AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
IRRIGATION AND HYDRAULICS DEPARTMENT

WATER QUALITY MANAGEMENT OF DRAINAGE SYSTEMS IN THE EASTERN NILE DELTA

by

Ashraf El Sayed Mohamed Ismail
M.Sc., Civil Engineering - Cairo University

A Thesis Submitted for the Fulfillment of the Requirements for the Degree of Doctor of Philosophy
in Civil Engineering

67896

Supervised by

Prof.Dr. Abdel-Mohsen El-Mongy
Irrigation & Hydraulics Dept.
Faculty of Engineering
Ain Shams University

Prof.Dr. Essam Ali Abdel-Hafeez
Irrigation & Hydraulics Dept.
Faculty of Engineering
Ain Shams University

Prof.Dr. Shaden Abdel-Gawad
Director, Environment and Climate Research Institute
National Water Research Center

628.3623
A. E

Cairo, Egypt
1997

Central Library - Ain Shams University

WATER QUALITY MANAGEMENT OF DRAINAGE SYSTEMS IN THE EASTERN NILE DELTA

Ph.D. Thesis Submitted by
Eng. Ashraf El Sayed Mohamed Ismail
in Civil Engineering (Irrigation and Hydraulics)

Signature

Examiners Committee:

Prof.Dr. Mohamed Abdel-Rahman Fawzi
Cabinet of Ministries
Egyptian Environmental Affairs Agency

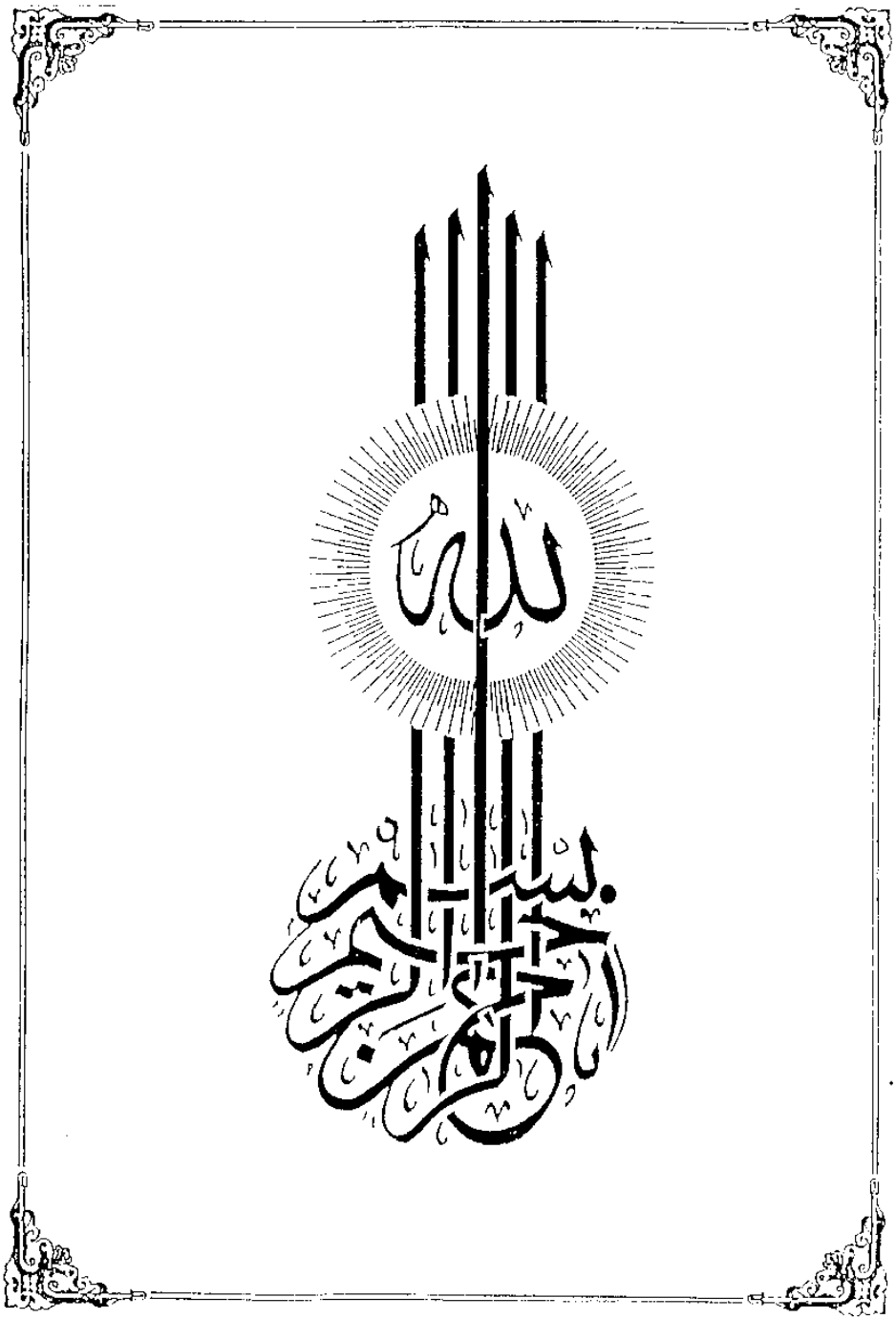
Prof.Dr. Mohamed Mohamed Nour El Din
Irrigation & Hydraulics Department
Faculty of Engineering
Ain Shams University

Prof.Dr. Abdel-Mohsen El-Mongy El-Mongy
Irrigation & Hydraulics Department
Faculty of Engineering
Ain Shams University

Prof.Dr. Essam Ali Abdel-Hafeez
Irrigation & Hydraulics Department
Faculty of Engineering
Ain Shams University

Date:

Central Library - Ain Shams University



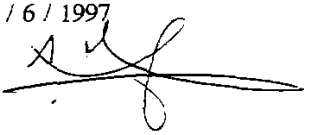
Central Library - Ain Shams University

STATEMENT

This thesis is submitted to Ain Shams University, Faculty of Engineering for the degree of Doctor of philosophy in Civil Engineering.

The work included in this thesis was carried out by the author in the Department of Irrigation and Hydraulics, Faculty of Engineering, Ain Shams University, from November 1994 to June 1997.

No Part of this thesis has been previously submitted for a degree of a qualification at any other University or Institution.

Name: Ashraf El Sayed Mohamed Ismail
Date: 30 / 6 / 1997
Signature: 

Central Library - Ain Shams University

VITAE

PERSONAL INFORMATION

Name	:	Ashraf El Sayed Mohamed Ismail
Nationality	:	Egyptian
Date of Birth	:	June 10, 1962
Place of Birth	:	Cairo, Egypt
Present Position	:	Civil Engineer, Drainage Research Institute National Water Research Center

Education

1990 - 1994	:	M. Sc. in Civil Engineering Major: Surface Water Pollution Hydraulics Department, Cairo University, Egypt.
1989 - 1990	:	Post-graduate Diploma in Hydraulic Engineering Major: Land and Water Development International Institute for Infrastructural, Hydraulic and Environmental Engineering, Delft, The Netherlands.
1980 - 1985	:	B.Sc. in Civil Engineering Faculty of Engineering, Ain Shams University, Cairo, Egypt

PROFESSIONAL EXPERIENCE

Organization	:	Drainage Research Institute, National Water Research Center.
Responsibility	•	Designing and executing Environmental monitoring of drainage water, conducting applied research predicting the quantity and quality of drainage water using mathematical modelling .
	•	Studying the environmental impact of drainage water reuse in the Nile Delta

Central Library - Ain Shams University

OTHER TRAINING

January	1995 •	Statistical analysis of Water Quality Data Using SPSS, National Water Quality Conservation Program, NWRC.
December	1994 •	Water Quality Modelling, Delft Hydraulics, Planning Sector, MPWWR.
November	1994 •	Water Quality Management, Delft Hydraulics, Planning Sector, MPWWR.
January	1994 •	Principle of Water Quality Management, Drainage Research Institute, Water Research Center, Cairo.
June	1993 •	Water Quality Management for Decision-makers International Institute for Infrastructure, Hydraulic and Environmental Engineering, Delft, The Netherlands.
October	1992 •	Computer modelling and application of SIWARE model, Wageningen, The Netherlands.
May	1992 •	Environmental Sound Management of Water Resources, United Nation Environmental Program, and The International Office for Water-Cefigre, Cairo, Egypt.
January	1992 •	Design of Water Quality Monitoring Systems, Colorado State University.
March	1989 •	Advanced Academic English Course, The American University in Cairo.
October	1988 •	Design and Construction of Subsurface drainage system, Mcgill University.

Central Library - Ain Shams University

ABSTRACT

Title: WATER QUALITY MANAGEMENT OF DRAINAGE SYSTEMS IN THE EASTERN NILE DELTA

Name: Ashraf El Sayed Mohamed Ismail

The surface water is one of the world's most precious resources and its management is responding to environmental standards and legislation aimed at sustainable development. Water resources planners worldwide are starting to balance the conflicting claims on the streams through integrated watershed management. Considering the behaviour of the entire watershed enables to assess the likely impact. This helps to target often limited human and financial resources on developing the most effective catchment management plans.

Due to lack of integrated management, the streams in Egypt currently suffer from increasing pollution load caused by the discharges of untreated domestic and industrial wastewater. In addition, the drainage systems contain toxic chemicals which are used to control particular members of biota.

In Egypt, Bahr El Baqar drainage system, which is the main concern of this study, is located at the Eastern part of the Nile Delta. It discharges about $1.2*10^9$ m^3/year into Lake Manzala which in turn discharges freely into the Mediterranean Sea. The agricultural drainage water, domestic and industrial wastewater represent 58%, 40% and 2% of the total drainage water in Bahr El Baqar drain respectively.

The main objective of this study is to develop a system that can formulate alternative strategies to improve the water quality in Bahr El Baqar drainage system to allow its safe usage for irrigation and livestock watering.

Central Library - Ain Shams University

To identify the major pollution problems in reusing Bahr El Baqar drainage water in irrigation, two activities have been carried out. The first is identification of the water quality characteristics through a monitoring program which has been carried out in 1995. The second is to compare and evaluate the drainage water quality characteristics based on the relevant standards and guidelines.

A number of possible quality improvement interventions are formulated and simulated through several scenarios using unsteady one dimensional hydrodynamic model, DUFLOW. A water quality module has been developed to fit with the drainage system circumstances and compiled to DUFLOW. To understand the water quality process in the drainage system, the decay rates for the water quality variables are estimated through spreadsheet programs. The calculated decay rates are used as input parameters in model calibration phase.

The results of simulated scenarios show different possibilities for using Bahr El Baqar drainage water in irrigation and livestock watering. For restricted use, the secondary treatment at the East Bank of Greater Cairo and major towns are required to meet the quality criteria for irrigation use. For unrestricted use, partial chlorination after secondary treatment at the East Bank of Greater Cairo should be done. The maximum flow of drainage water which can be reused for El Salam canal project at the downstream diversion point is anticipated without an increase in salinity at the abstraction point due to salt intrusion problems from Lake Manzala.

Based on the results of this study, further studies are recommended, these include an environmental impact assessment study for selecting the best water quality improvement option, taking into account the economic and socio-cultural aspects; and the impact of Bahr El Baqar water quality improvement on the water quality and fishery activities in Lake Manzala.

Central Library - Ain Shams University

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude and appreciation to my supervisor Prof. Dr. Abdel El-Mohsen El-Mongy, Professor of Coastal Engineering, Irrigation & Hydraulics Department, Faculty of Engineering, Ain Shams University, for his continuous encouragement, support, advice and skillful guidance to make the completion of this study possible.

Grateful thanks and appreciation are due to my supervisor Prof. Dr. Essam Ali Abdel Hafeez, Professor of Hydraulic structures, Irrigation & Hydraulics Department, Faculty of Engineering, Ain Shams University, for his continuous assistance, comments and valuable guidance throughout the whole work of this study.

Particular mention must be made to Prof. Dr. Shaden Abdel Gawad, Director of Environment and Climate Research Institute, National Water Research Center, Ministry of Public Works and Water Resources, whose sincere efforts extended more than supervising this study. Her endless support and encouragement have continued since the author started his professional career.

I would like to express my gratitude to Prof. Dr. Safwat Abdel Dayem, Director of Drainage Research Institute and Dr. Hesham Kandil Coordinator of DWIP project for their support, assistance and motivation.

Also, I would like to extend my appreciation to the staff of the Drainage Research Institute for their encouragement and support.

Central Library - Ain Shams University

TABLES OF CONTENTS

Central Library - Ain Shams University

Central Library - Ain Shams University

Central Library - Ain Shams University

Central Library - Ain Shams University

Central Library - Ain Shams University

Central Library - Ain Shams University