FACULTY OF ENGINEERING

DEPARTMENT OF WATER RESOURCES AND MINING ENGINEERING

FINAL YEAR PROJECT REPORT

INVESTIGATING POTENTIAL OF STORM WATER MANAGEMENT THROUGH ROOFTOP WATER HARVESTING TECHNOLOGY

BY

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ABSTRACT

The hydrological cycle describes water as a renewable and recyclable resource. It is a key determinant in the existence of life and agricultural activity. It is seemingly abundant on earth but in case of any scarcity, it is thought of as a precious resource. Being an integral of urban life, it is used in homes for several purposes such as drinking, cooking and even watering gardens. Away from homes, it is used for fishing, navigation and recreation. Storm water runoff is a part of this cycle. It is described as that portion of precipitation that is not lost to interception, surface detention, evaporation and infiltration.

Urban drainage systems of municipalities in Uganda are overwhelmed with runoff, most of which are generated from rooftops and left uncaptured, largely due to the presence of impervious surfaces resulting from increasing urbanization, surfaces that used to absorb water; vegetation and topsoil, are now covered with building tops, sidewalks, parking lots, paved and cemented roads causing water to run off them. Unfortunately, the existing drainage systems are not even in functioning conditions to hold the large runoff volumes. Most of this runoff ends up in stream channels and other receiving surface water bodies thus immensely affecting water quality. This study was aimed at investigating potential of storm water management through rooftop water harvesting technology in Western division, Tororo municipality.

This was achieved through hydrological modelling in HEC-HMS, the Rational method for roof areal runoff quantification and land use monitoring for modelling the effects of increasing urbanization on the watershed runoff potential rates. The output of the study includes generated hydrographs, peak discharge volumes and the water harvesting potential of the area. The results of the study from the hydrological model gives a peak discharge of $14m^3/s$ whereas that captured by roofs is $12.58m^3/s$ indicating an 89.8% decrease in the amount that would otherwise runoff. The area also has an annual water harvesting potential of $2,022,178.568m^3$. This could be used to supplement the existing sources of water supply and it is in itself a cheap technology if adopted, reducing on the cost of water bills as well as mitigating the occurrences of floods in the region. With increasing urbanization levels, the peak runoff discharges are also bound to increase because of increase in the percentage of impervious surfaces, thus increase even in the water harvesting potential.

Author's Declaration

I **ATIM CHRISTINE ROSE** hereby declare to the best of my knowledge that this is my true and original piece of work and has never been submitted to any university or institution of higher learning by anyone for an academic award.

Signature……..

Approval

This project proposal has been admitted to the faculty of Engineering with the approval of my supervisors;

Main Supervisor: Mr. Oketcho Yoronimo

Signature……..

Date……...

Co-Supervisor: Ms. Nakabuye Hope Njuki

Signature……

Date……

Dedication

I dedicate this report to my parents and guardians who have tirelessly supported and guided me to make me what I am today.

Acknowledgement

First and foremost, I would like to thank the Almighty God for His protection and guidance in my life.

I am also highly indebted to the entire staff in the department of Mining and Water resources engineering for imparting knowledge and skill regarding the above field to me. In a special way, I greatly appreciate supervisors, Ms. Nakabuye Hope Njuki and Mr. Oketcho Yoronimo for all the guidance, advice and encouragement as regards this research. May God richly bless you. I am grateful too to the discussion group members I have worked with right from my first year; Kadecember Agnes, Kalule Jessy, Adikin Helen, Ayebare Lucky, Nuwemukama Immaculate, Niringiye Ernest, Mugondi Chrisostom, Nuwomujuni Anatori, Butita Simon Peter and Tindimwebwa Doreen.

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ACRONYMS

HEC-HMS	Hydrologic Engineering Center's Hydrological Modelling Systems
FAO	Food and Agricultural Organisation
Df	Degree of freedom
RTWH	Rooftop Water Harvesting
DWRM	Directorate of Water Resources Management
MWE	Ministry of Water and Environment
GIS	Geographical Information System
IDF	Intensity Duration Frequency
CNGRID	Curve Number Grid
UBOS	Uganda Bureau of Statistics
SCS	Soil Conservation Service
HSG	Hydrologic Soil Group
DEM	Digital Elevation Model
NWSC	National Water and Sewerage Corporation
UNMA	Uganda National Meteorological Authority

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1 CHAPTER ONE: INTRODUCTION

This chapter entails relevant information about the project background, problem statement, and justification, objectives of the study, purpose of the study and the scope of the study.

1.1 Background of study

The hydrological cycle describes water as a renewable and recyclable resource. It is a key determinant in the existence of life and agricultural activity. It is seemingly abundant on earth but in case of any scarcity, it is thought of as a precious resource. Being an integral of urban life, it is used in homes for several purposes such as drinking, cooking and even watering gardens. Away from homes, it is used for fishing, navigation and recreation. Storm water runoff is a part of this cycle. It is described as that portion of precipitation that is not lost to interception, surface detention, evaporation and infiltration.(Nsubuga, Namutebi and Nsubuga-ssenfuma, 2014) However, many parts of the world today are being challenged by the increasing volumes of this runoff. Urban storm water challenges are on the increase at a global scale and Uganda has not been spared either.(Kitutu, 2013).Several towns including Tororo are faced with the above.(Perdikaki and Mason, 1999)

Largely due to urbanization and increased population growth, most municipalities in Uganda face major storm water challenges: surfaces that used to absorb and filter water are currently covered with streets, building tops and parking lots.(Erickson, Weiss and Gulliver, 2013) This has led to a change in the way water flows through catchments; water that once infiltrated the earth, recharging surface and ground water supplies or that was released by plants and trees through evaporation, or re-use for gardens, now runs off impervious surfaces. By the year 2002 as indicated by the Uganda Bureau of Statistics, the percentage of impervious surface was 7.5 and as of the year 2014, this value was reported at a percentage of 9.172 that is an increase by 18.5% in a period of 12 years. The world is on the move towards technology and more urbanization, an indicator that in the future, even the smallest pervious surface areas that can still be seen will be rendered impervious. The more the impervious surfaces, the more runoff is generated.

Additionally, changes in the climatic patterns, attributed to the warmer global temperatures in the atmosphere due to the buildup of carbon dioxide and other greenhouse gases induced largely by

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