

**A GIS MODEL FOR IMPROVEMENT
OF OPERATION AND
MAINTENANCE SERVICES OF
NATIONAL WATER SUPPLY AND
DRAINAGE BOARD**

By:

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DECLARATION OF CANDIDATE

The work described in this thesis was carried out by me under the supervision of Mrs. Badra Herath and Mr. Prabath Malavige and a report on this has not been submitted in whole or in part to any university or any other institution for another Degree / Diploma.



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DECLARATION OF SUPERVISORS

We certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation.

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TABLE OF CONTENTS

	Page
Table of Contents	i
List of Tables	iii
List of Figures	iv
List of Annexures	v
Abbreviations	vi
Acknowledgement	viii
Abstract	ix
CHAPTER 1 – INTRODUCTION.....	1
1.1 Background	1
1.1.1 National Water Supply and Drainage Board	1
1.1.2 Operation and Maintenance Activities of NWSDB	3
1.1.3 Significance of the Research	4
1.2 Research Problem	4
1.3 Research Objectives	6
CHAPTER 2 – LITERATURE REVIEW.....	7
2.1 Global Trends	7
2.1.1 Enterprise GIS for Water Distribution Systems	8
2.1.2 Mapping and Managing Potable Water Infrastructure Assets	13
2.1.3 Improvement of water supply through a GIS-based monitoring and control system for water loss reduction	17
2.1.4 Improving Water Quality Assessment through GIS Technologies	18
2.1.5 GIS for Improving Water Utility Infrastructure	23
2.1.6 Customer Management & Revenue Collection using GIS	30
2.2 Local Trends	34
2.2.1 Low Cost GIS Data Base Solution for Water Utility Network in Sri Lanka	34
2.2.2 National Level GIS Infrastructure	36

CHAPTER 3 – METHODOLOGY.....	38
3.1 Study Area	39
3.2 Methods and Data	41
3.3 Sampling Techniques	43
3.4 Analysis	47
3.4.1 Tools Used for the Analysis Work	48
3.4.2 Important O&M Activities and Present Work Practices	48
3.4.3 How GIS can be utilized for improving regular maintenance activities	55
3.4.4 Sample Analysis using the Tools available in ArcGIS Water Utility Model	57
CHAPTER 4 - CONCLUSION AND RECOMMENDATIONS.....	65
4.1 Recommendation	66
4.1.1 GIS Software, Tools and Other Software	66
4.1.2 Preparation of GIS maps for the Model	66
4.1.3 Enterprise Geodatabase	68
4.1.4 Tabular Datasets	68
4.1.5 Integration with Other Enterprise Information Systems	68
4.1.6 Web based GIS application	69
References	71

LIST OF TABLES

Table No.	Caption	Page
Table 3.1	Important Statistics about sample area used for analysis	42
Table 3.2	Maximum Time for Completing Specific O&M Activities	44
Table 3.3	Maximum Time for Completing Specific O&M Activities in GIS assisted environment	47
Table A4.1	Summary Statistics of the Water Service Connections Region-wise	A4

LIST OF FIGURES

Figure No.	Caption	Page
Figure 2.1	Architecture of the GIS System of Otay Water District	10
Figure 2.2	GIS Map of Water System of City of Cocoa (before correction)	15
Figure 2.3	GIS Map of Water System of City of Cocoa (after correction)	15
Figure 2.4	U.S. Environmental Protection Agency (EPA) Region 4 Water Management Division (WMD)	19
Figure 2.5	GIS Map of Water Infrastructure of a Local Authority in USA with Hotspot Analysis of Leaks	24
Figure 2.6	GIS Map of Water Infrastructure of a Local Authority in USA with Hotspot Analysis of Leaks (with transparency adjusted)	25
Figure 2.7	Output of a GIS Application Used by a Water Utility Company in Canada	28
Figure 2.8	Output of a GIS Application used by a Utility Company in North America	29
Figure 2.9	Map Indicating the Amman Network Information System coverage	31
Figure 3.1	Sample Water Distribution Network (Panadura Scheme)	40
Figure 3.2	Water Distribution System in Sample Area (Pandura)	41
Figure 3.3	Geometric Network of Water Distribution System in Sample Area (Pandura)	56
Figure 3.4	Downstream Trace Analysis on Water Distribution System	58
Figure 3.5	Valve Isolation Trace (Zoomed) of Water Distribution System	59
Figure 3.6	Valve Isolation Trace (Full View) of Water Distribution System	60
Figure 3.7	HTML Popup with Details of a Selected Valve of Water Distribution System	61
Figure 3.8	Water Utility Map indicating the Main Leak Locations	62
Figure 3.9	Density Map Indicating Susceptibility to Leaks	63
Figure 3.10	Use of GIS Model for New Service Connection Estimation	64
Figure A1.1	Regional Support Center Operation Areas	A1
Figure A2.1	Location Map of Water Treatment Facilities of NWSDB	A2
Figure A3.1	Customer Charter	A3

LIST OF ANNEXURES

Annexure No.	Caption	Page
Annexure I	Regional Support Center Coverage Areas	A1
Annexure II	Locations of Water Treatment Facilities of NWSDB	A2
Annexure III	Customer Charter	A3
Annexure IV	Summary Statistics of Customer base of NWSDB	A4

LIST OF ABBREVIATIONS

Abbreviation

NWSDB	-	National Water Supply and Drainage Board
CBO	-	Community Based Organization
O&M	-	Operation & Maintenance
ESRI	-	Environmental Services Research Institute
OWD	-	Otay Water District
GPS	-	Global Positioning System
AWWA	-	American Water Works Association
HTML	-	Hyper Text Markup Language
SCADA	-	Supervisory Control and Data Acquisition
CIS	-	Customer Information System
GIS	-	Geographic Information System
SQL	-	Structured Query Language
DSD	-	Divisional Secretariat Division
GND	-	Grama Niladari Division
DBMS	-	Database Management System
AWWA	-	American Water Works Association
LAN	-	Local Area Network
T&D	-	Transmission and Distribution
WLR	-	Water Loss Reduction
NRW	-	Non-Revenue Water
WMD	-	Water Management Division
EPA	-	Environmental Protection Agency
AU	-	Assessment Unit
TMDL	-	Total Maximum Daily Load
ATTAINS	-	Assessment and TMDL Tracking and Implementation System
WATERS	-	Watershed Assessment, Tracking and Environmental Results System
NHD	-	National Hydrography Dataset
WBID	-	Water Body Identifier
WERF	-	Water Environment Research Foundation

- CMMS - Computerized Maintenance Management Systems
- WAJ - Water Authority of Jordan
- AGWA - Amman Governorate Water Administration
- GC - Greater Colombo
- 3D - 3 Dimensional
- ORDBMS - Object Relational Database Management System
- ADB - Asian Development Bank
- IWMI - International Water Management Institute
- ICTA - Information and Communication Technology Agency
- RSC - Regional Support Center
- OIC - Officer In Charge
- SMS - Short Message Service

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Johnsge Chandradasa

ABSTRACT

GIS technologies are quickly emerging as a platform for innovation in every sphere of human activities. Spatial representation of data makes it easy for the humans to visualize the information much better than other conventional information systems. GIS has added a new dimension to the information systems where location information is associated with the data, enabling the users to feel the information systems are more realistic and easy to work with. With this nature, GIS has become the most appropriate platform for implementing solutions for many applications that involve wide verity of user community.

The use of GIS based approaches in utility industry has increased rapidly during the recent past where distribution systems are represented on GIS platform with associated solutions resulting significant improvement of operational efficiency and effectiveness of the daily operations. Water Utility industry too is benefiting from GIS technologies and many organizations engaged in water utility industry worldwide are in the process of adopting GIS based solutions as a means of improving their daily operations.

The National Water Supply and Drainage Board is the government institution in Sri Lanka responsible for providing safe drinking water and sanitation facilities to the entire country. It is maintaining a water utility network covering a significant part of the island, with over 1.6 Million water service connections. NWSDB is continuously expanding the water supply coverage keeping in line with the Mahinda Chinthana Vision and Millennium Development Goals. New water treatment plants are being added to the system and distribution system is being expanded to reach more and more customers, utilizing various funding sources.

Due to the wide geographic coverage and significantly high customer base, with its limited resources, carrying out operation and maintenance activities of the distribution system has become a challenge to the organization. Since the water is the most essential commodity in human life, the organization is responsible for maintaining a continuous water supply all the time without undue interruptions. People are pressing the organization for quick and better service for their needs. On the other hand, minimising water wastages is a major concern of the organization. Therefore, improvement of operation and maintenance functions of the organization is of utmost importance and is considered as the highest priority task.

Although, many attempts have been made by various interested parties to develop GIS maps of the water utility network and develop certain GIS applications for important O&M tasks, so far the organization has not being able to utilize them significantly and effectively for improving the O&M functions of the organization.

This research study is aimed at recommending a proper and comprehensive GIS based model for improving the operation and maintenance activities for the NWSDB. The study begins with a comprehensive literature review to understand the present global and local trends, best industry practices worldwide and how the similar organizations have utilized GIS for improving their operations. The details about the mapping works and other GIS activities in the organization were collected and carefully analysed in order to identify gaps. Also, important O&M activities and present work practices of the organization were analysed with a view to formulate better work practices under the GIS assisted environment.

The ArcGIS software systems Desktop and Server are considered as most popular and widely used platforms for implementing sustainable GIS solutions worldwide. The water utility model templates downloadable from ESRI web site was used to develop the water utility model for the organization and the available tools and capabilities of this model were used to verify the applicability of this model using a sample portion of the water utility network. Finally, the recommendations for a comprehensive GIS model for the organization is given as the conclusion of the research study.

CHAPTER 1

1.0 INTRODUCTION

1.1 Background

1.1.1 National Water Supply and Drainage Board (NWSDB)

National Water Supply & Drainage Board (NWSDB) is the government institution in Sri Lanka responsible for providing safe drinking water for the entire country. It is one of the largest public sector institutions with more than 40 years of operation and at present the employee capacity exceeds more than 10,000 of all categories. It's main functions include supply of drinking water and providing sewerage facilities. In addition to the main pipe born water supply through its network of large scale water purification and distribution system, to keep in line with the Millennium Development Goals, the institution promotes and facilitates the Rural Water Supply schemes islandwide operated through Community Based Organizations to increase the water supply coverage for rural areas which are not covered by the main distribution network. Also, the NWSDB has the responsibility to regulate the use of ground water in the country and has facilities to promote the ground water utilization for various purposes.

According to the NWSDB official web site, the following are the primary and secondary functions of the organization.

Primary functions:

- Investigation, planning, design and construction supervision of water supply and sewerage projects with local funds and donor assistance. Carry out feasibility studies, cost estimation & Environmental Impact Assessment for such projects
- Operation and Maintenance of water supply and sewerage schemes to provide satisfactory service to customers
- Billing and collection through affordable tariff setting