Improving Water Distribution Network Management through Implementation of Efficient Division into Supply Clusters

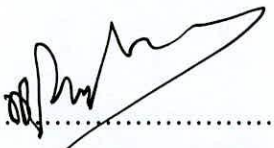
by

Tuan Nibras Booso

M.Sc. 2014

DECLARATION

The work described in this thesis was carried out by me under the supervision of Prof. CKM Deheragoda, Department of Geography, University of Sri Jayewardenepura and Mr. HMP Jayantha, Teaching Faculty Member of the M.Sc. Degree in GIS and Remote Sensing, Department of Geography, University of Sri Jayewardenepura and confirm that 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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15/06/2014

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Date

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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Signature of Senior Supervisor Date

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Mr. HMP Jayantha

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ABSTRACT

The latest reports revealed that the Non-Revenue Water (NRW) value of the Colombo Municipal Council (CMC) area is in between around 48 – 52 % against the total system supply of 105 – 109 Mm^3 of water per annum for 2010 - 2012. Therefore, the National Water Supply and Drainage Board (NWSDB) is considering in reducing the NRW percentage of water distribution volume against the total supply to the system up to 18% or lower value. Today, the international water infrastructure development, maintenance, operation, and construction institutions recognise the District Metered Area (DMA) concept as a suitable method to monitor and operation of water utilities. The accomplishment of such policies has a particular effectiveness at regional scale because of the "local" character of these resources and their positive impacts on socio-economic development and local employment. The minimisation of environmental impact is a further important aspect of the DMA concept.

CMC water distribution network is the oldest and most complicated water distribution network in Sri Lanka and it has been developed and expands slowly for decades. Therefore, finding updated and reliable GIS database of water distribution network is more difficult.

This study presents a GIS methodology including a hydraulic pipe network analysis to find preliminary boundaries to establish the new sub DMAs for the proposed DMAs by the Western Province Metropolitan Area Water Supply Master Plan Update (2013) programme.

Also calculation of the demand for sub DMAs, maintaining minimum pressure of 10m in sub DMAs and optimisation of existing pipes has been done in this study. Originally

proposed 12 numbers of DMAs by the Western Province Metropolitan Area Water Supply Master Plan Update (2013) programme was further subdivided and propose to have total number of 18DMAs from this study. Further the maximum numbers of service connections are limited to 3,500 service connections from this study.

The ultimate result of the study is facilitating the NWSDB with regard to reduce the NRW value in CMC distribution network and manage, operate and maintain the distribution system in a sustainable way in order to provide a more reliable and quality water supply to the service customers.

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LIST OF ABREVIATIONS

Abbreviation		
AC	-	Asbestos Cement
ALC	-	Active Leakage Control
AWWA	-	American Water Works Association
CI	-	Cast Iron
CMC	-	Colombo Municipal Council
DEM	-	Digital Elevation Model
DI	-	Ductile Iron
DMA	-	District Metered Area
ELL	-	Economic Level of Leaks
GCWWMIIP	-	Greater Colombo Water and Wastewater Management Investment Improvement Programme
GIS	-	Geographic Information System
GPS	-	Global Positioning System
HDPE	-	High-density Polyethylene
l/s	-	Litre per Second
m3/h	-	Cubic Meter per Second
mm	-	Millimetre
Ml	-	Million Litres
MS	-	Steel
inch	-	Inch
PE	-	Polyethylene
PLC	-	Passive Leakage Control
PMU	-	Project Management Unit
PVC	-	Polyvinylchloride
NRW	-	Non-Revenue Water
NWSDB	-	National Water Supply and Drainage Board

Abbreviation

QEPAWBWC	-	Queensland Environmental Protection Agency and Wide Bay Water Corporation
SCADA	-	Supervisory Control and Data Acquisition
TIN	-	Triangular Irregular Network
UK	-	United Kingdom
USA	-	United States of America

1.0 INTRODUCTION

1.1 BACKGROUND

In recent years, water and energy conservation has become increasingly important for water utilities throughout the world. Policy makers and utility managers realise that reduction of Non-Revenue Water (NRW) is important from environmental, political and commercial points of view. Similar developments took place in Europe and Southeast Asian countries few years ago.

Presently the National Water Supply & Drainage Board (NWSDB) is the main water utilities infrastructure development authority in Sri Lanka. NWSDB is under no or little regulatory pressure to control water leakage. Therefore the NRW value is very high in the water distribution networks and leakage management is generally limited to passive leakage (reactive leakage) control such as responding to visible water leakages in the distribution system or auditing to water loss. That is responding to reported breaks or pressure drops, usually reported by customers or noted by the NWSDB staff while carrying out other duties. In normal situations, the overall level of leakage will continue to rise under Passive Leakage Management. The NRW reduction has become a major issue for the NWSDB because high level of NRW currently experienced in the water distribution network for Colombo Municipal Council (CMC) area.

Recent draughts, desalination of water resources (i.e. desalination close to the Ambatale Intake), higher production cost of water, and increasing competition over limited water resources has created pressure to reduce NRW volume such as water leakages in the water distribution pipe network. The NWSDB have historically suggested conservation of water usage, but water rights issues could necessitate mandated leakage targets and proactive leakage management.

According to Fanner (2007) NRW volume such as water leakages in the water distribution pipe network can be effectively reduced and controlled in a sustainable manner and the reduced leakage water can be viewed as a new source of water that will