FEASIBILITY STUDY
ON
SHARQIYA WATER SUPPLY SYSTEM
IN
THE ARAB REPUBLIC OF EGYPT

MAIN REPORT

DECEMBER 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

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P R E F A C E

In response to the request of the Government of the Arab Republic of Egypt, the Japanese Government decided to conduct a feasibility study on Sharqiya Water Supply System Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Egypt a preliminary survey team headed by Dr. Keiji GOTOH, Professor of Toyo University, from February to March, 1983.

The team had a series of discussions with the officials concerned of the Government of Egypt, and in particular with those of the National Organization for Potable Water and Sanitary Drainage (NOPWASD), thereby completing the Scope of Work for the Study.

After preliminary survey, the study team led by Mr. Osamu WAKAMOTO, Nihon Suido Consultant Co. Ltd., organized by JICA, made further field survey and data analyses based upon the Scope of Work, from July 1983 to December 1984, and the present report has been prepared.

I hope that this report will serve for the development of the Project and thereby contribute to the promotion of friendly relations between our two countries.

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

December, 1984

Keisuke Arita

Keisuke ARITA
President
Japan International Cooperation Agency

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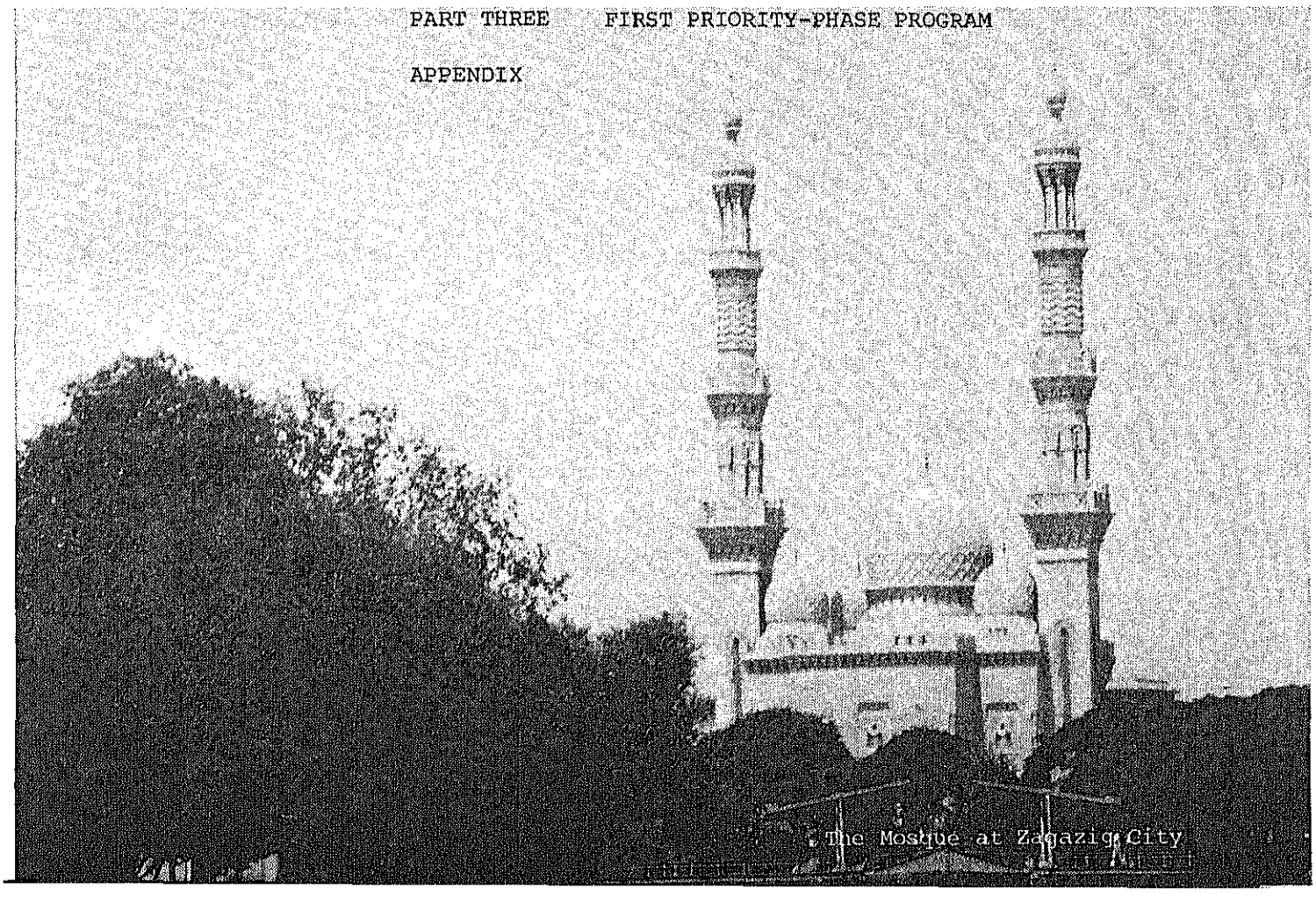

The Mosque at Zagazig City

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SUMMARY AND RECOMMENDATION

FEASIBILITY STUDY ON SHARQIYA WATER SUPPLY SYSTEM IN THE ARAB REPUBLIC OF EGYPT

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SUMMARY AND RECOMMENDATION

The Population of Sharqiya Governorate which was about 2.6 million in 1976 is estimated as about 3 million at present. Together with a rapid population growth, increasing water demand and superannuated supply systems with their limited capacity have resulted in a severe shortage of the potable water. In addition the groundwater is not fit for drinking purpose in the northern part of the Governorate due to salinity.

The present Study is planned to improve such severe condition from a broad standpoint.

1. Summary

1.1 Objective of the Study

The objective of the Study is to prepare the Long Term Program up to the year 2005 for the water supply development in Sharqiya Governorate and to study the feasibility of the First Priority-Phase Program as identified within the Long Term Program.

1.2 Present Water Supply Condition

The existing water supply systems in the Governorate consist of City-owned Water Supply Systems, Housing Department's Water Supply Systems and Abbasa Regional Water Supply System. The present systems supply about 76 % of the 1983 population with piped water.

Table 1.1 OUTLINE OF THE SYSTEMS

Systems	Served Area	Production (m3/day)	Served Population (x 1,000)	Total Population in Sharqiya (x 1,000)
City-owned	9 Cities	84,976	476	
Housing Dep.	189 Villages	27,211	630	
Abbasa	3 Cities 1 Town 240 Villages	114,739	1,216	
Total	12 Cities & 1 Town & 429 Villages	226,926	2,322	3,048

1.3 Future Water Supply Condition

The estimated supply conditions in the future are shown below :

Table-1.2 POPULATION AND WATER REQUIREMENT

Item	Unit	1983	1995	2005
Projected Population	x 1,000 capita	3,048	3,948	4,885
Served Population	x 1,000 capita	2,322	3,455	4,885
Water Requirement	x 1,000 m3/day	227	495	687

1.4 Water Source

The groundwater is available for the future water demand in the southern half of Sharqiya Governorate. The future water demand of the northern half area is compelled to meet by means of canal water treatment due to saline groundwater in the area.

Presently the irrigation authority makes a practice of stopping the flow of the canals for the maintenance for about 3 weeks in winter season.

1.5 Long Term Program

The population of Sharqiya Governorate estimated at about 3.0 million in 1983 will increase to 4.9 million in 2005. Together with the population increase, the rising living standard causes severe shortage of the water. The future water demand in 2005 will be 687,000 m3/day which is about 3 times of the existing supply capacity of the system 227,000 m3/day.

To cope with such future supply condition, the following tactics is employed :

a) The rural area consisting of 429 villages in 12 Marakaz is to be covered by groundwater due to their isolated location and limited water demand.

b) Urban area composed of 12 cities and one town is to be supplied by treated canal water because of comparatively concentrated and large magnitude of water demand. The northern part of the Governorate including the rural area will be supplied with treated canal water due to its salinity of groundwater.

c) In principle, existing groundwater stations and treatment Plants will be used continuously in future with periodical rehabilitation and/or replacement work.

In the whole Sharqiya Governorate, as studied in the body in detail, the total water demand in 2005 will be covered as the followings.

Existing treatment plants	73,000 m3/day
Existing groundwater stations	154,000 m3/day
New treatment plants	309,000 m3/day
New groundwater development	151,000 m3/day
Total	687,000 m3/day

To meet the whole water demand in 2005, newly developed groundwater stations scattered mainly in the southern area and four newly constructed treatment plants will cover all the Governorate.

In respect to the institution, the establishment of Sharqiya Public Water Company is proposed for the development of water supply sysems in the future.

1.6 Project Identified for First Priority-Phase Program

Considering urgent necessity and shortage of water in the northern area of the Governorate, both of Northeast and Kafr Saqr Treatment Plant Systems are selected to supply water to the area as the projects

to be implemented immediately. In connection with the works projected above, the Emergency Works are planned to relieve the present poor condition of water supply to a certain extent.

1.7 Works of First Priority-Phase Program

The projected works are listed below :

1) Construction of New Plant Systems

a. Northeast Treatment Plant and the distribution system

Plant Capacity : 90,000 m3/d x 1/2 = 45,000 m3/d
(Plant capacity for the year 1995 is about half of the year 2005's)

Distribution System : Trunk main (installed between cities or villages) Ø1,100 - Ø100 x 123 km
Service main (installed within cities and villages) Ø 250 - Ø150 x 96 km
Booster pumping station & Elevated tanks

b. Kafr Saqr Treatment Plant and the distribution system

Plant Capacity : 60,000 m3/d x 1/2 = 30,000 m3/d
(Targeted at 1995)

Distribution System : Trunk main Ø900 - Ø150 x 110 km
Service main Ø250 - Ø150 x 60 km
Booster pumping station & Elevated tanks

2) Emergency Works

a. Production increase of Zagazing Plant

Additional Capacity : 120 l/s

b. Rehabilitation of existing treatment plants

Rehabilitated Plants : Abbasa, Zagazing and Faqus Plants

c. Development of groundwater in southern area

Additional Capacity : City-owned Systems 11,700 m3/d
+ Housing Dept. Systems 5,900 m3/d
= 17,600 m3/d

d. Procurement of machines/vehicles for maintenance

Procureed Matters : Four-wheel-drive cars, trucks, backhoe, vibration rollers, etc.

1.8 Project Cost of First Priority-Phase Program

The estimated project cost (as of the year 1984) is as follows :

Table - 1.3 PROJECT COST

(Unit : LE x 1,000)

Item	Total	F/C	L/C
a) Construction of Northeast Plant System	44,056	22,815	21,241
b) Construction of Kafr Saqr Plant System	27,078	10,940	16,138
c) Emergency Works	11,758	4,465	7,293
d) Engineering Services	4,145	2,787	1,568
e) PhysicalContingency	8,704	4,071	4,633
f) Price Contingency	30,274	9,509	20,765
Total	126,015	54,287	71,728

(Note) F/C : Foreign Currency Component

L/C : Local Currency Component

F/C LE 54,287,000 equivalent to US$ 66,230,000.

1.9 Project Implementation Schedule

The project stated above will be carried out in the following schedule, with the duration as shown in the bracket :

a) Completion of the feasibility study : December 1984

b) Loan application : Early 1985 - middle 1985 (1/2 years)

c) Detail design : Middle 1985 - Middle 1986 (One year)

d) Emergency works : middle 1986 - Middle 1987 (One year)

e) Construction of Northeast Plant system and Kafr Saqr Plant system : Middle 1986 - Middle 1988 (Two years)

1.10 Executive Organization of the Project

Sharqiya Public Water Company vested with autonomous power is proposed to be established as a new executive organization for the unified control of the operation and expansion of the water supply system in whole Sharqiya Governorate including the newly proposed system expansion project.

1.11 Financing

The total investment cost of the First-Phase Program is LE 126 million including price contingency with foreign currency component of LE 54 million or US$ 66 million (43 % of total cost) and local currency component of LE 72 million (57 % of total cost).

In order to ensure the financial feasibility of the proposed project, the foreign currency portion is assumed to be funded by the foreign lending agency at the interest rate of 6 % per annum and 26 years repayment period including 6 years grace period and the local currency portion is assumed to be funded by the government subsidy. The more lenient foreign loan with low interest and extended repayment period would favor the financial feasiblity of the project.

The present low water tariff is proposed to be raised gradually to the level at the average water tariff of 12 Pts/m3 in the year 1993 in order to cover the operation and maintenance costs as well as debt service requirement. The financial rate of return (FIRR) is estimated to be 5 % based on the above funding and tariff schedule. Above FIRR is considered positive and sufficient for the viablility of the project and if the intangible socio-economic benefits are compounded, the figure of FIRR would increase remarkably.

2. Recommendation

During the course of the field survey and as a result thereof, some important issues have been found which are to be improved, rectified or prepared for as early as practicable. They are described below and recommended to be put in effect by the agencies concerned.

2.1 General

2.1.1 Guarantee of Uninterrupted Flow of Canals

The proposed new treatment plants are to take the raw water from Muweis Canal and Saidiya Canal which are maintained under the responsible irrigation authorithies. Though the canal water is easily available as the source of public water supplies, the flow of these canals is stopped for about three weeks during a certain period in winter, for maintenance purposes.

It is the best solution to take water from those Canals to realize most economical water supply. However, if the flow thereof should be stopped, another, very expensive, almost prohibitive, source must be sought for. Considering the above situation, it is recommended to obtain a grarantee of uninterrupted operation of the Canals.

2.1.2 Periodic Review of Long Term Program

When the Long Term Program was prepared, assumptions were made, mostly due to insufficiency of necessary data, on various parameters like the future development of the surveyed areas,population, water demand and others. The actual situation may differ somewhat from the Program based on the assumptions, and reviewing and revising it from time to time is most recommendable.

2.1.3 Calling-up Public Concerns in Water Supply

The public should be made more aware of the preciousness of water for the public health and the value of water supply services.

To reduce the pipeline leakage, the public should be encouraged to report, voluntarily and without delay, findings of the leakage.

To reduce the in-house loss and wastage, the public should be taught how to make simple repairs and to pay more attention to the dripping taps.

The public should be given more informations and education to learn that a good water supply service is worth paying for with the reasonable tariff.

2.2 Legislation and Organization

2.2.1 Legislation for Water Works

There is no established legislation for the water supply operation prevailing in the Governorate, except for the rudimental regulation or contract which partially regulate the service installation especially for the house connection and water tariff.

It is necessary to promulgate the national law or decree for the establishment of the local Public Water Company and this law or decree should authorize the PWC to develop the bylaw which includes the necessary provisions for the operation and maintenance of the water supply systems.

Such bylaw should include key provisions, among others :

- to authorize the water supply organization to operate and maintain the water supply systems,
- to prepare and introduce a water tariff bill in the legislative institution,
- to assess and levy the water tariff,
- to regulate the materials and equipments to be in accordance with the standard and design,

- to prevent the waste, contamination of water, misuse, and disorder of the public water supply systems,
- to allow the authority to examine and inspect the consumers' water related properties, and
- to regulate and control the safety measures for water supply operation,

Penalty should be imposed for the extreme cases of violation of he bylaws.

2.2.2 Establishment of Nation-wide Water Works Association

It is recommended to establish Egyptian Water Works Association consisting of the representative members of the water supply agencies /companies, manufacturers of pipes/equipments/chemicals/civil works contractors and so forth related to water works as an advisory center to provide the information, data and guidelines which can be utilized conveniently by the water related agencies or individuals. The followings are major activities of the association :

- Planning and preparation of the standards on pipes/equipments/ chemicals of water works including standard drawings,
- Inspection and checking of conformity of above with the standards,
- Preparation of the design and operation manual,
- Data collection and publication,
- Training of employee, and
- Other necessary activities to support water supply works.

2.2.3 Establishment of New Organization for Water Supply In Sharqiya Governorate

In the Governorate, there are three water supply organizations with different practices of services, water sources, treatment and distribution systems originated from the different historical development background. Such difference in an administrative area hinders efficient performance and development of water supply works in many respects.

It is therefore recommended to establish the new organization, amalgamating the existing three organizations in order to unify the water supply services. This new organization should be formed as a public company with the ultimate objective to achieve the managerial autonomy, supported with the arrangements of ordinance and decree under the intensified guidance of NOPWASD.

2.3 Financing and Tariff

2.3.1 Project Financing

A substantial amount of the capital investment will be required to realize the extensive water supply development envisaged in the Long Term Program up to the year 2005. Even the First Priority-Phase Program to be implemented immediately, for which the technical and financial feasibility has be studied, will require a sizable magnitude of investment funds.

To implement the project with financial validity, the funds should be secured by a coordinated and integrated preparation by all relevant government agencies. The foreign currency portion should preferably be financed from a foreign lending agency at a lenient loan condition of low interest and long repayment period. The local currency portion, almost equal in size to the foreign portion, should be funded from the government in accordance with the disbursement schedule shown in the study report.

2.3.2 Revision of Water Tariff

The present tariff is low, unreasonably and unrealistically, when compared to the water service's operation/maintenance costs and other commodity prices.

In order to achieve the new company's financial independence, a principal objective of the organizational improvement, the internal fund should be generated to a possible extent by raising the water tariff gradually.

Even when the affordability of low income water consumers is taken into account, still the present tariff can be raised up to a certain, realistic level. By paying a higher tariff, the consumers will learn that it will help improvement of the service, in addition to becoming aware of the value of water.

2.3.3 Billing

The water tariff should be billed, in principle, in accordance with the water metering because of its reasonableness and fairness. The particular attention should be paid, however, by the water authority to provide the meters sufficiently and perform the legitimate control for the maintenance and operation of the meters so that the billing by the water billing is practiced successfully.

The standpipes' consumption is to be metered and billed also, and the consumers, registering their right of usage for a particular standpipe, should share the water bill according to a pre-determined rule.

In cases when the supply is serviceable but a connection cannot be equipped by the water meter, due to shortage for instance, a flat-charge is recommendable to be adopted for the transitional period, until the meter becomes available. The flat-charge is best to be set, upon referring to the method consumption of similar households.

2.4 Personnel Management and Training

2.4.1 Manpower Development and Personnel Management

At present, each of the water services in Sharqiya Governorate employs sufficient number of personnel. However, it cannot be denied that the personnels' technique and knowledge are not necessarily satisfactory. Developing the manpower is urgent and important, and it will be achieved only by training the personnel intensively and extensively.

The personnel management is also important for the individuals and whole organization. Promotion, transfer, etc. should be made on the merit system. Fair and right management will motivate their will for self-improvement and self-discipline and end in a successful management of the whole organization. In connection with the merit system, introducing qualification systems to the organization will be worth-while.

2.4.2 Training of Personnel

a) For Personnel engaged in Operation

During the field survey of the existing water supply systems, Various inefficiencies in the operation were noticed. Such inefficiencies originate from the lack of skill and knowledge in the operation and insufficiency of the fund for maintenance. To remedy this situation, a thorough training of the personnel concerned is considered indispensable. It is, therefore, recommended that the personnel be given opportunities to participate in the training course held by NOPWASD and/or public water companies, in order to improve their capability in their assignments.

b) For Personnel engaged in Administrative and Engineering Works

It is worthwhile for the organizations, both public and private, to carry out the training through the routine works and to have their own in-house training programs, the curriculum of which usually include basic and general institutional, socio-economic and accounting courses and the high-level professional courses.

Also needed are the courses for promoting the managerial capabilities like educating/training the subordinates and coordination/integrating their functions.

c) For Personnel engaged in Engineering

Like any other organization, an engineering work is usually carried out by a team led by the engineer(s) and supported by the technicians and skilled workers. For a successful progress, communication and cooperation between the different organizational levels are of vital imoprtance while presenting the opportunities of on-the-job training for both the team and individuals.

2.5 Operation

2.5.1 Operation Manual

Operation manual for routine and emergency cases which cover intake, treatment, transmission and distribution facilities should be prepared for the convenience of operation. In the manual, careful and safe handling of chlorine gas should be emphasized.

2.5.2 Coordination of Public Utilities

As a city grows in size and the inhabitants' living standard rises, the necessity of using roads for the public service utilities such as laying the pipes of water supply, sewage and drainage underground and spanning the cables of electricity and telephone on the sides of public roads increases, while the traffic congestion worsens obviously.

In planning and executing these utilities, coordination of the responsible agencies concerned is essential for the better use of road spaces, both above- and under-ground, and is effective in saving the construction costs. For such a coordination of plans and schedules, the interested agencies, including the service utilities, road maintenance and traffic control, are recommended to have meetings periodically or to form a joint-committee, in which every location of the structures to be installed/constructed in the right-of-way along the

roads and every stage of the works should be consented.

2.5.3 Filing of Drawing/Documents

One of the most serious problems experienced in the field is the lack of records, drawings, and documents which every organization is expected to keep in file and make ready for use. These documents are needed both for the proper execution of routine operations and for the right planning of facilities expansion.

For the appropriate maintenance of meters and adequate billing, every record of meters should be kept on file.

As the documents are the public property, taking out and returning to the library must be recorded. The regulations and organizational set-up for it should be prepared, as required.

The documents should be classified, indexed and filed, preferablly in plural numbers for different offices concerned, and kept in order under the care of responsible persons.

a) Distribution Pipelines

Drawings and related documents of the pipelines should be kept in good order and condition, while the list of materials, dimensions and technological records like installation, accidental damages and repairs should be revised and updated for technical and managerial purposes.

b) Service Installations

A service installation differs from other water supply facilities in that it has two components of the public and private property. The record of service installation is to be considered as a contract document which must be kept in file under a good care. Such records should be classified by the consumer's name and/or address.

Every service installation should be maintained with a positive goodwill management of consumers.

c) Identification of Valve/Hydrant Location

In the surveyed area for the leakage study, finding the exact location of stopvalves, drain valves and fire hydrants has often presented difficulties, especially in case of the old supply systems.

Making the marks of them on nearby structures like house-walls, electricity poles and curbstones will be helpful for easy detection, while recording the location on the map should be practiced.

2.5.4 Groundwater

The groundwater in the Governorate has some problems in its quality and quantity. In the northern area, it is not potable due to the salinity, and in the southern area, some existing wells contain a high concentration of iron and manganese sometimes. Also in the southern area, some wells fail to produce water due to the seasonal dropdown of the water table.

Monitoring the wells with regard to the mentioned points will be both useful and valuable for the future development of groundwater in the area.

2.5.5 Leakage and Wastage Problem

As a result of the leakage survey in the field, it has been found that most part of leakage and/or wastage was caused by the faulty valves/taps damaged by the consumers' carelessness and left unrepaired and by the leaking pipes and valves. It seems that leaks found by the nearby residents are not reported to the water supply authority. Almost all public taps like standpipes are left damaged and/or unclosed. A considerable amount of water should have been saved, if they were taken care of without delay.

To this end, the consumers should be encouraged to report any leaks, be it in their house connections or in the public roads. The water supply authority is recommended to train the staff and form teams specialized in detection and repair of leaks and let them make the perodical surveys of service area for leakage.

2.5.6 Repair of Water Meters

In most of the existing water supply services, malfunctioning water meters are left unrepaired, leaking to affect the supply services' financial situation adversely, and also to damage the mutual trust between the services and consumers.

Periodical checking of the water meters and immediate repair of the mulfunctioning meters should be made a rule in the services. An appropriate setup including the meter inspection/repair teams and the meter repair shop together with store should be prepared. The ownership and management of the water meters should be clarified legally and institutionally.

2.5.7 Provision of Bulk Water Meters

Except at the treatment plants' outlet, no bulk water meter has been installed to measure and/or record the flow for distribution. The bulk water meter's record should be used in estimating the daily use and the hourly fluctuation. Comparison with the consumer meters' record will be useful in evaluating the relationship of production and consumption.

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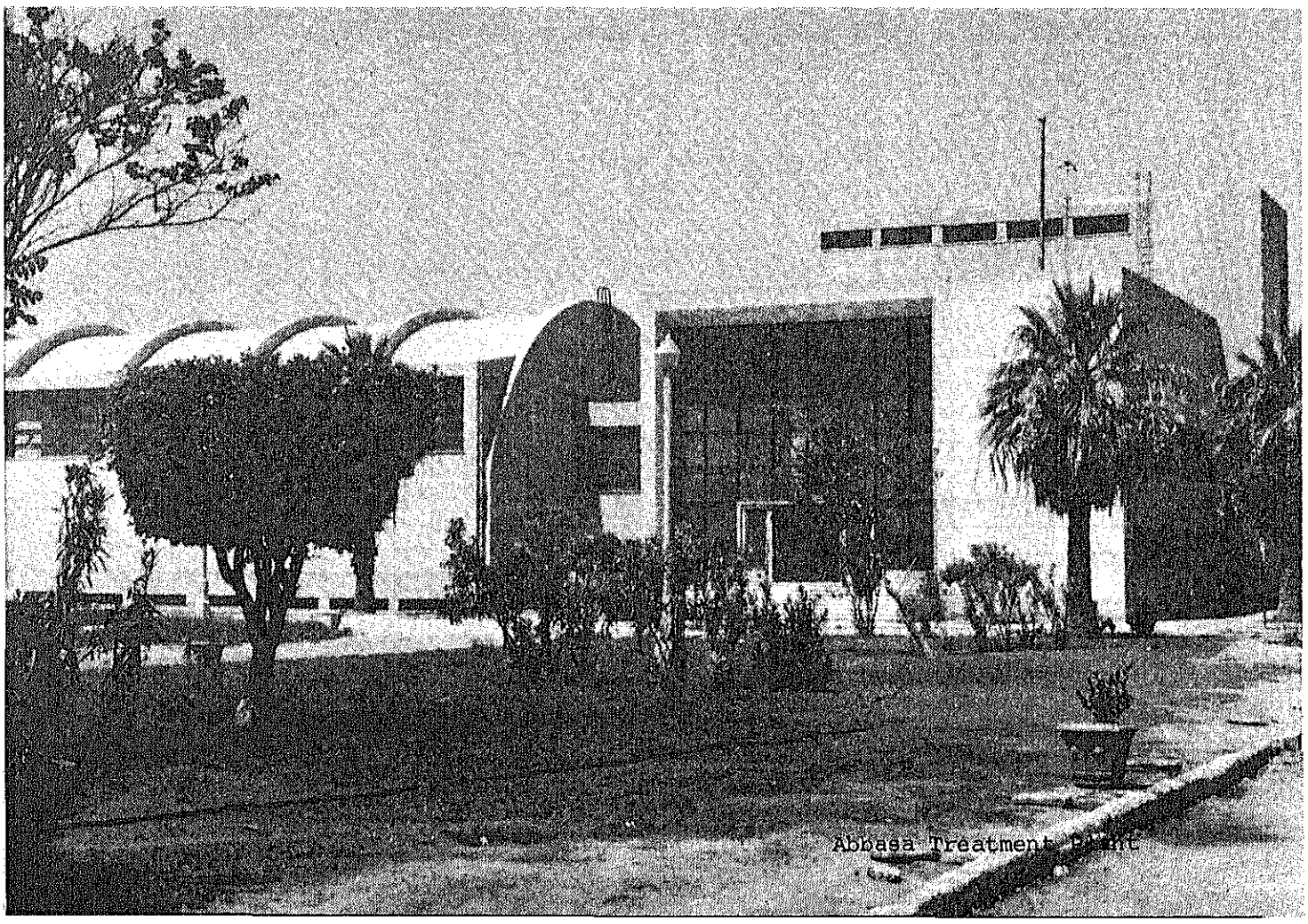
PART ONE
GENERAL



Abbasa Treatment Plant

FEASIBILITY STUDY ON
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PART ONE GENERAL

1. Background of the Study

The first large scale public water works were developed in Egypt at the beginning of this century. By 1940 about 30 surface water plants and 45 groundwater abstraction plants were in operation throughout the country. At present almost all municipalities in Egypt receive in part piped public water supply although the extent of coverage and supply conditions vary widely from place to place.

According to the study report of water supply all over the country prepared in the late 1970s with a financial assistance from the World Bank, it is of urgent necessity to rectify or improve severe shortage of potable water supply capacity, inadequate operation and maintenance. As the top priority areas to be improved, the five areas were selected as follows : Sharqiya, Beheira, Kafr el Sheikh, Suez-Ismailiya-Port Said, and Faiyum.

The Government of Egypt requested the Government of Japan to assist in improvement of one of selected areas, Sharqiya, with terms of reference based on the aforenamed report. In response to the request, the Government of Japan has decided to conduct a feasibility study on Sharqiya Water Supply systems.

Accordingly, Japan International Cooperation Agency (abbreviated as JICA), the official agency responsible for implementation of technical cooperation program of the Japanese Government, dispatched a mission to Sharqiya Governorate from February to March 1983. The Mission headed by Dr. Keiji Gotoh conducted a preliminary survey in the Governorate and held discussions on the scope of work for the forthcoming study.

On the basis of the preliminary survey report conducted by the mission, JICA organized a study team and send them to Sharqiya in Egypt for Feasibility Study on Sharqiya Water Supply System from August to November 1983, and May to August 1984. The schedule of the Feasibility Study was divided into two parts, namely, Long Term Program and First-Priority Phase Program, as follows:

Long Term Program

Field Survey	:	August - November 1983
Home Work in Japan	:	December 1983 - February 1984
Interim Report	:	March 1984

First Priority-Phase Program

Field Survey	:	May - August 1984
Home Work in Japan	:	September - December 1984
Final Report	:	December 1984

2. Objective and Scope of the Study

2.1 Objective of the Study

The objective of the Study is to prepare the Long Term Program up to the year 2005 for the water supply development in Sharqiya Governorate and to identify the First Priority-Phase Program up to feasibility level suitable for financing consideration by external sources.

2.2 Scope of the Study

The Study Area covers the administrative area of Sharqiya Governorate, excluding the area of 10th of Ramadan. The Study Area is shown in the Figs-1.1 and 1.2. The scope of the study is as follows:

1) Long-term Program

Study Area : Sharqiya Governorate

Target Year : A.D. 2005

Outline of the Study:

i) Basic Survey
   a) Collection of Data and Information
   b) Study of Present Status of Water Supply Systems
   c) Study of Socio-economic and Health Aspects

ii) Served Population and Water Demand
   a) Estimation of Population
   b) Study of Service Area and Service Level
   c) Estimation of Served Population
   d) Projection of Water Demand

iii) Planning of Water Supply System
   a) Study of Improvement of Existing Facilities
   b) Study of Water Sources
   c) Study of Required Facilities and Layout
   d) Design Criteria

iv) Construction, Management
   a) Cost Estimation of Construction and Operation & Maintenance
   b) Study for Organization, Operation and Maintenance Plan
   c) Economic and Financial Analysis

v) Identification of the First Priority-phase program

2) First Priority-phase Program

With regard to the urgently required works out of the whole works as identified above, a feasibility study for the First Priority-Phase Program will be carried out as shown below:

Study Area : Identified Area

Outline of the Study:

i) Served Population and Water Demand
   a) Estimation of Served Population
   b) Estimation of Water Demand

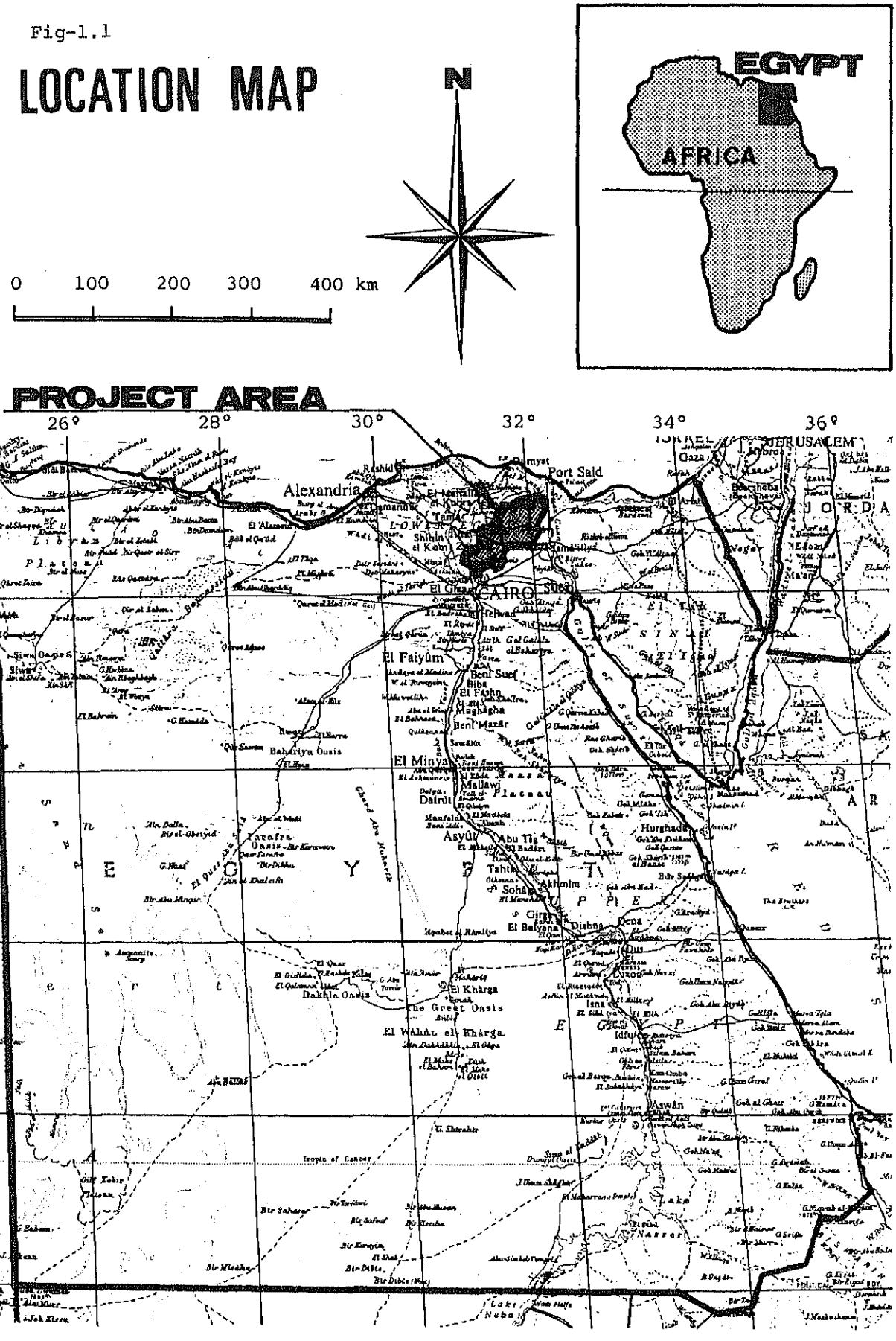
ii) Leakage Survey and Measures to be Taken
   a) Survey of the Leakage
   b) Measures for Reducing the Leakage

iii) Plan of Water Supply System
   a) Study for Alternative Plans
   b) Preliminary Design
   c) Labor, Materials and Construction Ability
   d) Construction Method and Procurement

iv) Construction and Management
   a) Cost Estimation of Construction and Operation & Maintenance
   b) Evaluation of Benefits
   c) Economic and Financial Analysis
   d) Study of Tariff System
   e) Organization, Operation & Maintenance Plan and Training Program
   f) Implementation Program

Fig-1.1

LOCATION MAP



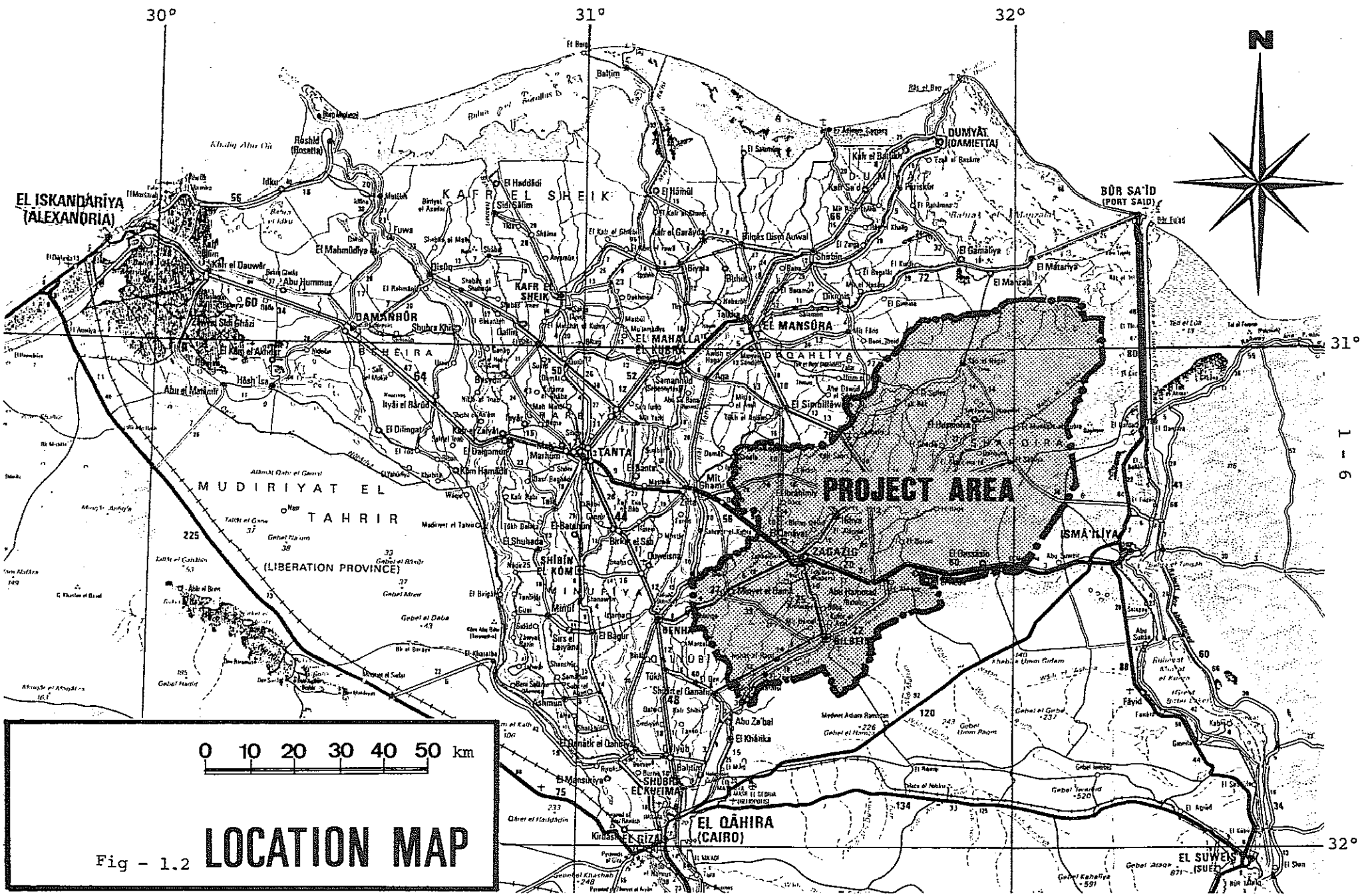


Fig - 1.2 **LOCATION MAP**

3. Terminology and Abbreviation

3.1 Terminology

The present study defines the terminology as follows:

Governorate	:	The political division of the nation. The Arab Republic of Egypt is composed of 26 governorates.
City	:	The governorate capital or the markaz capital.
Town	:	Refers to El Qenayat Town, which was separated from Zagazig Markaz in 1980 and have its own incorporated government for local affairs.
Markaz	:	Subdivision of governorate.
Marakaz	:	Plural of Markaz
Village	:	Sub division of markaz.
Urban	:	City and Town. There are 12 cities and 1 town in Sharqiya Governorate.
Rural	:	Villages of Markaz.
Standpipe	:	The publicly utilized hydrant connected with public pipelines. The standpipe is usually installed outdoors along pipeline for consumers' convenience, and may have a simple drain device.

3.2 Abbreviation

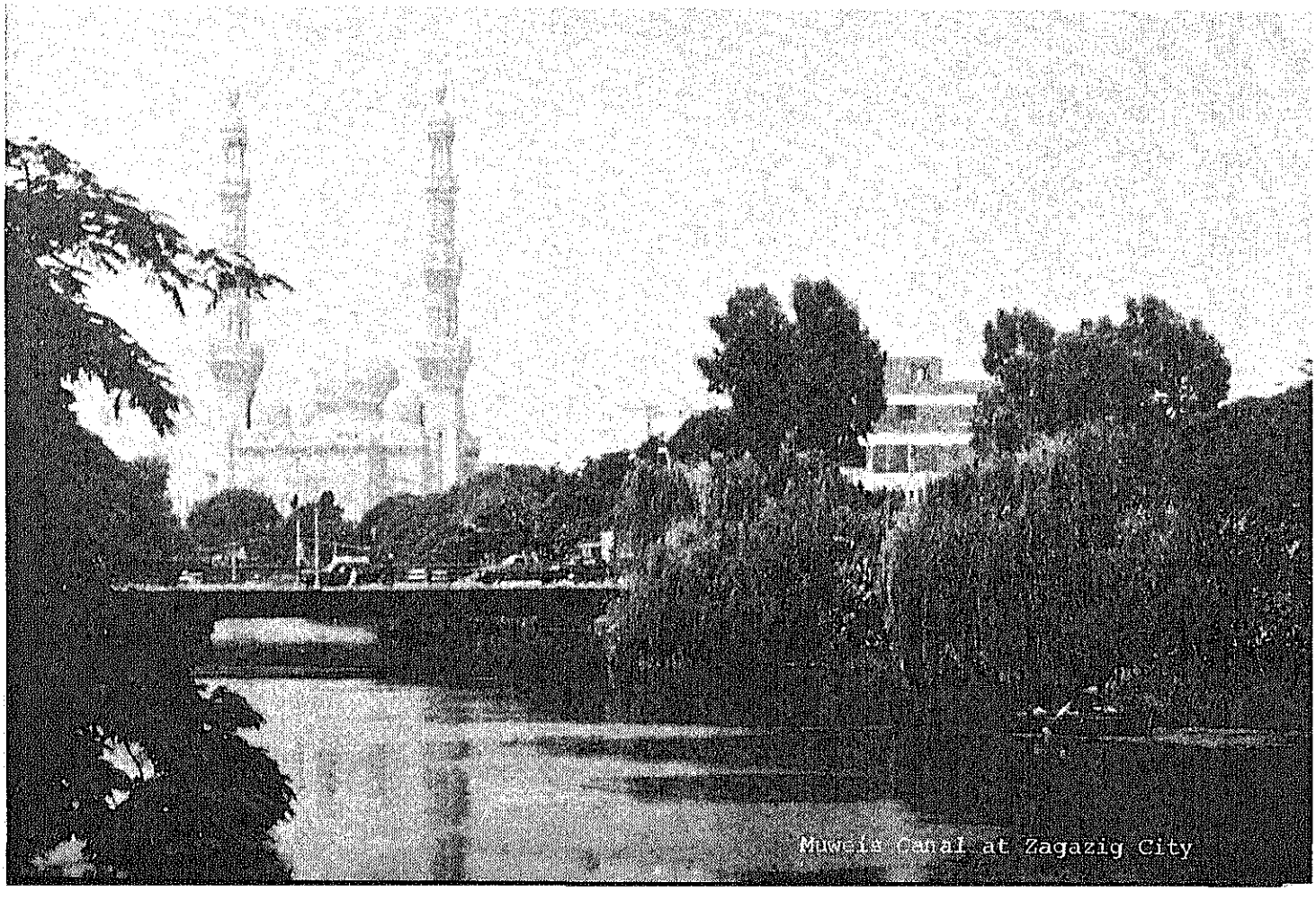
km	:	kilometer
m	:	meter
cm	:	centimeter
mm	:	millimeter
km2	:	square kilometer
ha	:	hectare
m2	:	square meter
cm2	:	square centimeter
m3	:	cubic meter
l	:	liter
ml	:	milliliter
cm3	:	cubic centimeter
d	:	day
hr	:	hour
min	:	minute
sec	:	second
ft	:	foot, feet
in or "	:	inch
lb	:	pound
kV	:	kilo volt
V	:	volt
kA	:	kilo ampere
A	:	ampere
MVA	:	mega volt ampere
kVA	:	kilo volt ampere
kW	:	kilo watt
kWh	:	kilo watt hour
Hz	:	hertz
a.c.	:	alternating current
d.c.	:	direct current
a.m.	:	ante meridiem
p.m.	:	post meridiem
WL	:	Water Level
HWL	:	High Water Level
MWL	:	Mean Water Level
LWL	:	Low Water Level
Ø	:	diameter
lcd	:	liter per capita per day
US$	:	US dollars
LE	:	Egyptian pounds

μS/cm	:	micro Siemens per centimeter (= micro mho per centimeter)
ppm	:	parts per million
pH	:	potential of Hydrogen
mg/l	:	miligram per liter
exp	:	exponential
Fig	:	Figure
No.	:	Number
DIP	:	Ductile iron pipe
SP	:	Steel pipe
PVC	:	Polyvinyl chloride pipe
ACP	:	Asbestos cement pipe

NOPWASD	:	National Organization for Potable Water and Sanitary Drainage, which was unified and organized with GOPW and GOSSD described below in 1981.
CAPMAS	:	Central Agency for Public Mobilization and Statistics
GOPW	:	General Organization for Potable Water
GOSSD	:	General Organization for Sewerage and Sanitary Drainage
JICA	:	Japan International Cooperation Agency
WHO	:	World Health Organization
UNDP	:	United Nations Development Programme
IBRD	:	International Bank for Reconstruction and Development

FEASIBILITY STUDY ON
SHARQIYA WATER SUPPLY SYSTEM
IN
THE ARAB REPUBLIC OF EGYPT

PART TWO
LONG TERM PROGRAM



Muweis canal at Zagazig City

FEASIBILITY STUDY ON
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CONTENTS

2. Existing Water Supply

3. Plan for Long Term Program

4. Project Identification

PART TWO LONG TERM PROGRAM

1. Present Condition of the Study Area

1.1. Natural Conditions

1.1.1 Location and Topography

Sharqiya Governorate, the study area, is located in the eastern part of the Nile Delta. The Governorate measures 100 km from northeast to southwest and 40 km from northwest to southeast and occupies about 4,000 km2. The elevation ranges approximately from 3 m to 10 m above sea level. Zagazig City, the Governorate Capital, is located 60 km northeast of Cairo, at approximately longitude 31°30' east and 30°43' north.

1.1.2 Climatic Feature

In Alexandria and neighboring area, the precipitation is about 100 to 200 mm throughout the season, while in the inland area it is far less. Table-1.1.1 shows the temperature, humidity and reinfall on various locations.

In Alexandria, the gap of temperature between the maximum and minimum is smaller, humidity slightly higher and rainfall much more than in the inland area, owing to the Mediterranean Sea's existence. The lower Egypt cities, Tanta, Zagazig and Cairo, located in that order from north to south, are similar in the climatic elements. The Upper Egypt city of Aswan shows severe conditions like a high maximum temperature in summer, very low humidity and no rainfall at all.

The local climate is characterized by hot dry weather usually from May to September. Although the average maximum temperature reaches above 30°C in summer, the heat is not too oppressive due to low humidity.
There is a distinct winter season, from December to February, when most of annual precipitation takes place.

Table-1.1.1 CLIMATIC CONDITIONS

Location	Season	Temperature (°C) Max.	Min.	Humidity (%)	Rainfall (mm)	Remarks
Alexsandria	winter	18.2	9.1	62	124.4	
	summer	29.1	21.4	66	Nil	
Tanta	winter	19.0	6.5	60	15.4	
	summer	31.7	17.7	60	0.2	
Zagazig	winter	18.6	7.9	60	13.8	
	summer	32.5	19.8	54	Nil	
Cairo	winter	18.2	8.8	54	1.0	
	summer	33.3	20.5	55	Nil	
Aswan	winter	22.9	9.0	47	Nil	
	summer	40.8	24.9	31	Nil	

1.2 Socioeconomic Conditions

1.2.1 National Economy

1.2.1.1 General Economy

Egypt's economic activities are characterized by its historic background after revolutionary independence by the ex-president Nasser in 1952 from the imperial rule extended over a long period with frequent intervention of foreign countries.

The nationalism was accentuated as dramatized by the nationalization of Suez Canal in 1956 and the centralized government control and subsidy system to enhance the living standard of the people especially for the poor dictated by a concept of the socialism.

Such economic policy was not fully capable, however, to solve the problem of resources shortage resulted from the rapid population increase in that period. Then the new economic open-door policy started since 1973 in the era of succeeding president Sadat in order to stimulate the economic activities and increase of foreign trade.

The present economic policy under the president Mubarak is a flexible reflection of the preceding policies with the centralized government control over the economic activities and amplified international connections. The general outlook of the policy is, however, oriented to the more decentralized government control and "laissez faire" economy to keep pace with the world-wide internationalization of the economic activities.

The main economic resources of Egypt are agricultural products and petroleum which affect the gross national products (GNP) and the main origin of the foreign currency contributing to the national balance of payment are the export of the oil, receipts from the tourism, tolls of Suez Canal and the remittance from Egyptian expatriate workers in the foreign countries mainly in the Middle East. The GNP per capita in 1981 is US $ 610.

Among the economic resources factor, the oil prices have an impact on both the government revenues and foreign exchange earning and resultant balance of payment which will further be related to the debt service problem. The recent deficit in the current balance of payments amounted to about US $ 2.4 billion (LE 2 billion).

The present government explicit and implicit subsidies and price control have been in operation on most of commodities which are effective to avoid the price escalation and to keep the economic stability. But its excessive government subsidies and sometimes interferences induce the economic distortion and anomaly in contact with international free market ignoring real opportunity costs and is liable to lead to the capital shortages in many corporations thus limiting their capacity to maintain or improve the quality in an open and competitive economy.

The government subsidies on essential commodities such as bread, rice and sugar are considered to be continued although some methods to restrict subsidies on non-essential commodities and benefits to the better-off are being reexamined. The direct subsidy costs have increased from LE 464 million in 1972 to about LE 2,000 million in 1981/2.

In spite of the government efforts to subdue the prices the consumer prices have escalated for the past several years due to the imbalance growth in supply and demand indicating the average escalation ratio of about 12 percent from 1974 to 1981. The following are tables indicating the price tendency for the past several years.

Table-1.2.1 INDEX NUMBERS OF WHOLESALE PRICES

(1965/1966 = 100)

Divisions	1976	1977	1978	1979	1980	1981
All Items	170.7	186.6	214.1	234.6	285.2	308.9
Agriculture Crops	188.6	214.8	258.9	266.6	342.4	372.3
Poultry & Fish	210.6	240.0	295.0	322.7	370.1	449.4
Inedible Animal Produces	231.7	281.0	293.0	313.9	335.4	372.5
Foodstuffs & Beverages	205.6	225.4	241.4	270.9	392.3	356.5
Tobacco & Its Manufact.	122.7	122.9	122.9	134.3	138.2	138.4
Yarn, Textile & Under Garments	124.7	127.6	163.9	183.0	218.2	237.5
Tanned Skins	187.3	187.4	187.4	187.7	180.4	201.7
Household Appliances	120.0	125.4	139.6	146.5	156.6	159.7
Petroleum & Fuel	154.3	159.1	168.6	190.3	230.6	240.1
Wood	292.3	369.1	361.9	363.8	482.2	478.5
Paper	257.2	241.0	248.1	291.3	390.0	415.4
Construction Materials	186.3	207.1	250.3	383.7	410.3	462.3
Medicines	110.2	148.1	158.3	158.3	178.2	183.2
Chemical Materials	131.9	130.8	132.1	146.3	183.8	200.9
Metals & Their Manufact	181.0	210.6	228.7	246.8	290.2	319.5
Machinery & Implements	169.0	169.0	207.3	245.3	262.3	263.3
Transportation Equipments	173.9	195.8	218.2	243.9	276.3	287.8

Source of Data : Statistical Yearbook July 1982

Table-1.2.2 INDEX NUMBER OF CONSUMER PRICES

URAN (RURAL)

(1966 / 1967 = 100)

Item	1976	1977	1978	1979	1980	1981
Furniture & Durables	134.7 (185.0)	149.0 (217.8)	176.7 (240.6)	187.7 (272.8)	187.7 (322.6)	200.5 (369)
Food & Beverages	196.8 (211.9)	225.0 (234.9)	246.5 (270.6)	264.9 (284.7)	335.6 (362.3)	383.1 (413)
Services	142.7 (151.6)	169.5 (177.0)	200.2 (201.5)	238.3 (228.5)	270.8 (267.0)	272.0 (305)
Housing	109.8 (112.9)	109.4 (111.9)	110.1 (112.2)	112.7 (114.7)	116.1 (134.3)	114.6 (135)
Transportation & Comm.	145.3 (125.0)	144.9 (125.0)	145.1 (125.0)	185.6 (125.0)	193.9 (125.0)	307.9 (125)
Clothing	145.3 (189.4)	172.7 (215.2)	225.2 (244.7)	246.2 (275.0)	284.3 (339.1)	308.3 (405)
Personal Expenses	127.5 (120.0)	132.7 (121.0)	149.7 (121.0)	182.3 (130.2)	210.7 (149.5)	213.8 (157)
All Items	164.2 (187.8)	185.1 (206.7)	205.6 (234.2)	226.0 (248.7)	272.7 (331.0)	301,2 (353)

* Figures in blackets are index number in rural area

Source of Data: Statistical Yearbook, July 1982

1.2.1.2 Population

The present population of whole Egypt is about 45 million mostly concentrated in the narrow Nile Valley and its Delta Region and several projections of future population were carried out by the local and international agencies and most estimates for the year 2000 fall in the range 65 - 70 million. The long term trends since 1950 in both the birth rate and death rate seem to be declining. This would leave the net rate of natural increase at around 2.2 to 2.5 % per year.

The family planning campaigns and birth control demonstrated its successful accomplishment indicating the first drop in the birth rate from 41 per 1,000 in 1981 to 37 per 1,000 in 1982. Family planning campaigns and birth control measures, however successful, are very slow to halt the momentum of population growth due to some religious constraints although population increase is the most fundamental problem facing Egypt.

1.2.1.3 Employment and Wage

The labor force in Egypt occupies about 31 % of the total population and is increasing at an average annual rate of 2.2 %. The female's participation in the total labor force is still limited consisting of less than 10 % of the total labor force although its growth rate is higher than that of male.

The employment in the agricultural sector is still the highest although its percentage has declined over the years representing 54 % in 1971 and 42 % in 1978. The employment in the government and social services is still significant and holds the second place in the labor force supported by the government policy to guarantee employment of the graduates with minimum qualification.

The growth rate of labor force in the industry, construction, manufacturing, transport and communication has recently been increased remarkably reflecting the Egyptian new economic policy for the industrial development. The new development of the industry motivated the continued flow of the workers from the rural areas to the urban areas.

The wages are varied widly among the different sectors. The wages of the agricultural laborers are far less than that of the industrial sectors and the shift of Egyptian economy away from the agriculture may increase the national income to be shared by the workers in the industrial sectors and thus increase the purchasing power and aggregate consumptions.

Such shift away from the labor intensive sector such as the agriculture to the capital intensive sector may, however, result in an increase of unemployment depending on the absorbing capacity of the industrial sectors for the increasing population. The unemployment rate of 1.6 % in 1973 has risen to 3.6 % in 1978 although this ratio is not so discouraging as compared to the population increase ratio of 7.08 % during the same period.

1.2.1.4 Water supply and development plan

The most of public water supply systems in Egypt are very old and their renewal and rehabilitation have been neglected over the years resulting in deterioration of the water supply services with frequent interruptions of supply and difficulties in pumping water to the upper stories in urban buildings. The rural areas are also suffering accute shortage of dependable sources of water.

The government has started to pay a serious attention most recently to solve the ever increasing problems and LE 129 million has been allocated in the five year plan in which the water production in most local governorates has been aimed to increase by one million cubic meters per day for the average per capita consumption of around 50 litres per day with expansion of water supply network so as to attain the service ratio of 85 % during the plan period.

1.2.2 Economy of the Study Area

1.2.2.1 Geography

The study area of Sharqiya is located in the Nile Delta region with an area of about 4,000 km2 or about 850,000 feddans and considered as the largest in all governorates in Egypt consisting of 2,960 km2 for the cultivated land, 240 km2 for the residence and 800 km2 of desert. The governorate played an important role in the history of Egypt owing to its strategic location in the struggle against the foreign invaders and for the revolutionary war.

The present land for the agriculture is fertile because it consists mostly of the mud which was distributed and accumulated from the Nile River when there were no dams and canals to interfere such flow of mud. There exist also many geographical elements advantageous to breeding ducks and fishes in many ponds and canals. The location of Sharqiya is convenient to contact with other governorates.

1.2.2.2 Population

The population of Sharqiya is 3,048,000 in 1983 divided into 692,000 (22.7 %) in the urban area and 2,356,000 (77.3 %) in the rural area, and its detailed description is presented in the separate section of this report specific for population. The migration of population from the rural area to the urban area and emigration to the Middle East countries to seek for incentive works are also apparent in Sharqiya in conformity with the national tendency in this respect.

The birth control to subdue the population increase is one of the subjects to be achieved in compliance with the national policy. The publicity activities have been attempted so that importance of the birth control and its method become generally known. Some difficulties are, however, anticipated due to the religious constraints especially in the rural areas.

1.2.2.3 Economic Activity

The main economic activities are related to agricultural productions including rice, wheat, beans, maize, potato, and other vegetables, breeding cows, chickens, rabbit, sheep and other animals for food. Table 1.2.3 indicates the leading crops in Sharqiya.

Table 1.2.3 Leading Crops in Sharqiya, 1982

Crops	Area (Feddan)	Annual Production (ton)
wheat	177,000	93,500
rice	165,000	21,900
corn	18,900	10,500
maize	23,500	12,200
cotton	114,700	41,200
bean	21,500	7,000
sugarcane	5,000	5,800
peanut	5,700	3,400
onion	1,500	8,640
others*	10,700	47,400

* others: include herb, seed, cereal, potato and fruit

Data Source : Sharqiya Governorate

1 Feddan = 4,710 m2

Many projects related to development of the agriculture are therefore undertaken such as the irrigation and land reclamation. In addition to the many poulty farms, dairies, fish farms and farms for pigeon, rabbit, sheep and cows, there are many public distribution centers for food commodities derived from the said farms.

Most of the food producing corporations are owned by the government and the prices of foods are controlled. The distribution of the essential commodities such as rice, wheat, and sugar are strictly controlled and price level of such commodities are kept under stable condition.

The following are some projects related to the agricultural development most recently undertaken in Sharqiya.

- The modernization of the agriculture by introducing machines in 59 villages with total cost of LE 537,344 including U.S. financing of LE 15,000,
- The livestock farming project in 3 local units to feed 280 head of cattle annually,

- Development of honey production by introduction of modern method to produce honey 70 tons annually,
- Planting 200,000 trees at sides of roads and canals,

- Construction of workshop for furniture as beds, doors, windows
- Chicken farm project,
- Transportation project for agricultural purpose, surfacing the rural roads, and
- Distribution of agricultural machines, workshop for repair, maintenance.

While the major economy of Sharqiya is agriculture, there are some other industries such as spinning, carpet manufacturing, wood-working, textile industries distributed mainly in the urban area. The Table 1.2.4 shows the distribution of the factories.

Table 1.2.4 Industries in Sharqiya

Markaz	Number of Factory	Main Products
Zagazig	8	textile, soap, rice milling, cooking oil, cattle feedes, coca cola
Kafr Saqr	1	carpet
Faqus	7	spinning, ice
Abu Kebir	5	fruits, canned juce
Abu Hammad	4	fruit juce
Ibrahimiya	2	food processing
Hihya	12	N.A.
Diarb Nigm	170*	tile, iron, carpet, milk
Bilbeis	90*	spinning, cattle feedes
Minyet el Qamh	9	N.A.
Mashtul el Soak	12	jute
Qenayat Town	3	wood-work, carpet

* The number includes small commerce shops

N.A. : Data is not available

Data Source: Questionary Survey by Survey Team

1.2.2.4 Employment and Wage

The higher percentage of the labor force in Sharqiya is engaged in the agriculture followed by employment in the government sector.

The factory workers and those working in commerce and business mostly in the urban areas are comparatively small in number.

The agricultural sector and government sector are playing a buffering role to subdue unemployment by absorbing those people otherwise unemployed. Those employment figures in above two sectors are therefore not necessarily meaning full employment in real terms of productivity.

The average individual wage is LE 50 - 60 per month and such wage is not sufficient to sustain normal quality life especially in the urban areas where general price level is higher and they are obliged to engage normally in multiple additional jobs with labor force of the family to earn gross family income sufficient to make both ends meet. The average family income per month can be considered ranging from LE 100 - 200 based on the household visit survey.

1.2.2.5 Public Utilities

Since there were no data to indicate the existing utilities, the questionary survey has been made to every Markaz in Sharqiya. Although the data obtained by above survey are considered not physically accurate and some of them are based on extemporaneous estimation, they are presented by Table-1.2.5 to show the outlook of present condition.

Table-1.2.5 Utilities Service Ratio (%) in Sharqiya

Markaz	Urban (Rural) Water Supply	Sanitary System	Electricity	Paved Road
Zagazig	80 (70)	80 (60)	(70)	(60)
Kafr Saqr	70 (N.A.)	50 (N.A.)	N.A.	N.A.
Faqus	50 (5)	5 (N.A.)	50 (95)	20 (N.A.)
Abu Kebir	90 (40)	50 (N.A.)	95 (80)	50 (N.A.)
Abu Hammad	95 (10)	75 (15)	95 (80)	N.A.
Ibrahimiya	90 (10)	20 (10)	100 (80)	90 (50)
Hihya	70 (30)	20 (0)	90 (70)	50 (10)
Diarb Nigm	100 (80)	90 (2)	100 (90)	20 (0)
Bilbeis	48 (N.A.)	40 (N.A.)	48 (N.A.)	15 (N.A.)
Minyet el Qamh	68 (30)	68 (5)	100 (8)	20 (5)
Mashtul el Soak	66 (33)	-	70 (40)	-
Qenayat Town	60 (-)	-	85 (0)	10

Note : Above figures are intact transcription of the data obtained from questionnaire and figures should be observed with a certain reserve since they are considered based on subjective estimation of those who provided the data.

N.A. : Data is not available,
Data Source : Questionary survey by survey team

As for the water supply, the details of existing water supply systems are described in other section of this report.

The public water supply of the Sharqiya governorate is largely dependent on the two water sources, i.e., surface water from the canal through the treatment plant and groundwater from the well. The water supply systems are presently controlled by three different functional units, namely, Abassa Regional Water Supply, City-owned Water Supply and Housing Department Water Supply Systems. The whole aspect of the water supply is identified as below.

Functional Unit	Water Source	Served Population
Abassa Regional Water Supply	Canal water & Groundwater	1,548,000
Housing Department Water Supply	Groundwater	802,000
City-owned Water Supply	Canal Water & Groundwater	607,000
		2,957,000

The above served population is approximately 97% of total population of 3,048,000. This high service ratio numerically obtained as above is rather disguising and not necessarily indicating a satisfactory water supply condition. Most of the people are suffering water shortage from the insufficient supply capacity owing to the multiple causes such as the deterioration of the water supply facilities and leakage as well as scarce water production.

Among the various public utility systems the irrigation and canal are well developed due to its importance for the dominant agricultural activities. The electricity and road network are also well developed in parallel with introduction of new equipments, pumps and plants driven by electric power and transportation systems for the agriculture purpose.

1.2.2.6 Education

The development of the education is emphasized in Sharqiya in accordance with the national policy to render all people equal opportunity for education and all costs of the public schools consisting of primary school (6 - 12 years, of school age), preparatory school (13 - 15 years), and secondary school (16 - 18 years) are subsidized by the government and the public high school (18 - 20 years) and public universities are free except for the expenses of textbooks.

The keen interest of Sharqiya governorate to develop education system is illustrated by its significant budget allocated in this sector in 1983 approximately 40% of governorate budget as shown in Table-2.5.1 of section 2.5.2 Existing Financing Status. The distribution of schools and numbers of the students in whole Sharqiya are indicated in Table-1.2.6.

Table 1.2.6 Numbers of schools and students as of 1983

Markaz	Level school	No. of school	No. of students
Zagazig	primary	121	42,074
	preparatory	25	13,792
	secondary	2	577
Huseiniya	primary	84	21,860
	preparatory	19	6,598
	secondary	6	3,422
Kafr Saqr	primary	78	28,122
	preparatory	17	9,150
	secondary	7	4,958
Faqus	primary	115	42,000
	preparatory	21	15,419
	secondary	9	8,817
Abu Kebir	primary	62	23,876
	preparatory	12	6,902
	secondary	6	5,069
Abu Hammad	primary	74	27,800
	preparatory	19	10,097
	secondary	7	6,040
Ibrahimiya	primary	25	8,311
	preparatory	4	1,875
	secondary	2	524
Hihya	primary	47	16,073
	preparatory	13	5,567
	secondary	2	1,159
Diarb Nigm	primary	73	26,621
	preparatory	18	9,829
	secondary	7	6,172
Bilbeis	primary	91	42,565
	preparatory	24	14,270
	secondary	9	11,863
Mashtul el Soak	primary	23	8,500
	preparatory	6	3,252
	secondary	4	1,830
Minyet el Qamh	primary	116	12,038
	preparatory	23	12,944
	secondary	13	7,555
EL Qenayat Town	primary	11	4,278
	preparatory	1	1,806
	secondary	1	595
Total		1,197	474,200

Data Source : Questionary survey by survey team

1.2.3 Public Health

The government is exerting efforts to combat infections, endemic diseases by the extensive gratis health services especially for the rural areas. The medical services are available to all people in the government hospitals at nominal fees. The local pharmaceutic products are being increased and they are distributed by privately owned pharmacies. The total number of pharamacy in Sharqiya as of 1981 is 259.

The prevalent causes of the morbidity, more or less related to waterborne diseases, are bilharzia (schistosomiasis), amoebic dysentry, ankylostomiasis, diarrhea, enteric fever, cholera, poliomiyelitis, infective hepatitis, food poisoning. Among the above, more rampant diseases are bilharzia and amoebic dysentry for which official data have been obtained and they are indicated in Table 1.2.7.

The questionary survey was made for the present condition of health facilities since there were no written data concerned. The replies to the questionnaire are presented in Table 1.2.8.

The waterborne diseases are, in general, closely related with availability of drinking water and number of incidence of the diseases normally decreases in accordance with the increase of per capita production of the drinking water.

The ratios of incidence of two representative deseases in Sharqiya as indicated in Table-1.2.7 are compared with the production per capita in every Marakaz as manifested in Table-1.2.9 and the graphical illustrations have been explored, based on above Table, as shown in figure-1.2.1 to verify above relation of inverse proportion to be apparent in the Sharqiya Governorate.

Such phenomenon as illustrated induces the socio-economic justification for the water supply development which reduces waterborne diseases and enhances the public health standard of the community.

Table 1.2.7 Incidence of waterborne disease 1980 - 1981

Markaz	Area	1980		1981	
		Bilharzia	Amoebic Dysentry	Bilharzia	Amoebic Dysentry
Zagazig	Urban	2,923	209	3,504	687
	rural	16,575	4,471	15,144	3,287
Huseiniya	urban	981	860	1,032	920
	rural	11,490	3,145	14,037	3,548
Kafr Saqr	urban	9,566	6	2,591	13
	rural	12,597	1,727	11,060	1,304
Faqus	urban	1,856	243	1,413	307
	rural	10,370	2,730	15,226	2,277
Abu Kebir	urban	8,348	833	1,933	803
	rural	6,848	1,573	8,520	1,826
Abu Hammad	urban	1,721	158	1,483	140
	rural	6,561	1,177	8,828	2,728
Ibrahimiya	urban	834	140	711	209
	rural	2,521	370	2,006	521
Hihya	urban	1,206	50	1,082	50
	rural	2,894	1,534	9,204	1,386
Diarb Nigm	urban	1,464	36	1,105	45
	rural	7,086	2,124	8,306	1,930
Bilbeis	urban	1,694	477	1,215	318
	rural	6,957	2,714	9,156	2,598
Mashtul el Souk	urban	1,109	462	1,037	607
	rural	2,289	740	2,204	1,052
Minyet el Qamh	urban	1,200	507	964	468
	rural	7,987	1,425	8,758	1,908
TOTAL	urban	32,902	3,981	18,070	4,567
	rural	94,175	23,730	112,449	24,365
		127,077	27,711	130,519	28,932

Data Source: Health Department for Sharqiya Governorate, Ministry of Health

Table 1.2.8 Health Facilities in Sharqiya

Markaz	Hospital	Clinic	Bed	Doctor
Zagazig	7	9	1,340	216
Huseiniya	1	25	564	112
Kafr Saqr	1	19	30	253
Faqus	16	-	399	196
Abu Kebir	3	55	192	57
Abu Hammad	21	-	782	68
Ibrahimiya	10	-	200	12
Hihya	6	25	250	80
Diarb Nigm	1	26	156	92
Bilbeis	2	-	146	86
Minyet el Qamh	2	50	302	89
Mashtul el Soak	6	10	40	15
El Qenayat	1	4	52	13
Total	77	223	4,453	1,289

Data Source: Questionary survey by survey team

Table-1.2.9 INCIDENCE RATIO OF WATERBORNE DISEASES AND PER CAPITA PRODUCTION

Marakaz	Per Capita Production(lcd)	Incidence of Bilharzia per 10,000 persons		Incidence of Amoebic Dysentry per 10,000 persons	
		1980	1981	1980	1981
1. Zagazig	159	127.2	152.5	9.1	29.9
2. Huseiniya	33	605.6	637.0	530.9	567.9
3. Kafr Saqr	88	6,211.7	1,682.5	3.9	8.4
4. Faqus	194	421.8	321.1	55.2	69.8
5. Abu Kebir	76	1,370.8	317.4	136.8	131.9
6. Abu Hammad	68	869.2	749.0	79.8	70.7
7. Ibrahimiya	72	401.0	341.8	67.3	100.5
8. Hihya	118	474.8	426.0	19.7	19.7
9. Diarb Nigm	136	602.5	454.7	14.8	18.5
10. Bilbeis	164	216.9	155.6	61.1	40.7
11. Mashtul el Souk	72	450.8	421.5	187.8	246.7
12. Minyet el Qamh	111	317.5	255.0	134.1	123.8

Note : 1. Per Capita Production is based on production status of existing city-owned water supply system in every Marakaz.

2. Incidence ratio is derived from the figures in Table-1.2.7 and approximate urban population in every Marakaz assumed from Table-3.3.1 Projected Population in Page 2-119.

1.2.4 Sanitary Sewerage

GOSSD, the former national organization of NOPWASD, studied the sanitary sewerage all over the country and reported that every urban dwelling with an individual water connection had some sort of piped drainage system. Buildings not served by an individual connection were unlikely to have any drainage facilities. In the rural area the most common places for defecation were the fields and the animal room, but latrines were used where available.

According to the World Bank Study carried out in 1980, the percentage of urban population within Egypt that had wastewater facilities, septic tanks and so forth is estimated as follows :

a)	Population served by sewers	10%	55%
b)	Population served by septic tanks	45%	
c)	Population served by soakaways	10%	45%
d)	Population without wastewater disposal facilities	35%	

At present, 14 existing sewerage systems are operated in provincial Egypt and there are two systems in Sharqiya Governorate, that is, at Zagazig city, the capital of the Governorate, and at Faqus city which is one of Markaz capitals located at about 30 km northeastward from the said Zagazig city. Zagazig system was constructed at the end of 1930s with British engineering. The system consists of pipelines, pump stations and a treatment plant. Faqus system is composed of only pipelines and pump stations without a treatment plant.

The population served by sanitary sewerage system is estimated as follows :

Table -1.2.10 SANITARY SEWERAGE IN THE GOVERNORATE

System	Population	Served Population	Service Ratio
Zagazig city	257,000	231,000	90%
Faqus city	49,000	34,000	70%
Total	306,000	265,000	87%

For a typical sewerage system in Sharqiya Governorate, Zagazig system is employed to state the present condition of sewerage being operated currently, as Zagazig system resembles to Faqus.

1.2.4.1 System of Facilities

Not only in Zagazig city but also in the whole area of this part of the Nile Delta, the sanitary sewerage system is characterized in that storm sewers are not needed due to the extremely low rainfall.

Historically, the city's system was constructed in the end of the 1930s and consisted of a treatment plant and a pipework of sanitary sewers collecting wastewater in the city area, which was smaller than the present one. A pumping station that received the city's wastewater, located close to the railway station, pumped it to the treatment plant, 2 km distant to the southeast. The plant effluent, treated through a process of primary sedimentation followed by aeration, was again pumped and discharged to Ghar drain canal of about 1 km away.

As the city area expanded, the sewers were extended with additional installation of three pumping stations, one in the north and two in the south district of the city. Owing to flatness of the area, a pumping station is always needed for the pipework covering the area. Of the four pumping stations, two are working in series to send water to the treatment plant while the other two, bypassing the plant, discharge directly to the canal. As the city has expanded westwards recently, a new pumping station is planned to be constructed in the near future.

The pump station in the original system has become gradually obsolete, while being overloaded, and rehabilitation works are ongoing to restore and increase the capacity to 27,000 m3/day. Upon completion of the works, however, the station will be reserved for a standby as new station, constructed in the same compound as the old one side by side, has been in operation since 1981. The new station's present capacity is also 27,000 m3/day, being limited to the sewer pipeworks' collection capacity, while the pumps are capable to pump 50,000 m3/day. The station as a whole is called the main station.

The treatment station constructed in the 1930s was put out of operation since 7 years ago. A new plant has been under construction to be completed by the middle of the 1990s. It will employ a process comprising primary sedimentation, biochemical treatment and chlorination.

The list of the existing pipework, classified by the diameter, material, length and the year of construction, is shown in the following table. While the overall length of pipes has grown remarkably, the large trunk mains have not been renewed for about half a century. It obviously becomes bottleneck of the collection capacity.

1.2.4.2 Organization

Under the mayor of Zagazig city who serves concurrently as the headmaster of Zagazig Markaz, a chief engineer manages two public services of water supply and sanitary sewerage, each of which is managed by a sub-chief engineer under the control of the chief engineer.

Sanitary Sewerage Division is divided into two sections of Pipework Section and Station Section.

About 120 persons working for the Pipework Section are categorized into : 20 engineers and technicians with 40 administrative personnel assigned to store-keeping, gardening, car driving and so forth on the daytime work schedule and about 60 laborers engaged in maintenance works. The 60 laborers, doing maintenance works mostly and extension works occasionally, are to clean the whole pipelines at three months' interval for a week's duration at night.

About 100 persons working for the Station Section are categorized into : 25 engineers and technicians with 15 laborers under them, serving exclusively on the daytime schedule and about 60 persons on the three-shifts schedule, all engaged in operation of five plants, one treatment and four pumping. A shift team consists of one technician and three laborers.

Table-1.2.11 SANITARY SEWERS

No.	Dia.		Material	Length	Construction
	Inch	mm		(m)	Year
1	36	900	Cast Iron	150	1938
2	30	750	Cast Iron	900	1938
3	24	600	Clay	100	1938
4	22	550	Cast Iron	600	1940
5	18	450	Clay	1,500	1945
6	15	375	Cast Iron	300	1945
7	12	300	Clay	2,500	1955 ~ 60
8	12	300	A.C.P.	1,000	1979
9	9	225	Clay	12,000	1955 ~ 60
10*	9 - 7	225~175	Clay	20,000	1938 ~ 80
	36 - 7	900 - 175		39,050	1938 ~ 80

(Note) Data Source : Sanitary Drainage Dept. of Zagazig city.

* : All branches from main to housing.

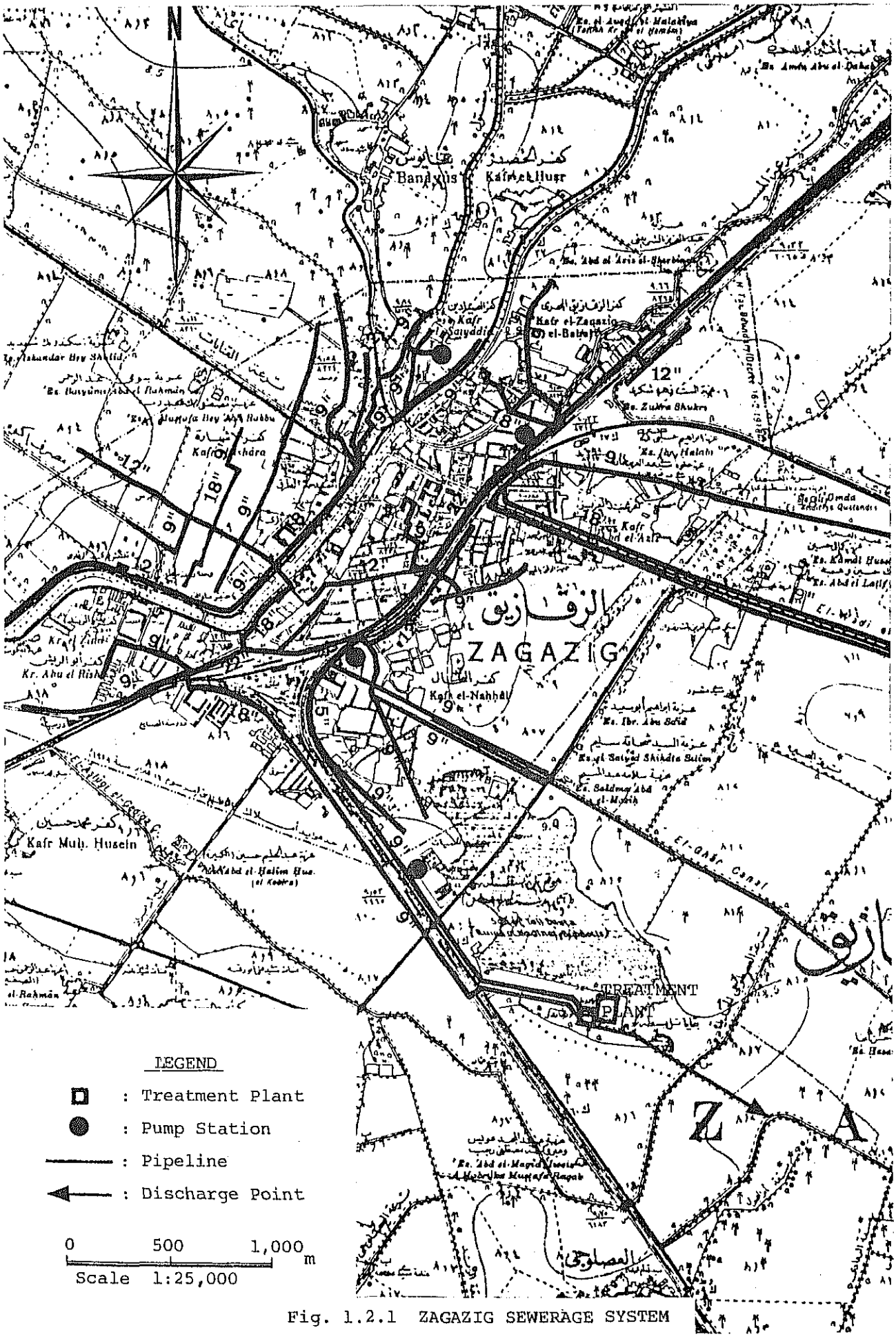


Fig. 1.2.1 ZAGAZIG SEWERAGE SYSTEM

1.3 Population

1.3.1 Records of National Census

The national censuses were conducted in the country in 1882,1897,1907,1917,1927,1937,1947,1960,1966 and 1976. CAPMAS is the organization that conducts the census, analyses data and publishes the results. It is also responsible for the studies such as estimating the future population of the country and analyzing the internal migration.

The records of 1960, 1961 and 1976 Censuses, containing populations down to the village level, are available in Arabic at CAPMAS.

The census records of Sharqiya Governorate, from 1882 to 1976, are presented in Table-1.3.1. Further detailed populations by Markaz from 1960 to 1976 are shown in Working Paper No.5 attached in Appendix.

Sharqiya Governorate's population has been about 7% of all Egypt's for the last two decades. Since 1960, the male population has been larger than the female's.

The administrative changes were frequently undertaken : two Marakaz and one Town were established as described in the following section ; merger, separation, and renaming were often among villages. In addition to such administrative changes, lack of the census maps makes the demographic analysis impractical at the village level. From such condition 1976 populations only are adjusted according to the present Markaz boundaries.

1.3.2 Administrative Changes

After the execution of the 1976 National Census of Egypt, three times the administrative changes of merger and separation were carried out among the Marakaz and villages as shown in Table-1.3.2.

Table-1.3.1 Sharqiya Governorate Census Records

Year	Male	Female	Total (A)	Egypt(B) (x 1,000)	A/B(%)
1882	227,768	229,663	457,431	6,712	6.8
1897	367,615	367,270	734,885	9,669	7.7
1907	435,076	437,397	872,473	11,190	7.8
1917	462,884	475,108	937,992	12,718	7.4
1927	521,377	550,752	1,072,129	14,178	7.6
1937	575,412	597,046	1,173,458	15,921	7.4
1947	668,072	693,591	1,361,663	18,967	7.2
1960	913,878	905,920	1,819,798	26,085	7.0
1966	1,058,803	1,049,168	2,107,971	30,076	7.0
1976	1,334,860	1,283,078	2,617,938	36,626	7.2

(Note) Source : CAPMAS

Table-1.3.2 Reform of Markaz

No.	Before Separation	After Separation	Year Undertaken
1	Zagazig Markaz	Zagazig Markaz	1980
		El Qenayat Town	
2	Bilbeis Markaz	Bilbeis Markaz	1977
		Mashtul el Soak Markaz	
3	Hihya Markaz	Hihya Markaz	1979
		El Ibrahimiya Markaz (Including 3 villages separated from Abn Kebir Markaz and 1 village from Kafr Sagr Markaz)	

(Note) Source : Planning Department, Sharqiya Governorate

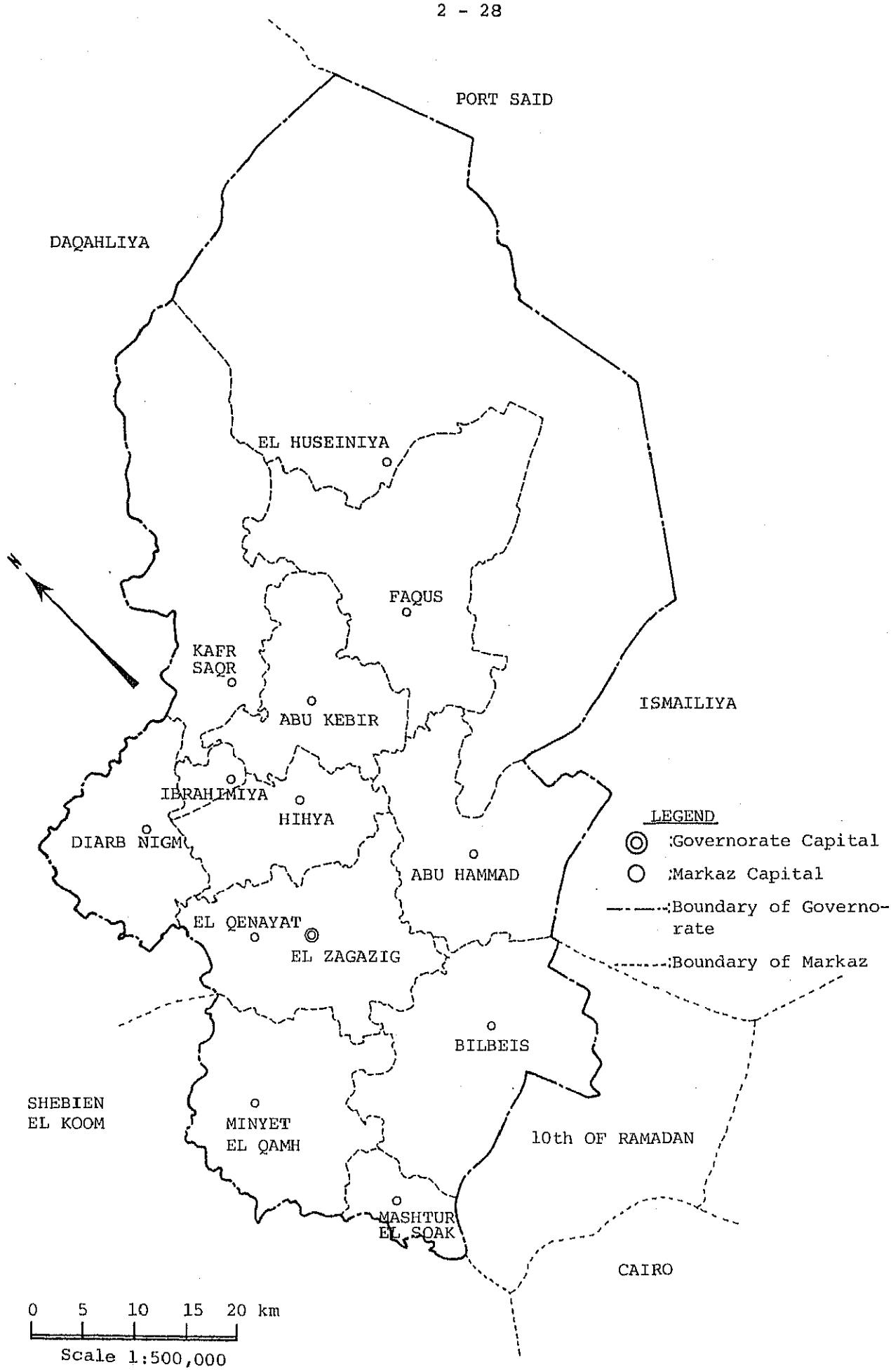


Fig. 1.3.1 SHARQIYA GOVERNORATE

1.3.3 General Trend

The increase rate of the population in Sharqiya Governorate is in general bigger than that of all Egypt, although the difference is small. For instance, the annual increase rate between 1960 and 1976 in the Governorate is 2.30% and in all Egypt the rate is 2.17%.

According to the 1976 Census conducted by CAPMAS, it is estimated that the outgoing population is about two times of the incoming one in the Governorate.

The increase rate in the Governorate is shown below;

Table-1.3.3 Intercensal Growth Rate

(% per annum)

Period	Sharqiya Governorate			Egypt		
	Urban	Rural	All	Urban	Rural	All
1947 - 1960	3.03	2.18	2.31	3.43	1.91	2.45
1960 - 1966	4.71	2.03	2.49	3.52	1.67	2.39
1966 - 1976	3.14	1.96	2.19	2.82	1.47	2.04
1947 - 1976	3.42	2.07	2.31	3.24	1.70	2.29
1960 - 1976	3.73	1.99	2.30	3.08	1.54	2.17

"Urban" refers to the Governorate capital and Markaz capital, while "Rural" to the villages.

2. Existing Water Supply

2.1 General

The first modernized water supply system in Sharqiya Governorate was constructed at Zagazig city in 1909. The treatment plant of the system supplied the settled water obtained from Muweis Canal water to the central area of the city at that time, through cast iron pipelines which are still utilized at present as distribution system. Secondly Bilbeis and Minyet el Qamh cities' systems were constructed in 1928, and Faqus city in 1932, respectively. In this manner a number of cities had their own systems until 1954.

In the meantime, for isolated areas where groundwater was obtainable as potable water, many rural water supply systems were planned and constructed by the Housing Department of Sharqiya Governorate from the beginning of 1950s. At present groundwater 27,000 m3 a day is supplied to about 802,000 persons in 189 villages. In the isolated rural areas, however, supply condition of electric power is very poor in spite of every effort to improve such condition, and almost all cases of the Housing Department systems are compelled to operate their systems for only several hours a day.

To supply potable water to many municipalities and communities which had not their own systems and/or no appropriate water sources, Abbasa Water Supply System started operation in 1959 as one of regional systems planned nationwide by GOPW which was the former national organization of NOPWASD. In addition, many groundwater pumping stations have been added to Abbasa System as supplementary facilities, in response to the intense and frequent request of the public for supplying water.

It is estimated at present that 227,000 m3/day of potable water is supplied for 2.3 million of served population which accounts for about 80% of total population 3.05 million persons through these city-owned systems, systems managed by the Housing Department of Shqrqiya Governorte and Abbasa Regional System.

Nowadays these systems stated above are operated and managed by Sharqiya Governorate in line with the national policy of decentralization, although there may be certain confusions in some aspects.

In this chapter, the existing water supply will be studied and evaluated from both of technical and managerial sides.

2.2 Water Sources

2.2.1 General

All of the water sources in the Nile Delta, of surface water and groundwater, depend fully on the Nile River. The Nile River builds up a vast delta area spread to the north of Cairo city located at the pivot of a fan, delta. In the Nile Delta a numerous canals which are branched from the Nile River develop, in which two Branches of Rosetta and Damietta are representative and they are diverted from the Nile River at Shubra el Kheima.

Rosetta Branch flows through the western area of the Nile Delta and directly empties into the Mediterranean Sea, and Damietta Branch runs north at about the middle of the Delta and the water flows into Manzala Lake located at the northeastern part of the Delta.

Ismailiya Canal, one of the biggest canals in the Delta and branched from the Nile River at Cairo city, flows down along the southeastern edge of the Delta from west to east, and reaches finally Ismailiya city.

As for the geology of the Nile Delta, unconsolidated strata of sediment cover the base rock. The sediment consists mainly of sand and gravel of Alluvial-Quaternary which forms a huge aquifer in the Delta, and partly contains lenslike layers of clay in the aquifer.

The geological structure of the aquifer looks like a plate which is thickest at the middle of the Delta and becomes thin at the edge. The thickness of aquifer will be about 100 - 900 m. However the aquifer keeping the concentration of salinity of 1,000 mg/l or less lies within 300 m below the surface.

Figs-2.1.2 and 2.1.3 show the north-south and east-west sections of the Delta, and Fig-2.1.4 the estimated contour of the fresh water across the Delta.

The groundwater in the northern Delta is generally saline and the boundary of the fresh water area (less than 1,000 mg/l) passes through Ismailiya city and Abu kebir to Kafr el Sheik. The permeability coefficient of the aquifer is about 60 - 100 m/day, and the layer at 55 - 150 m depth has the highest permeability. The storage coefficient of the center of Rosetta and Damietta Branches is about 0.20, and in the neighboring area of the center 0.001 - 0.0001.

The groundwater of the aquifer flows along the topographic gradient from south to north. The groundwater table at the pivot of the Delta fan is about 15 m above the sea, and at the coastal area about 1 m above the sea.

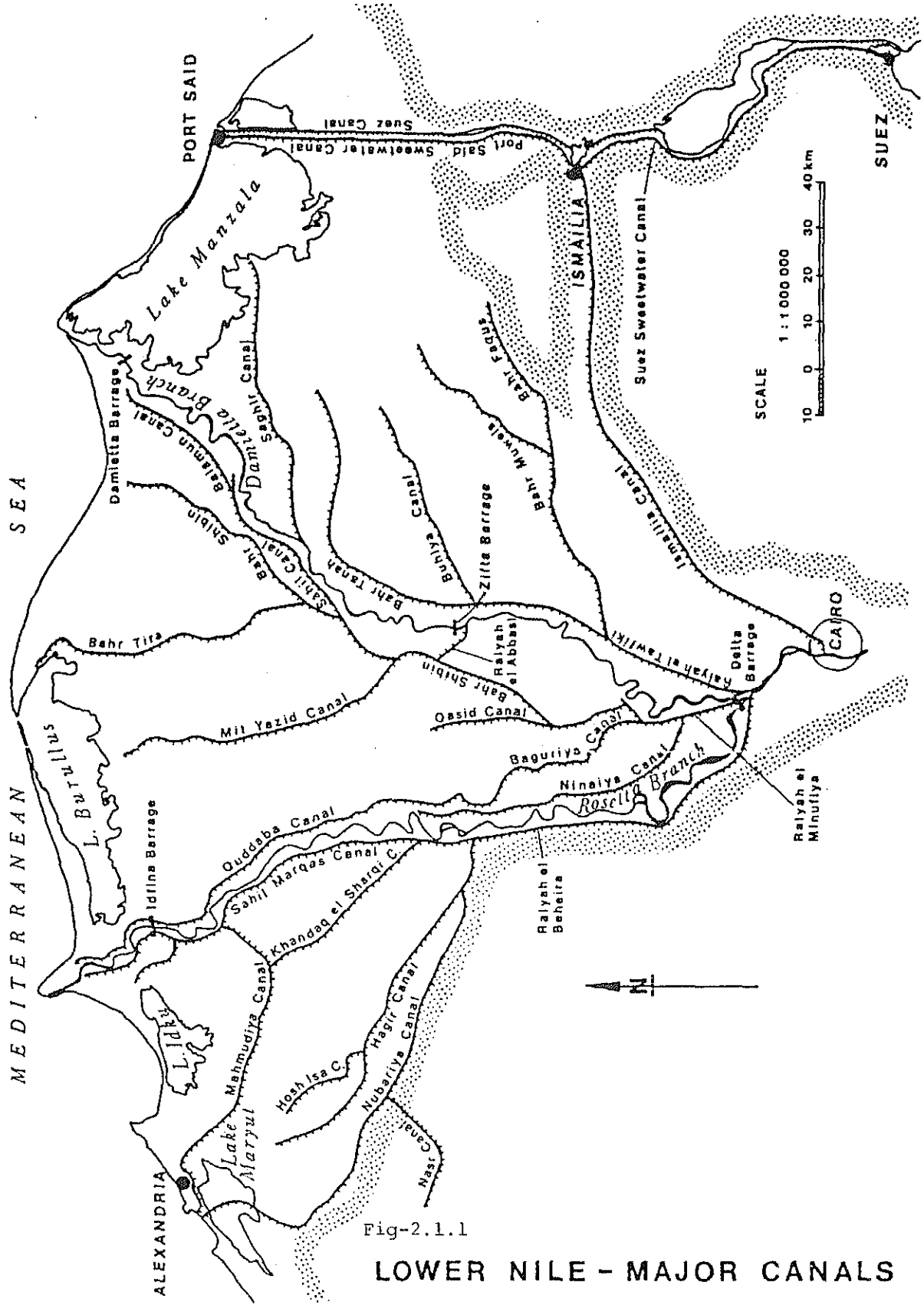


Fig-2.1.1

LOWER NILE - MAJOR CANALS

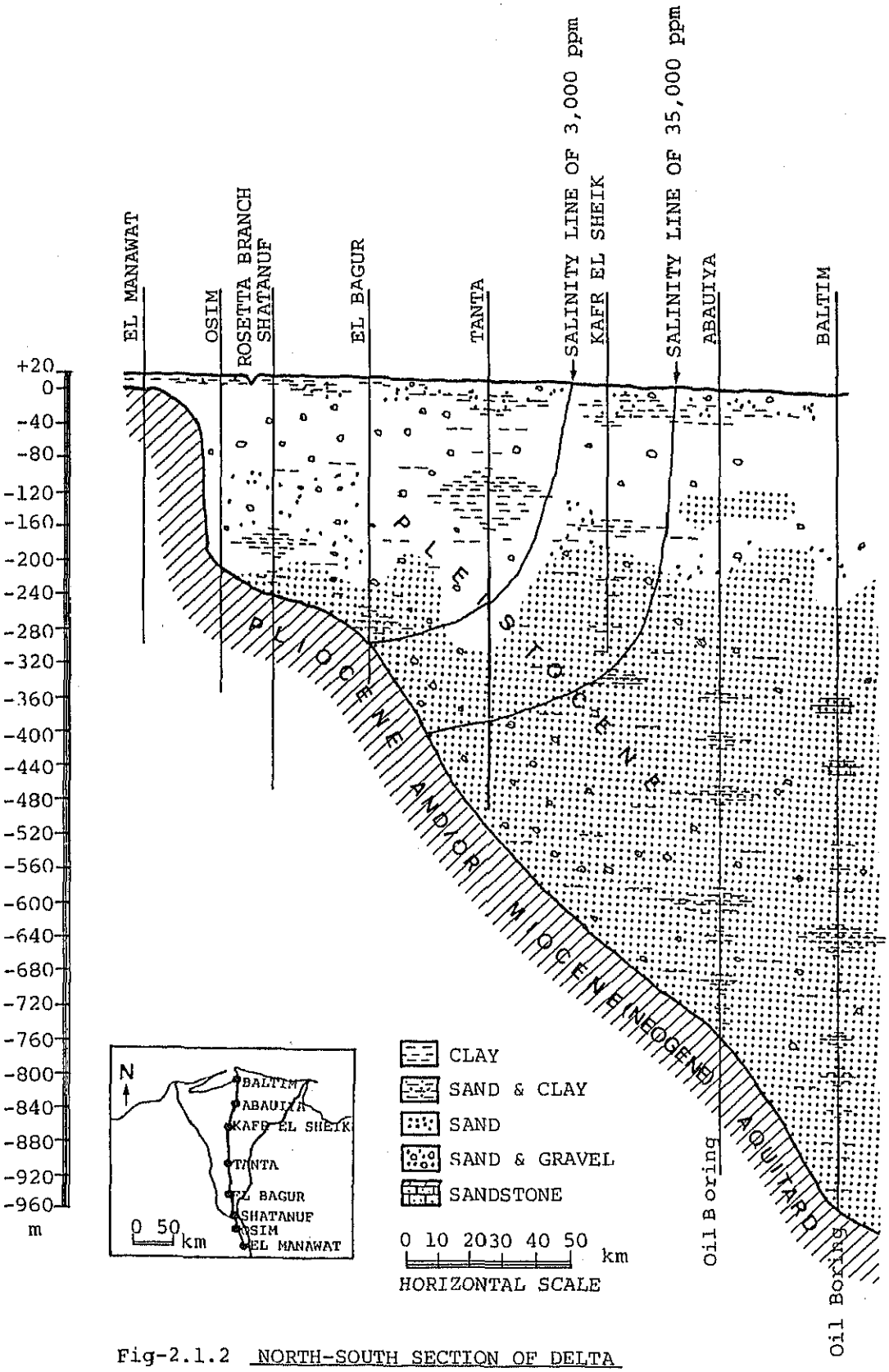


Fig-2.1.2 NORTH-SOUTH SECTION OF DELTA

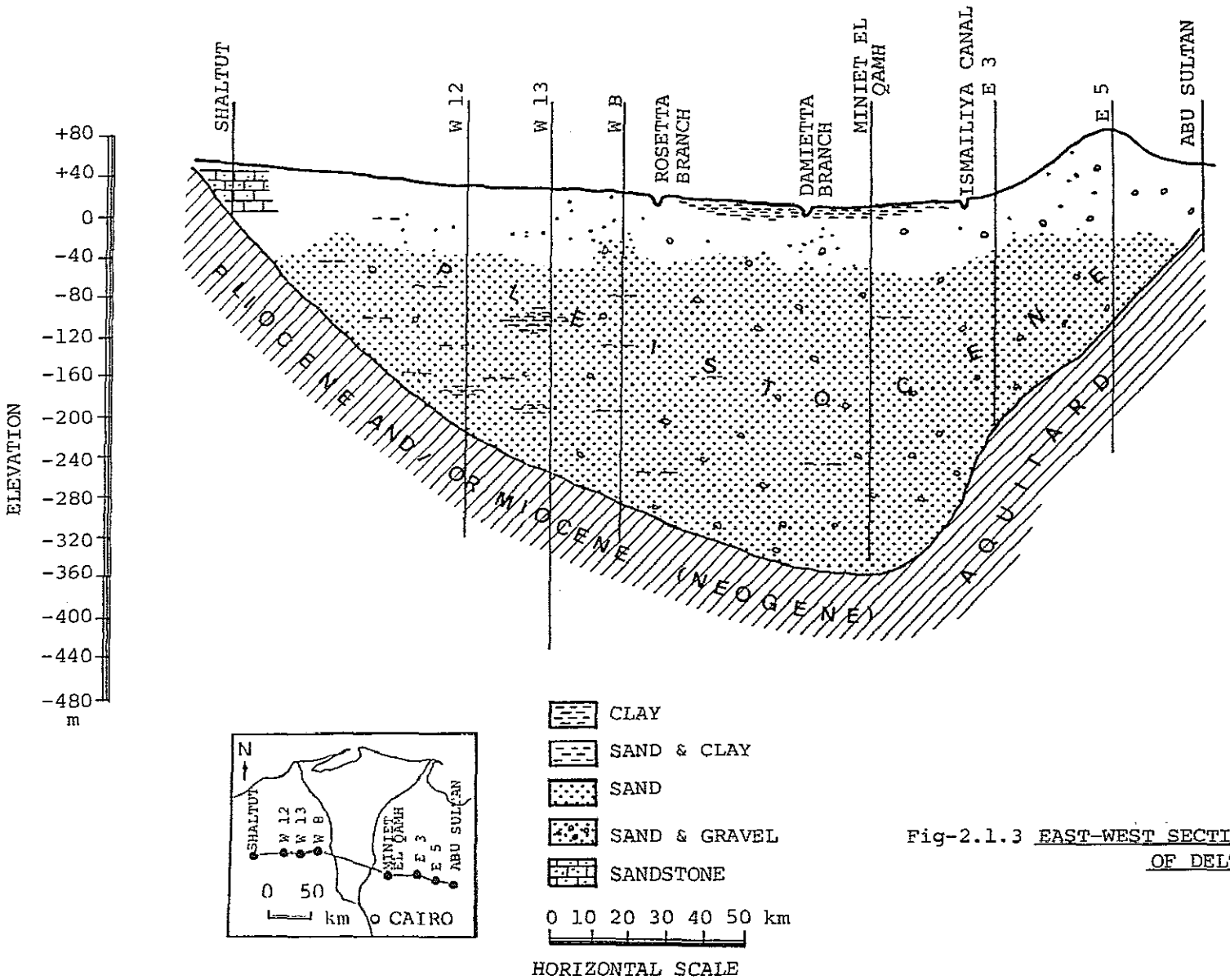


Fig-2.1.3 EAST-WEST SECTION OF DELTA

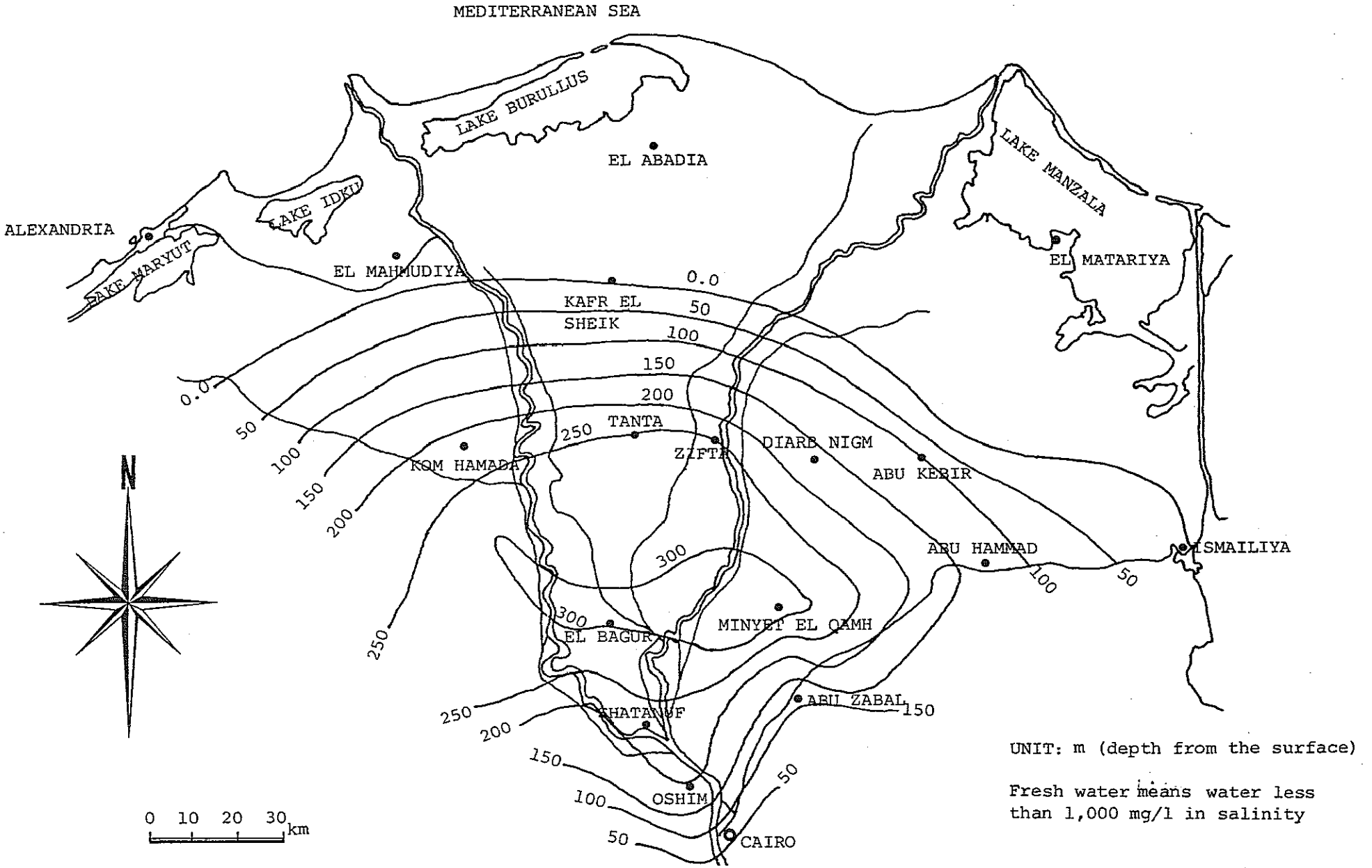


Fig. 2.1.4. CONTOUR MAP OF FRESH WATER THICKNESS IN THE DELTA

2.2.2 Existing Canals

The canals are mapped on Fig-2.2.1. All canals flowing in or through Sharqiya Governorate originate in the mainstream of the Nile River. Except for the Ismailiya Canal, which heads east, the major canals run northwards and discharge into Manzala Lake, and collect inflows of drainage canals on the way.

The major canals are divided into two groups according to their sources, one taking water from El Raiyah El Taufiqi Canal and another from Ismailiya Canal. Muweis Canal belongs to the former group while El Wadi and El Saidiya to the latter. Faqus Canal, though originating in El Raiyah El Taufiqi Canal, receives water of El Wadi Canal, a branch of Ismailiya Canal.

Muweis Canal is a branch of El Raiyah El Taufiqi Canal, branched at Benha, and flows northwards through Minyet el Qamh, El Zagazig, Hihya and kafr Saqr Marakaz. The mainstream changes its name to El Hanut Canal between Hanut and Kasaby, and to El Dafan Canal from Kasaby downwards, through San el Hagar, to Manzala Lake.

The water quality upstream of Hanut is kept well as it does not receive any wastewater dicharge, but at Hanut, it receives a substantial amount of both domestic and agricultural wastewater, resulting in deterioration of water quality. Examination of the conductivity and chloride concentration shows that they change from 600 µS/cm, 83 - 100 mg/l between El Zagazig and Kafr Saqr to 1,500 µS/cm, 246 mg/l at Hanut and 1,600 µS/cm, 260 mg/l at Dafau, indicating obvious increase of the values or notable decrease of the water quality as shown in Table 1 and 2 of Working Paper No.1.

Ismailiya Canal is branched from the Nile River at Cairo, flows northeast and runs about 50 km distance through Sharqiya Governorate, approximately one third of the 130 km total length from Cairo to Ismailiya. It turns east after crossing the Governorate boundary near Abbasa and reaches Ismailiya.

El Wadi Canal is branched from Ismailiya Canal at Abbasa, flows through the city of Abu Hammad and discharges into Faqus Canal at Abu el Akhder. A pump station located on the way pumps wastewater to the canal. Another station is planned to be installed in the future. Deterioration of the water quality will be almost inevitable.

El Saidiya Canal is also branched from Ismailiya Canal, at a point close to the branch of El Wadi Canal and then flows northwest, passing by the east of Faqus City. The canal does not receive wastewater. Faqus Canal is the downstream part of Bahr Abu el Akhder Canal, a branch of Muweis Canal, the name being changed on the way, and reaches Faqus City. It merges with El Wadi Canal which has received wastewater and further downwards it will receive more wastewater from a planned pumping station. Degradation of the quality will be forecast with certainty.

El Samana Canal, branched from Faqus Canal at Faqus City area, flows north to El Huseiniya City. Beside the major canals as described heretofore, a number of minor canals branched from them run across the area like trees' branches and boughs.

Also, canal systems which contain wastewater from habitation and drainage from farmland run in a similar way as canal systems which are used for water supply.

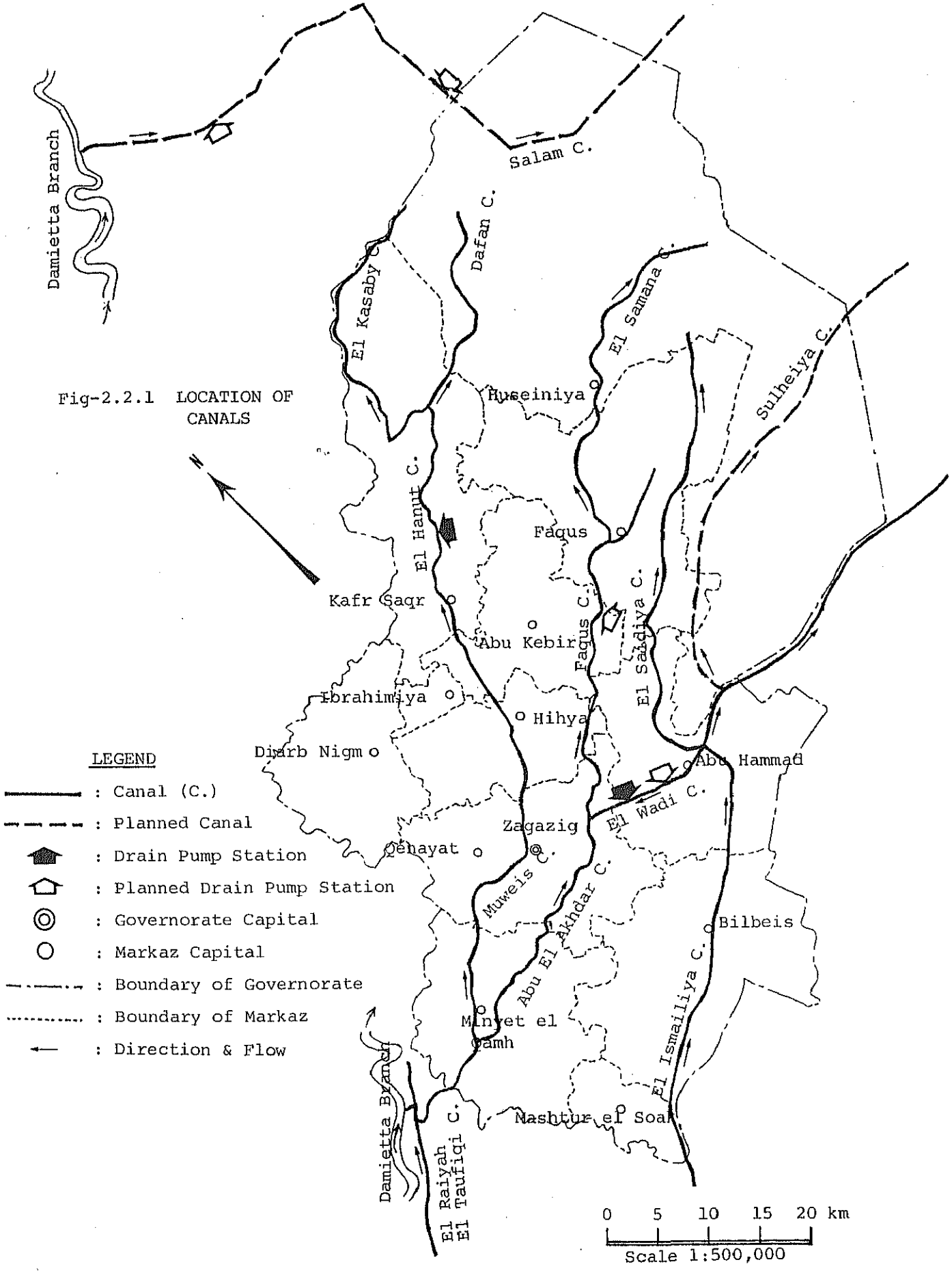


Fig-2.2.1 LOCATION OF CANALS

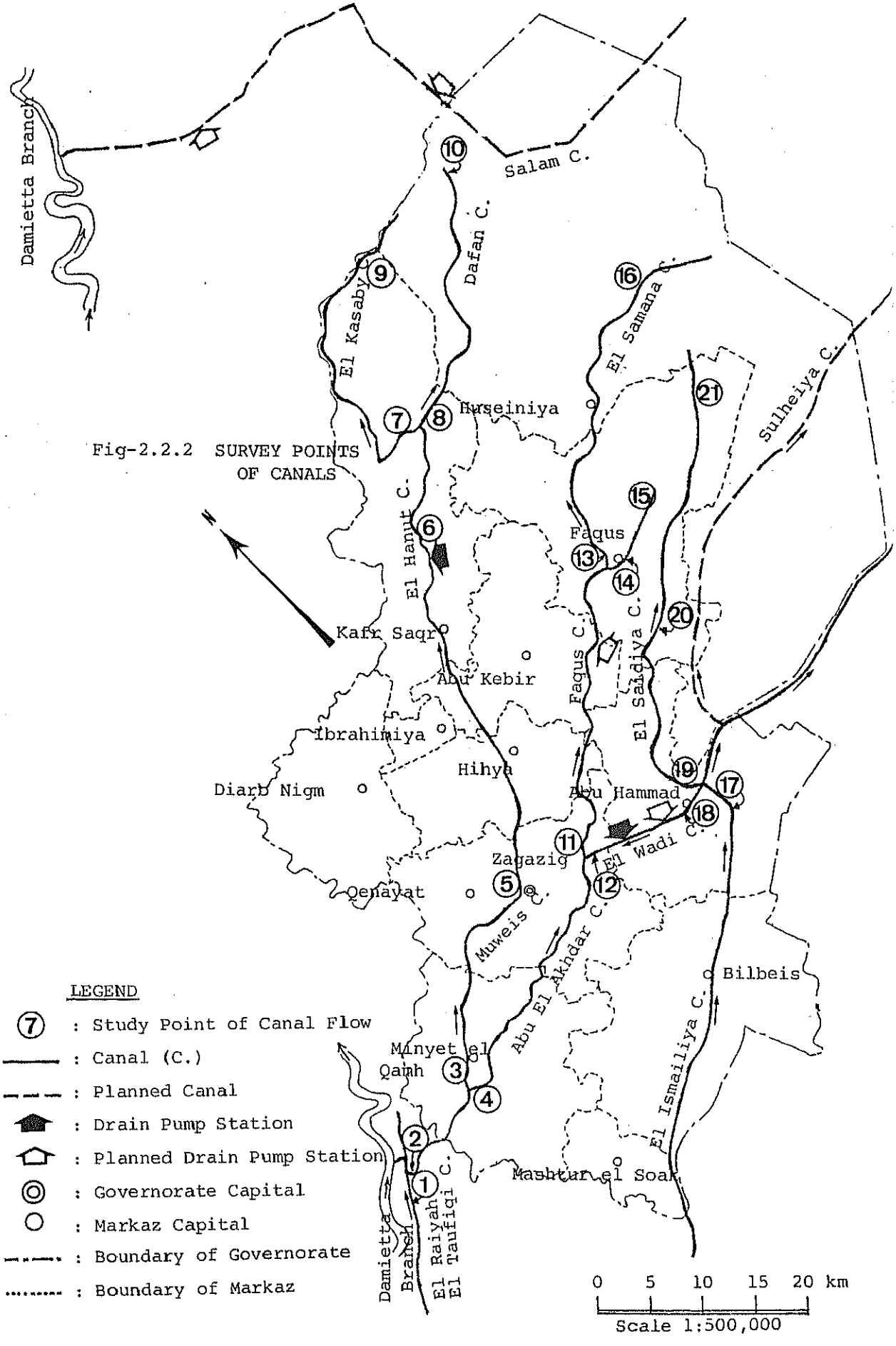
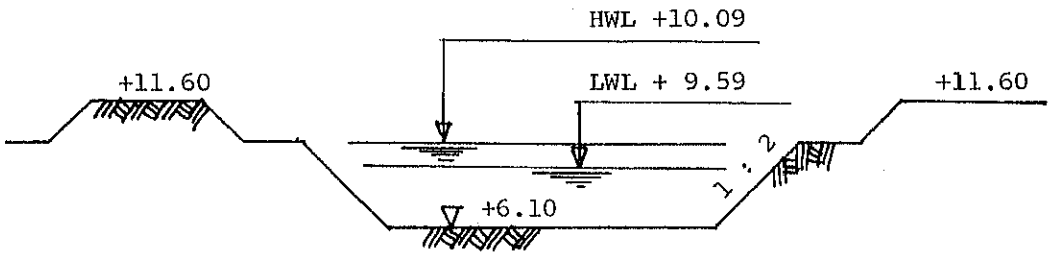


Fig-2.2.2 SURVEY POINTS OF CANALS

Dimension of Ismailiya Canal at Abbasa

High Water Level	(HWL)	= +10.09 m	above sea level
Low Water Level	(LWL)	= + 9.59 m	above sea level
Elevation of Bank		= +11.60 m	- do -
Elevation of Canal Bed		= + 6.10 m	- do -
Width of Canal Bed		= 54.00 m	
Gradient of Canal Edge		= 1:2	

Fig-2.2.3 SECTION OF ISMAILIYA CANAL



(Note) The section denotes the final plan at Abbasa Plant.

Table - 2.2.1 WATER LEVEL, DISCHARGE AND SECTION OF CANALS (a)

No.	Name of Canal and Location	Water Level High (m)	Water Level Low (m)	Discharge Max. (m3/sec)	Discharge Min. (m3/sec)	Cross Section Width of Canal Bed (m)	Cross Section Elevation of Canal Bed (m)	Cross Section Side Slope	Note
1	El Raiyah El Taufiqi (Before Muweis branch)	+12.47	+12.00			40	+7.50	1:2	1/
2	Muweis Canal (After branch)	+12.40	+10.50	144.7	34.7	46	+8.60	1:2	1/
3	Muweis Canal (Before Abu El Akhdar branch)	+11.30	+9.75	137.1	31.8	46	+7.75	1:2	1/
4	Abu El Akhadar Canal (After branch)	+10.60	+8.80	46.3	13.8	20	+7.50	1:2	2/
5	Muweis Canal (In Zagazig City)	+ 9.40	+8.75	111.1	23.1	26	+5.15	1:2	1/
6	Muweis Canal (After Kawasienr)	+ 4.00	+2.70	21.8	6.5	13	+1.43	2:3	2/ 3/
7	El Kasaby Canal (After branch)	+ 2.40	+1.80	14.2	4.3	8	+0.15	2:3	2/ 3/
8	Dafan Canal (After branch)	+ 2.40	+1.80	13.9	4.2	9	+0.15	1:2	2/ 3/
9	End of Kasaby Canal	+ 0.70	+0.45	zero	zero	5	-0.20	2:3	2/ 3/
10	End of Dafan Canal	+ 0.20	-0.65	zero	zero	1	-1.46	1:2	2/ 3/
11	Faqus Canal (After branch)	+ 7.60	+6.60	64.35	19.3	25	+4.40	2:3	1/ 4/
12	East Wadi Canal (supplying to Faqus Canal)	+ 8.00	+7.00	24	7.2	13	+5.05	2:3	1/ 4/
13	El Samana Canal (After branch)	+ 5.40	+4.50	32.1	4.6	15	+2.40	2:3	2/ 4/

Table - 2.2.1 WATER LEVEL, DISCHARGE AND SECTION OF CANAL (b)

No.	Name of Canal and Location	Water Level High (m)	Water Level Low (m)	Discharge Max. (m3/sec)	Discharge Min. (m3/sec)	Cross Section Width of Canal Bed (m)	Cross Section Elevator of Canal Bed (m)	Cross Section Side Slope	Note
14	Faqus Canal (After Samana Canal branch)	+5.42	+5.10	5.13	1.5	14	+2.65	2:3	2/ 4/
15	End of Faqus Canal	+5.35	+4.50	10.3	7.4	8	+3.05	2:3	2/
16	End of El Samana Canal	+2.40	+2.10	nil	nil	8	+1.13	2:3	2/ 4/
17	Ismailia Canal (Before East Wadi branch)	+9.45	+8.90	332		54	+5.46	1:2	
18	East Wadi Canal (After branch)	+8.70	+7.90	19.8	6	15	+5.80	2:3	1/
19	El Saidiya Canal (After Canal)	+8.20	+7.75	42	12.6	19	+5.10	1:2	2/
20	El Saidiya Canal	+6.30	+5.50	35	10.5	16	+3.31	1:2	2/
21	El Saidiya Canal (After branch of Brttigh)	+4.20	+3.50	21.4	6.4	14	+1.90	1:2	2/

Note :
1/ No water flow during period end of December to around 20th January.

2/ In addition to above condition, water level is not constant throughout the year.

3/ Hanut Drain water is mixed.

4/ Kaliadria Drain water is mixed.

2.2.3 Canals under Construction

Two canals, which are planned by the Ministry of Irrigation and are under construction, pass through the Sharqiya Governorate as shown on Fig-2.2.1. The canals are named Salam Canal and Sulheiya Canal, and the former runs in the coastal area of the Delta and the latter, branched from Ismailiya Canal, runs through the area between Cairo and Ismailiya cities.

Salam Canal is planned to irrigate about 263,000 ha (650,000 acres) consisting of 81,000 ha in the northern coastal area of the Delta and 182,000 ha in Sinai area. The construction of the canal was commenced in 1981 and it will be completed in 1985, as the first stage construction, reaching Suez Canal. The second stage will be executed with the construction of the invert siphon to cross Suez Canal to supply water to Sinai area. The headwork at the river-mouth of Damietta Branch has been constructed together with the barrage to prevent the sea water intrusion.

The diverted water of 9.5 million m3/day (110 m3/sec) flows into the canal through the headwork by gravity. At a point about 12.5 km distant from the headwork, Sroui Drain Canal water of 1.5 million m3/day is to be added into the canal flow, and Hadus Drain Canal water of 8.0 million m3/day also will be pumped into the canal.

Sulheiya Canal branched at the downstream of the left-bank of Isamiliya Canal near Abbasa Treatment Plant has been constructed since 1980 for irrigation and cultivation of the so-called Sulheiya desert, located close to the north-eastern oblique line of the Nile Delta.

The water conveyed through the canal of 83.3 m3/sec will be served to an area of 77,000 ha (190,000 acres) located along 32.0 km canal length. The construction of the canal is expected to be completed in 1985. Sulheiya Canal is not mixed with wastewater by any drain canals.