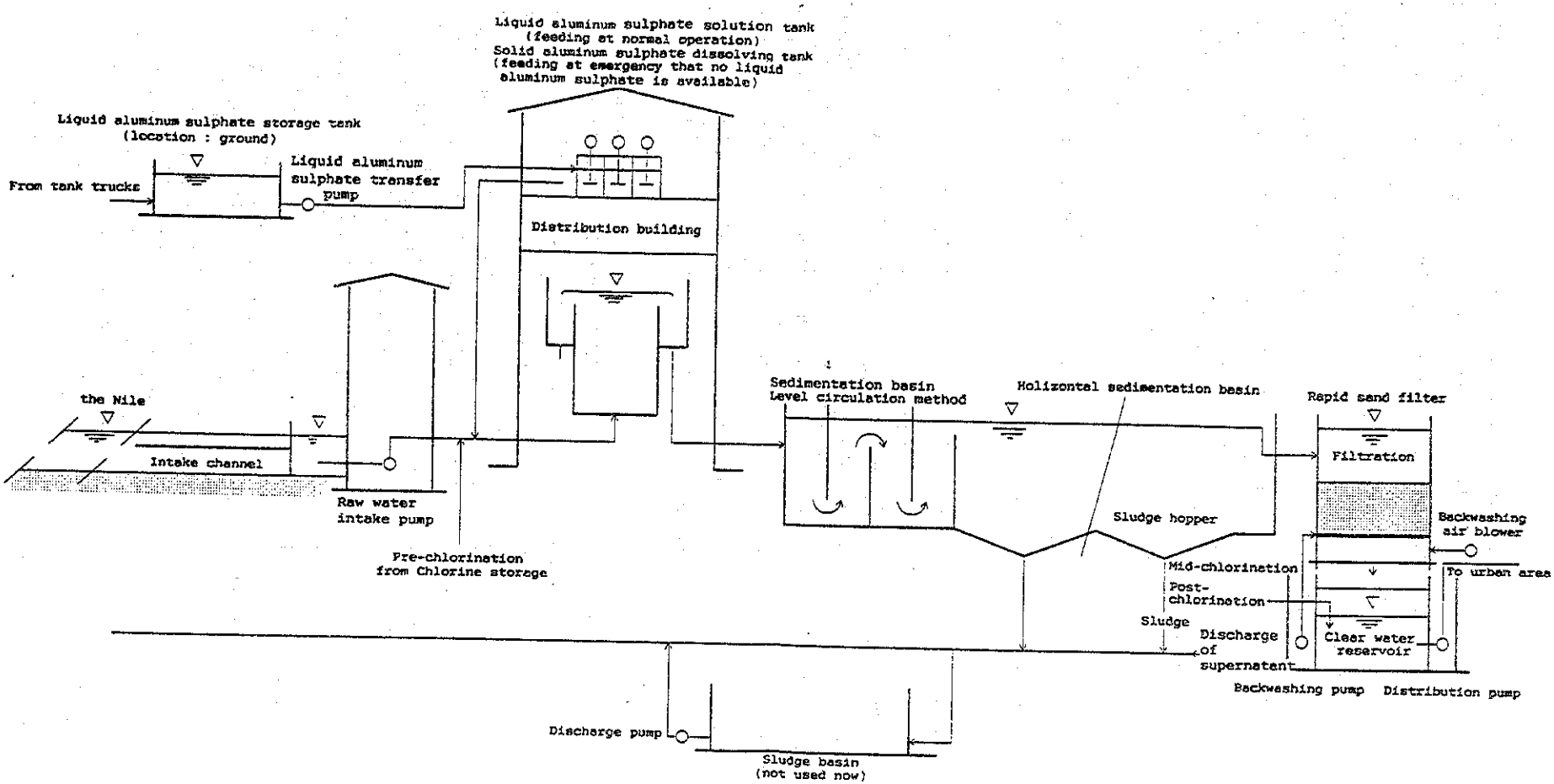



Fig. 2-19 Water Purification Process at South Giza Waterworks

Under these circumstances, South Giza Waterworks is currently carrying out water quality tests at a rate of approximately once/hour to regulate the amount of chemicals used in order to maintain the officially required water quality.

GCWSA is well aware of these problems and recognises the importance of conducting repair work at South Giza Waterworks. Nevertheless, it will be impossible to commence such work in the immediate future due to the tight water supply situation. GCWSA hopes to conduct repair work following the completion of the South Giza Waterworks Expansion Plan (design water supply capacity: 200,000$m^3$/day) planned for 2010.

The current conditions and problems of various facilities of South Giza Waterworks are described next.

1) Water Source

The discharge of the Nile at the intake point is sufficiently large enough as described in 2.3.2-(4) while the speed of flow of approximately 0.6-0.8m/sec is rather slow. Water quality data on raw water at South Giza Waterworks for the last 5 years (1988-1992) are given in Table 2-26. The algae count is fairly high throughout the year, necessitating a middle chlorination process at the rapid sand filter stage in addition to the pre and post-chlorination processes.

Table 2-26 Water Quality Data on Raw Water from the Nile (1988-1992)

| Item | General Value | | Item | General Value | |
|---|---|---|---|---|---|
| | Winter | Summer | | Winter | Summer |
| Ammonia (as N) | None | None | Total Hardness ($CaCO_3$) | 150 | 120 |
| Nitrite (as N) | None | None | Calcium Hardness (Ca) | 35 | 28 |
| Nitrate (as N) | None | None | Magnesium Hardness ($CaCO_3$) | 14 | 9-13 |
| Turbidity (N.T.S) | 4.5-9.25 | 3.25-10.75 | | | |
| Temperature (℃) | 14 | 25 | Chloride (Cl) | 19-28 | 19-28 |
| Total Dissolved Matter (ppm) | 190-247 | 150-237 | Sulphate ($So_4$) | 16-30 | 18-33 |
| | | | Oxygen Consumed ($O_2$) | 1.6-5.7 | 1.95-8.2 |
| Conductivity (m/s) | 300-590 | 150-265 | Iron (Fe) | 0-0.3 | 0-0.3 |
| PH | 8 | 8 | Manganise (Mn) | None | None |
| Total Alkalinity ($Caco_3$) | 165 | 128-150 | Algae count (unit/mℓ) | 2,000-6,800 | 4,000-9,000 |
| Carbonate Alkalinity ($CaCO_3$) | 12 | 12 | | | |

The Study Team checked the water temperature 3 times/day (09:00, 13:00 and 17:00) some 1.9km downstream of South Giza Waterworks during the period between June 5th and June 26th, 1992 which is almost the height of summer and the recorded temperatures ranged between 25°C and 27°C.

2) Raw Water Intake Facilities

Raw water taken from the Nile is sent under pressure by intake pumps to the distribution basin and mixing basins. As the Venturi meter is out of order, the intake volume is calculated based on the operating hours of the pumping facility and the rate of flow/pump. The current conditions of the intake and intake pumps are described below.

Intake

The intake is located at a stream at a distance of some 150m from the bank and the some 2m wide jetty with a floor height of approximately 2m above HWL stretches from the bank to the intake point. Underneath the jetty are the intake channels (1,200mm in diameter x 4 lines) laid some 5-6m below the water level upto the forebay at the intake pumping station. A manual sluice gate is installed at the intake point of each intake channel (4 channels) but no filtering device, such as a bar screen, is provided.

Intake Pumps

8 intake pumps, the specifications of which are given in Table 2-27, are currently in operation on the same floor in the intake pump building located at the southern end of South Giza Waterworks premises, i.e., some 230m upstream of the subject site for upgrading work under the Project. No space is available in the building to accommodate an additional pump.

Table 2-27 Specifications of Intake Pumps at South Giza Waterworks

| Item | Specifications | | |
|---|---|---|---|
| Pumping Capacity | 275 litres/sec. | 600 litres/sec | |
| Country of Manufacture | Czechoslovakia | Czechoslovakia | Japan |
| Number of Pumps | 4 | 2 | 2 |
| Total Head | 14m | 14m | 14m |
| Year of Installation | 1970 | 1970 | 1981 |
| Power Source | Motor | Motor | Motor |

Although measures are not taken to prevent damage to the pumps from the water hammer action, no water hammer occurrence and subsequent damage has so far been reported. The water level meter on the intake side is out of order and the pumps are operating without water level control. The Flow meter for raw water is also out of order.

3) 6th October Waterworks and Planned Intake Facilities Under Project

The intake for the 6th October Waterworks is located in the lowerstream of the intake for South Giza Waterworks at a distance of some 150m from the bank. The intake channels (1,600mm in diameter × 4 lines) are laid some 5-6m below the water level and a manual sluice gate is installed for each channel. A hand-operated bar screen and motor-operated rotary filter (net screen distance: approximately 10mm) are installed for each channel at the entrance to the intake pump building.

Inside the intake pump building, space to accommodate 10 pumps is provided on 2 floors and space equivalent to 8 pumps has already been taken up for the 6th October Waterworks as described below.

- Number of pumps already installed : 4
  (design intake volume: 600 litres/sec/pump × total head of 125m)
- Number of pumps currently being installed : 2
  (design intake volume: 600 litres/sec/pump × total head of 125m)
- Drainpipe space for intake pipes : 1 pump space equivalent
- Space for additional pump : 1 pump space equivalent

Total : 8 pump spaces equivalent

In short, the remaining space can only accommodate 2 pumps on the upperstream side of this intake facility which can be used for the overall plan to increase the water supply capacity (to 200,000m$^3$/day) of South Giza Waterworks which includes the Project aiming at increasing the supply capacity by 35,000m$^3$/day.

While there is no provision against water hammer action, no damage to the pumping facilities due to water hammer has been reported.

There is one properly functioning overhead travelling crane (hoisting load: 10 tons) for maintenance purposes which is operated from the floor where the motor to operate the pumps is also installed. This floor is equipped with a service trench

(some 58cm wide and 20cm deep) to accommodate power and control cables. Since the trench is not currently in use, it can be used for the Project.

The duct (made of steel pipes of 1,000mm in diameter) for the intake channels is buried some 2.5m below the intake pump building site (near the intake pump building for South Giza Waterworks).

The intake pumps are not equipped with a water level meter at the intake side and the pumps operate without water level control, as in the case of the intake pumps of South Giza Waterworks.

4) Raw Water Pipe

The raw water pipes are, as shown in Fig. 2-20, buried in a loop shape under the ground at both ends (upper and lowerstream sides of the Nile) of the intake pump building of South Giza Waterworks to 2 diversion pipes (earth cover: some 1.2m). These raw water pipes have diameters of 1,000mm and 1,200mm. A sluice valve is installed at key points to allow access to each distribution basin and mixing basin from any channel.

The distribution basin and mixing basins are connected to 800mm diameter pipes and the network is designed to ensure water flow to all waterworks facilities to maintain undisrupted operation even if any part of the raw water pipeline breaks down or requires repair. An overflow pipe (diameter: 800mm) is also provided for each distribution basin and mixing basin to prevent overflow accidents due to the sending of excess raw water above the design rate of flow and to discharge excess water to the Nile.

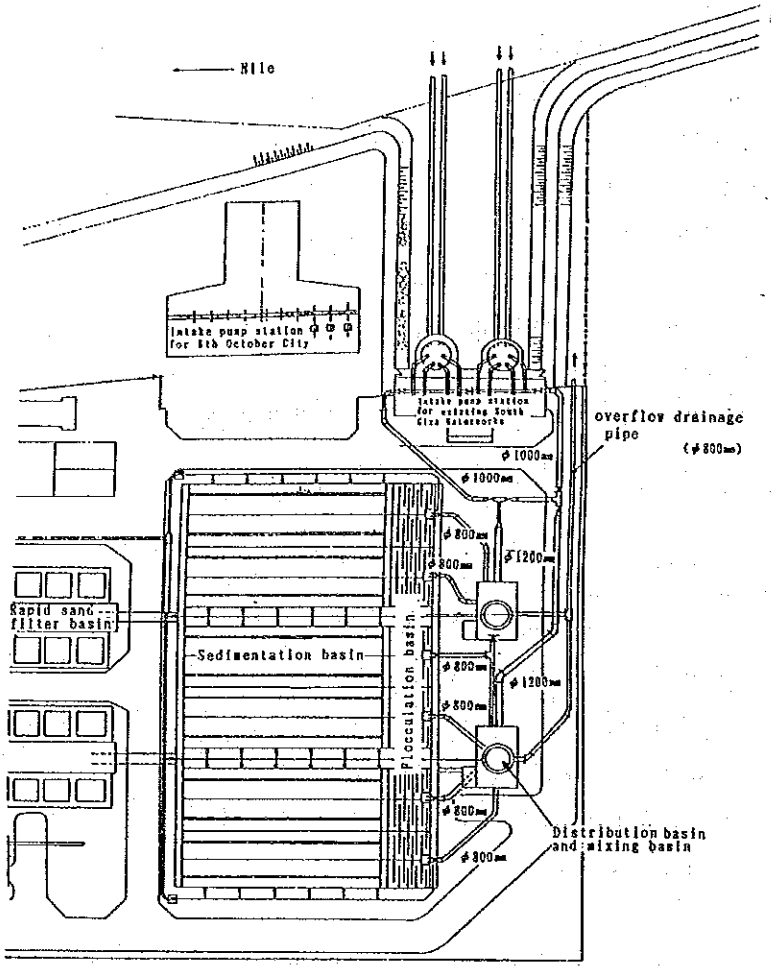



Fig. 2-20 Raw Water Pipes of South Giza Waterworks

5) Chlorine Storage and Injection Facilities for Pre-Chlorination Process

Chlorine injection under the pre-chlorination process takes place at the raw water pipes (2 of them) immediately prior to the distribution basin and mixing basins and each channel is equipped with its own chlorine injection facilities. The chlorine used is liquid chlorine which is manufactured in Egypt. The chlorine injection facilities show much deterioration with noticeable corrosion, making the valves inoperable. As a result, there is no control flow at present. Maintenance of the chlorine injection facilities is difficult to conduct as access to them is limited to manholes.

There are no chlorine neutralisation facilities for the chlorine storage and injection facilities. The normal operation procedure is to open doors and windows when these facilities are in use. An outdoor cylinder isolation tank, capable of storing

one chlorine cylinder (1 ton cylinder) is provided to deal with emergencies when chlorine leakage from a cylinder occurs.

6) Dosing Apparatus for Coagulation

The coagulants in use are liquid aluminium sulphate and solid aluminium sulphate with preference given to liquid aluminium sulphate. However, the production of liquid aluminium sulphate in Egypt has only recently started and the production and supply systems are still fragile. Consequently, a stable supply to the waterworks is not guaranteed. In preparation for a breakdown in the liquid aluminium sulphate supply, solid aluminium sulphate which was used for a long time with no supply difficulties is stored in the underground space below the flocculation basin (quantity: equivalent to 3 months' consumption). When the liquid aluminium sulphate runs out, this solid aluminium sulphate is dissolved by agitators ($14m^3$ x 3 units, made in Czechoslovakia) installed on the second floor of the distribution basin and mixing basin building and is then fed to the sedimentation basin. These agitators are also used for liquid aluminium sulphate.

Solid aluminium sulphate is, in fact, regularly used once or twice a week, partly in practice for an emergency.

The liquid aluminium sulphate is stored in an outdoor tank ($100m^3$) which is refilled approximately once a week from a tank lorry. It is pressure-fed to the agitators by motor pump. The concrete floor around the pump and the tank inlet are noticeable corroded due to leakage.

The standard liquid and solid aluminium concentrations in the solution are as follows.

- liquid aluminium sulphate : 8.5-10%
- solid aluminium sulphate : 7.5%

Dosing apparatus for such auxiliary coagulation agents as coal and caustic soda is available to adjust the alkalinity. It is not used at present, however, because the high alkalinity of the raw water (total alkalinity: approximately 160) does not require such auxiliary agents.

7) Mixing Basins (Distribution Basins)

Raw water from the Nile is pressure-fed by the intake pumps to the mixing basins, each of which is a round basin (approximately 2m in diameter, approximately 3m in height and a crown height of approximately 5.7m from the ground) made of concrete and which also acts as a distribution basin. The water is mixed with chemicals (chlorine for pre-chlorination and aluminium sulphate) by upflow and downflow and is sent to the flocculation basins.

Each mixing basin formerly had an agitator for rapid mixing but these were removed due to deterioration and have not yet been replaced. As a result, mixing of the chemicals totally depends on the energy of the water current, failing to create desirable flocs.

Distribution Basins

The distribution basins are connected to each other by 800mm pipes to ensure water supply to other facilities (flocculation basins, sedimentation basins, etc.), even if the water channels from the intake pumps fail to function.

Water distribution to the flocculation basins and sedimentation basins is conducted by fan-shaped weirs which divide the perimeter of the distribution basin into 4 zones. Distribution from the distribution basins to the flocculation basins is conducted by the gravity flow method using 800mm pipes. The design elevation of the distribution basins is as follows.

LWL = GL + 7.05m
HWL = GL + 7.85m

8) Flocculation Basins

The flocculation basins (crown height: approximately 5.7m above ground level, 3 lines × 4 basins) use the horizontal circulation method and have 13 hirizontal circulation channels. The gravity flow method with no mechanical operation is employed for easy and low cost maintenance. Nevertheless, the following problems have arisen.

① There is a strong possibility of insufficient floc growth due to the occurrence of short-circuit currents and the inadequate residence time caused by overload operation of some 60% as described earlier.

② The flocculation basins are not equipped with mixing devices, such as a baffle wall.

③ It is necessary to manually remove the scum which tends to stay on the water surface at the flocculation basins.

9) Coagulation Basins

The sedimentation basins have a standard single layer structure and use the horizontal sedimentation method. Each basin has a rectangular shape (approximately 50m in length, 10m in width and an effective depth of 5.4m). There is a total of 12 basins, i.e. 3 lines × 4 basins although each basin is capable of functioning independently. The crown height of the basins is some 5.7m above ground level (the margin between the HWL and the crown is some 30cm).

The sedimentation of flocs at these basins is inadequate because of the following reasons and flocs are discharged to the channels connecting the rapid sand filters.

① The some 60% overload operation of the sedimentation basins has caused a faster flow speed of some 60% than the design flow speed, resulting in insufficient sedimentation.

② The high temperature of around 35°C-45°C in summer raises the water temperature and the resulting upflow prevents the efficient flocculation of flocs.

③ There is no baffle wall halfway through the sedimentation process to encourage sedimentation.

The removal of sludge is conducted by the header pipe method. The structure of the sedimentation basins has caused the following problems.

① There is no system to gather sedimentation flocs to the sludge hoppers for mechanical removal.

② The gradient of the sludge hoppers at the sedimentation basins is rather gentle, making the collection of sludge difficult. The impossibility of efficient sludge removal due to the reason described in ① above makes it essential to completely drain the basins once a year for the manual removal of the sludge which has accumulated at the bottom of the basins using pressurised water.

③ During the above sludge removal and clearing work, the other basins must bear an extra load, aggravating the insufficient sedimentation caused by the overload operation of some 60%. At the same time, the discharge of flocs to the rapid sand filters is worsened due to the increased water speed.

10) Rapid Sand Filters

There are 2 lines of rapid sand filters, each consisting of 10 basins (a rectangular shape of approximately 7.3m × 5.4m). The crown height of the basins is approximately 6.65m above ground level. The rapid sand filter consists of a layer of sand with a thickness of approximately 1m. The filter speed is some 100m/day vis-a-vis the design clear water production and 160m/day vis-a-vis the actual clear water production.

Backwashing is manually conducted using the on-site control board. The air nozzles for backwashing are made of plastic with a slit and these break from time to time with the resulting outflow of filtering sand necessitating a large resupply of sand once a year or so.

Samples of the filtering sand used at South Giza Waterworks and Rod El Farag waterworks and also sand/gravel samples obtained from local suppliers were taken back to Japan and their analysis results are given in Table 2-28.

Table 2-28 Analysis Results of Filtering Sand Samples

| Analysis Item | JWWA Standard | Sample from South Giza Waterworks | Sample from El Farag Waterworks | Samples from Egyptian Suppliers | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | A | B | | C | |
| | | | Gravel (Small) | Gravel (Large) | Sand (2-3.5m) | Sand (3-7mm) | Gravel (5-10mm) | Sand (3.8mm) |
| Effective Size (mm) | 0.45-0.7 | 0.93 | - | - | 1.08 | - | - | 3.1 |
| Uniformity Coefficient | 1.7 or less | 1.28 | - | - | 1.46 | - | - | 1.35 |
| Backwashing Turbidity | 30 or less | 278 | 1.48 | 12.4 | 532 | 440 | 155 | - |
| Ignition Loss (%) | 0.75 or less | 1.48 | - | - | 0.59 | - | - | - |
| Dissolution Rate by Hydrochloriic acid (%) | 3.5 or less | 2.92 | 1.06 | 0.055 | 1.09 | 0.79 | 1.43 | 1.13 |
| Specific Gravity | 2.57-2.67 | 2.65 | 2.64 | 2.67 | 2.64 | 2.64 | 2.58 | 2.64 |
| Abrasion Loss (%) | 3 or less | 0.12 | - | - | 0.52 | - | - | - |

Note: Analysis conducted pursuant to JWWA Regulation: A.103 (1988).

The effective size (0.93mm) of the filtering sand used at South Giza Waterworks is slightly larger than the JWWA (Japan Water Works Association) standard (0.45-0.7mm) but does not pose any problem in producing clean water. However, it is desirable that filtering sand with an effective size meeting the JWWA standard be used to establish an economical facility with an appropriate sand filter thickness and the minimum requirement for backwashing frequency.

The backwashing turbidity is very large (155-532) except for gravel from Supplier A, suggesting the necessity to procure well washed filtering sand and gravel to obtain filtering materials to meet the necessary specifications.

The rapid sand filters currently have the following problems.

① The water to be filtered flows into the sand filter basins from a trough (some 80cm wide, 60cm deep and 80-90cm above the sand surface) located between 2 basins. As the upper edge of the trough is not quite level, the inflow volume per unit length of the trough is not uniform.

② As the drainage of the backwashing water takes place upto below the filtering sand surface, the water to be filtered drops from a height of 80-90cm in some parts immediately after backwashing. In addition, the filtering sand has been scoured and has moved sideways, causing an inadequate sand thickness in some parts.

③ Backwashing is conducted by compressed air and pressurised water. Compressed air is firstly used, followed by a combination of both and finally pressurised water is used.

④ During backwashing by compressed air, the membrane formed by flocs caught by the sand surface is rather thin and air holes appear in places where the tension of the membrane is weak. As the compressed air tends to go through these holes, the sand surface backwashing becomes insufficient.

⑤ The poor raw water quality caused by the propagation of microbes, algae, etc., in the Nile means that pre-chlorination is not always sufficient to remove them. When the existence of microbes, algae, etc., is found by the hourly water quality test on water flowing into the rapid sand filters, the middle chlorination process is added to completely remove microbes, algae, etc., in the sand filters.

11) Clear Water Reservoir

A clear water reservoir (approximate size: 5.4m wide, 85m long and 4.5m high) is located in the ground under the rapid sand filter site and is made of concrete.

12) Chlorine Storage and Injection Facilities for Post-Chlorination Process

Post-chlorination is conducted at the clean water reservoir and the relevant chlorine storage and injection facilities are located at the upperstream side of the rapid sand filter site. As in the case of the pre-chlorination facilities, all the facilities show much deterioration. There is no chlorine neutralisation unit and the facilities are operated with doors and windows open to facilitate ventilation.

13) Chlorine Cylinder Storage Building

The chlorine cylinder storage building (for all chlorination processes) is located on the Nile side near the centre of South Giza Waterworks. The buildings is less deteriorated than the other buildings and the motorised hoist (5 ton) to handle the cylinders functions properly. It is possible to use this building for the Project as well as for any future expansion plan.

The cylinder weighing equipment is out of order due to severe corrosion. The chlorine neutralisation unit, of which the main equipment has recently been installed, is not yet functioning as a system due to the lack of an air inlet duct, a damper and neutralising agent in the reaction tower. Consequently, the building uses natural ventilation with the doors and windows open when any work is conducted inside the building.

14) Sludge Discharge Systems

A sludge discharge system associated with the rapid sand filters uses gravity to directly drain to the Nile with the facility which pumps out supernatant to the Nile via the sludge basin. The facility is not currently in use due to the prohibitive cost of sludge disposal and pump maintenance.

15) Water Distribution Facilities

Water Distribution Method

There is no distinction between the service pipeline and water distribution pipeline and pressurised water is directly distributed from the waterworks to households,

offices, public facilities, etc. As a result, those users near the waterworks can enjoy a plentiful supply of water while those users at the far end of the distribution network can only expect the remaining water.

Water Distribution Pumps

8 water distribution pumps are installed on the same floor of the water distribution pump building located near the main gate on Cornesh Street. No space is available for additional pumps. While no measures have been taken in regard to water hammer action, damage to the pumps by water hammer has not been recorded. The main specifications of the water distribution pumps are given in Table 2-29.

Table 2-29 Main Specifications of Water Distribution Pumps at South Giza Waterworks

| Item | Specifications | | |
|---|---|---|---|
| Capacity | 200 litres/sec | 730 litres/sec | 600 litres/sec |
| Country of Manufacture | Czechoslovakia | Czechoslovakia | Japan |
| Number of Pumps | 4 | 2 | 2 |
| Total head | 60m | 60m | 60m |
| Year of Installation | 1970 | 1970 | 1981 |
| Motor | 240KW, 3.3KV | 630KW, 3.3KV | 550KW, 3.3KV |

Water Distribution Pipeline

There are 2 pipelines used for both service and distribution pipeline each served by 4 pumps. The pipe diameter upto the main gate is 800mm and increases to 1,000mm thereafter. The pipes are ductile cast iron pipes. Although a Flow meter is installed at the underground pit of the outlet side of the pump, its maintenance is inadequate due to the lack of a bypass with appropriate valves.

16) Water Quality Analysis

The water quality laboratory is equipped with a turbidity meter, jar tester and other water quality analysis instruments. The raw water quality and purified water quality are tested hourly and the results recorded in the water quality register. Although some of the present testing equipment is old, the range of equipment available at the laboratory (see Table 2-30) is sufficient to conduct minimum water quality control.

Table 2-30 Main Water Quality Testing Equipment in Use at South Giza Waterworks

| Equipment | Purpose of Use | Country of Manufacture | Number |
|---|---|---|---|
| Electric Incubator | bacteria incubation | Germany | 2 |
| Electric Heater | bacteria sterilisation | UK | 4 |
| Weighing Machine | weighing of samples | UK | 3 |
| Electric Incubator | bacteria incubation | Spain | 1 |
| Turbidity Meter | turbidity testing | US | 1 |
| Jar Tester | determination of best quantity of chemical dose | US | 1 |

Source: GCWSA

17) Power Facilities

South Giza Waterworks receives power supply from the Giza City's power distribution network (10.5KV) through 2 lines (one for ordinary use and one as a reserve) and lowers the voltage to 3.3KV (for the water distribution pumps) or 380-220V (for other power loads) on site. The substation is located inside the water distribution pump building.

An emergency power generation system (2 × 1,100KVA generators made in former East Germany in 1978) is provided on the premises (near the Nile) in the case of the failure of the commercial power supply.

All the power facilities, including the emergency power generators, show a high degree of deterioration. The name plates of the indicator lamps of the power distribution board have been either lost or are illegible and the operators must rely on experience to operate the board. While the main distribution route uses the cable pit method, many cable racks have been damaged. There are places where the pit cover is not properly placed, causing damage to the cable by concrete pieces and other objects.

<u>New 66/10.5KV Substation</u>

As shown in Fig. 3-2, the construction of a new substation (outdoor type, 66/10.5KV) designed to supply power to the new waterworks and its surrounding area is in progress on the site for the expanded South Giza Waterworks with completion expected in 1994. In fact, GCWSA is currently implementing a policy of constructing a 66/10.5KV substation for each main waterworks to ensure a

stable power supply and the construction of this type of substation is in progress at the Rod El Farag Waterworks and Embaba Waterworks. In the case of other waterworks, however, power failures are seldom reported due to the stable supply of power by the 66KV transmission system.

2.3.4.2 Sewer Facilities

The planned sewer improvement work in the Project Site will be part of the overall sewer improvement work for the west bank of the Nile (see 2.1.2) as in the case of the water supply improvement work.

(1) Current Conditions of Sewer Facilities in Project Site

There are no sewer facilities in the Project Site at present and the outflow of sewage onto roads creates unsanitary conditions. The current conditions and problems of sewer facilities in the Project Site are summarised below.

1) No public sewer facilities are provided in the Project Site.

2) Each apartment building or group of 2-3 buildings has a cesspit by the road and the disposed sanitary sewage is collected 2-3 times/week by a vacuum vehicle of GOSD.

3) The sanitary sewage collection service using vacuum vehicles has not expanded in line with the population increase. In addition, some inhabitants with little disposable income cannot use this service for which a fee is charged, resulting in overflow from the cesspits.

4) Overflow from cesspits has almost become part of the daily life in and around Monib Street and Gamal Abd El Nasr Street where the population density is particularly high, creating an unhealthy environment.

5) Some of the sewage collected by the vacuum vehicles is dumped into the Zomor Canal in the Project Site, adversely affecting not only the sanitary conditions in areas along the canal but also the water quality of the Nile.

(2) Current Conditions of Pumping Stations Similar to Planned No. 5 (B).

The planned Sewer Transfer Pump Station No. 5 (B) will use screw pumps which are adopted as the standard for pumping stations under the Greater Cairo Wastewater

Project assisted by the ODA organizations of the US (USAID) and UK. The locations of the pumping stations using screw pumps in the Greater Cairo Region are shown in Fig. 2-20 and are outlined in Table 2-31.

Table 2-31 Screw Pump-Type Pumping Stations in Greater Cairo Region

| Pumping Station | | Design Pumping Capacity ($m^3$/day) | Construction Progress | Connection with the Project |
|---|---|---|---|---|
| East Bank (Cairo Side) | Ameria | 560,000 | in operation | no |
| | Kossous | 1,800,000 | test operation | no |
| | Khalag | 1,500,000 | test operation | no |
| | Gabal El Asfar | 1,730,000 | planned completion in December, 1993 | no |
| | Berka | 600,000 | planned completion in December, 1992 | no |
| West Bank (Giza Side) | Embaba | 240,000 | test operation | no |
| | Boulac | 624,000 | test operation | no |
| | South Muheit | 624,000 | test operation | no |
| | Junction | 832,000 | test operation | yes |
| | Abu Rawash | 832,000 | test operation | yes |
| | Zenein | 393,000 | in operation | yes |
| | Pyramids | 416,000 | test operation | yes |
| | Cheops | 100,000 | planned completion in July, 1993 | no |

Among the pumping stations listed in Table 2-31, the Pyramids Pumping Station is located in the lowerstream of Sewer Tranfer Pump Station No. 5 (B) and transfers wastewater to Abu Rawash Wastewater Treatment Plant. The Pyramids Pumping Station was completed in 1990 and its management responsibility was transferred to GOSD. At present, it acts as a training center for the management, operation and maintenance of screw pump-type pumping stations with the technical assistance of engineers of the AMBRIC, a joint consultant of US and UK companies. The actual operation of the Pyramids Pumping Station is planned to commence in January, 1993 in line with the commencement of the operation of Abu Rawash Wastewater Treatment Plant.

The Pyramids Pumping Station is the model for the screw pump-type pumping station to be constructed with USAID assistance and its current situation is outlined below.

1) Pumps: screw pumps

2) Number of Pumps: currently 3 (one as a reserve). An additional 2 pumps will be installed in the future and the building size and structure anticipate such additions.

3) Pumping Capacity: the present capacity of 416,000m$^3$/day will be increased to upto 832,000m$^3$/day by 2010.

4) Pump Specifications

- pump diameter : 3,048mm
- total head : 8.6m
- installed angle of pump : 38°
- maximum revolutions : 25 RPM
- motor capacity : 298.4KW (400 HP)

5) Air Blower

A blower to supply air to the lower pump section is installed for each pump on the workfloor level to prevent accidents due to toxic gas from the wastewater and to maintain a workable environment during maintenance/inspection work at the inlet section of the screw pump. The air supply capacity of the blower is 5.54m$^3$/sec.

6) Dust and Sand Removal Facilities

There is no facility, such as a screen, at the Pyramids Pumping Station to remove dust and/or sand. Moreover, all the other screw pump-type pumping stations constructed with US or UK assistance have no such facility. This is because a screw pump does not become clogged by the solids contained in wastewater and also because of the American and European idea that the function of a pumping station is not to remove solids but to simply transfer wastewater to the final treatment plant where the solids are removed. The wastewater sometimes contains such large objects as dead cows or donkeys, etc., which cannot be removed by the screw pump.

7) PVC Lining

In the case of the pump building's concrete walls of the wastewater inlet and pump inlet which may come into contact with hydrogen sulphide generated by the wastewater, PVC lining called T-Lock is applied to all surfaces down to ground level.

8) Measure to Combat High Temperature

Temperatures can reach a maximum 45°C in summer (April-October). In order to prevent deformation of the screw pump shaft and blades due to the linear

expansion of the steel materials caused by such high temperatures, the pumps are shaded by a structure with a steel roof but no walls.

(3) Wastewater Treatment Plants

The current operating conditions of the wastewater treatment plants in the Greater Cairo Region are shown in Table 2-32.

Table 2-32 Wastewater Treatment Plants in Greater Cairo Region

| Wastewater Treatment Plant | | Capacity (1,000m³/day) | | Completion of Construction | Connection with Phase II Project |
|---|---|---|---|---|---|
| | | 1990 | 2010 | | |
| East Bank (Cairo Side) | Gabal El Asfar | 1,000 | 3,000 | 1995 | No |
| | Berka | 600 | 600 | Dec., 1992 | No |
| | Shobula El Heima | 600 | 600 | Dec., 1992 | No |
| | Nahya | 100 | 100 | in operation | No |
| | (Total) | (2,300) | (4,300) | | |
| West Bank (Giza Side) | Abu Rawash | 400 | 1,000 | Jan., 1993 | Yes |
| | Zenein | 330 | 330 | in operation | No |
| | (Total) | (7,30) | (1,330) | | |

As shown in Fig. 2-21, wastewater from the Project Site is drained to the Sewer Tranfer Pump Station No. 5 (B) via the Abu Nomros Main Collector and finally reaches Abu Rawash Wastewater Treatment Plant via the Pyramids Pumping Station, Junction Pumping Station and Abu Rawash Pumping Station. The construction of Abu Rawash Wastewater Treatment Plant is currently in progress with the assistance of USAID and its operation is planned to commence in January, 1993.

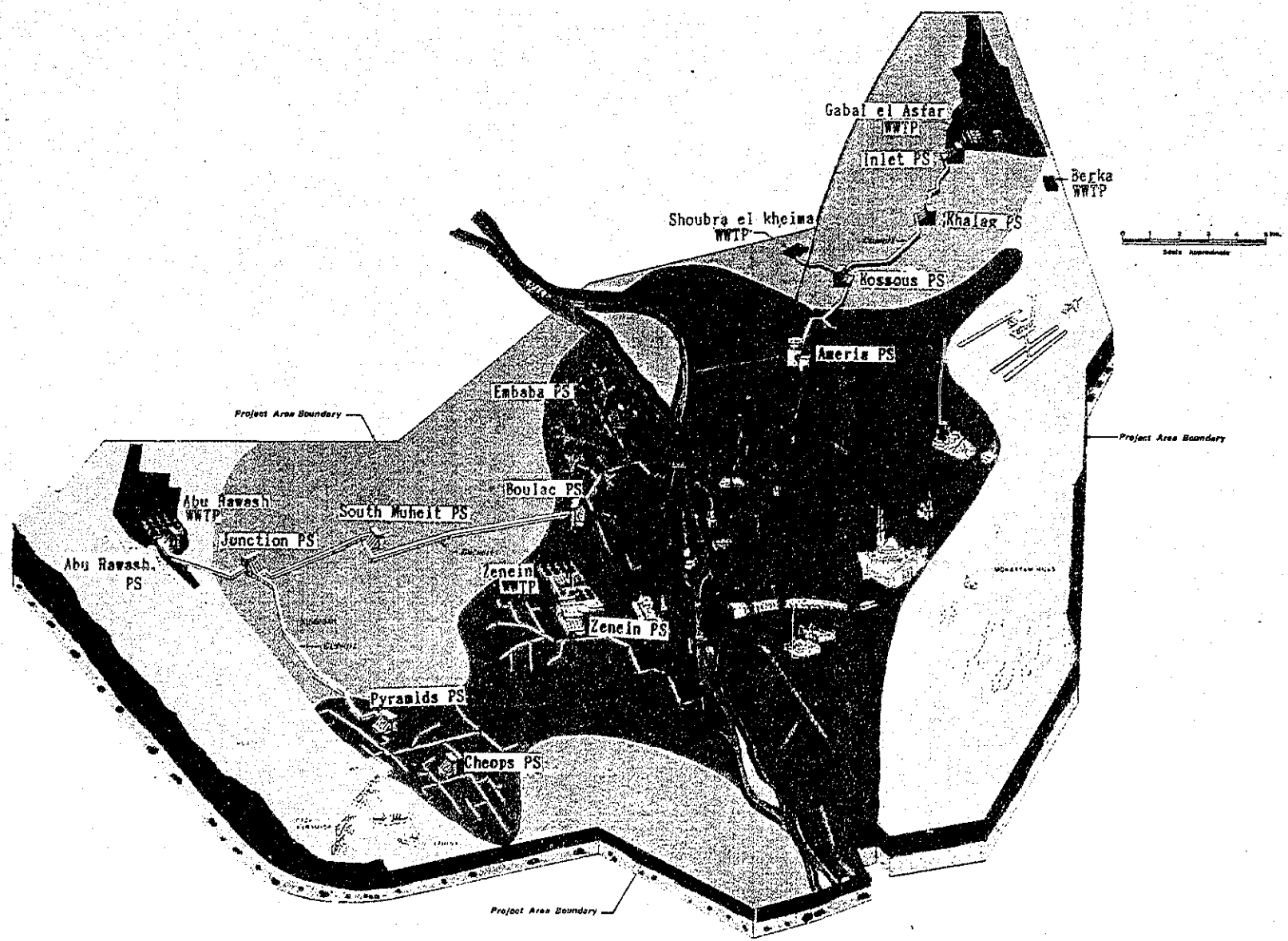



Fig. 2-21 Locations of Screw Pump-Type Sewer Transfer Pump Stations in Greater Cairo Region