FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF WATER RESOURCES ENGINEERING

FINAL YEAR PROJECT REPORT

PROJECT TITLE

INTEGRATING SUSTAINABLE URBAN DRAINAGE SYSTEM INTO STORM WATER MANAGEMENT FOR AN EFFICIENT MUNICIPAL DRAINAGE

A CASE OF KASESE MUNICIPALITY.

BY

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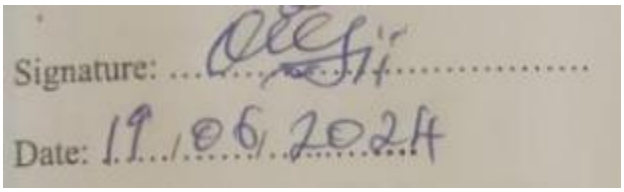
ABSTRACT

Flooding of urban areas is a worldwide problem as cities grow and the amount of impermeable surfaces increase generating more surface runoff. This poses significant challenges to traditional stormwater management systems, leading to increased flooding. This thesis explores the integration of Sustainable Urban Drainage Systems (SUDS) as a solution for a more resilient municipal drainage network for Kasese Municipality. The research evaluated the performance of the existing natural and artificial drainage systems within the municipality using hydrologic and hydraulic models in PCSWMM. Rainfall frequency analysis was carried out using the Gumbel distribution after best fit tests and the design storms that correspond to the 2, 5, 10, 25, 50, 100, 200 and 500-year return periods were computed. Using a high-resolution Digital Elevation Model (DEM) of 12.5m, a watershed delineation was carried out and the sub-basin parameters calculated accordingly. Using the watershed parameters obtained, the design storm and the hydraulic properties of the existing drainage network collected from the field as inputs to PCSWMM, runoff simulations were carried out. The analysis revealed that the current system experiences frequent flooding and high flow rates, highlighting the need for improvement. To address this issue, a multi-objective approach was adopted. Firstly, the TOPSIS method was employed to identify the most suitable SUDS option for stormwater runoff control. In light of the analysis, infiltration trenches emerged as the most effective solution. Subsequently, an infiltration trench design was developed and incorporated into the PCSWMM model using LID controls tool. The results demonstrated a significant reduction in flooding and flow rates following the inclusion of the infiltration trench. This finding suggests that integrating SUDS, particularly infiltration trenches, offers a promising approach to enhance the resilience and sustainability of municipal drainage systems for managing urban stormwater runoff.

Keywords: Sustainable Urban Drainage Systems (SUDS), Stormwater Management, Hydraulic Model, Hydrologic Model, PCSWMM, TOPSIS, Urban flooding.

DECLARATION

I OCHWO ANDREW, solemnly declare that this final year project is my own research, and has never been submitted to Busitema University or any other institution of higher learning for any academic award.



APPROVAL

I am presenting this report which has been done, read and produced under my efforts to the department of Water Resources Engineering with Approval from the following supervisors:

Ms. Anano Gloria

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Date: **18th June 2024**

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DEDICATION

I dedicate this report to God for all the ideas and help He gave to me through the Holy spirit, May His name be Glorified. To my supervisor, Mr. Kajubi Enock, for his support, guidance, and encouragement throughout this project preparation. To my parents and siblings for their unending support rendered unto me and to the people of Kasese, who deserve a flood-resilient and environmentally sustainable future.

TABLE OF CONTENTS

LIST OF ACRONYMS

PCSWMM: Personal Computer Storm Water Management Model

SDGs: Sustainable Development Goals

SUDS: Sustainable Urban Drainage Systems

IPCC: Intergovernmental Panel on Climate Change

NBI: Nile Basin Initiative

GIS: Geographical Information System

MCDA: Multi Criteria Decision Analysis

AHP: Analytical Hierarchy Process

LID: Low Impact Development

TOPSIS: Technique for Order Preference by Similarity to Ideal Solution

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Flooding is a global challenge that has been exacerbated by factors such as climate change and rapid urbanization. Globally, urban areas are experiencing increased flooding due to the alteration of natural hydrological systems. The development of impervious surfaces leads to decreased infiltration and increased surface runoff, overwhelming existing drainage systems (Bazrkar et al., 2015). Cities growing bigger means more buildings and less nature. This disrupts how water naturally soaks into the ground. Rain runs off paved surfaces like roads and sidewalks instead, overloading drainage systems and causing worse floods(Khan et al., 2022).

Across Africa, flooding is a big problem that keeps happening. Heavy rains cause rivers to overflow and flood plains to fill up, leading to trouble everywhere from deserts to the coast. This flooding forces people to move, wrecks buildings and roads, and hurts food crops. While people are trying to fix this with things like higher walls and better weather warnings, there's a need for a bigger plan to keep these floods from causing so much damage (Douglas, 2017).

The concept of Sustainable Urban Drainage Systems (SUDS) has gained prominence globally as a holistic and environmentally friendly solution to urban stormwater challenges(Fletcher et al., 2015). SUDS focus on mimicking natural drainage processes and promoting water infiltration through the integration of green and blue infrastructures (Zhou, 2014). Cases of effective SUDS implementation is found in cities around the world(Vincent et al., 2017). For instance, in Portland, Oregon, SUDS have been credited with reducing flooding by 85% and improving water quality by 90%. (Abellán García et al., 2021; Lashford et al., 2019).

In Uganda, the impact of urbanization on natural hydrology is evident, with severe flooding incidents reported in various parts of the country. The situation in Kasese Municipality is particularly dire. The region has experienced repeated flooding events, with significant consequences for the local population (Nsubuga et al., 2014; Noble & Kingsland, 2019).

Despite the Ugandan government’s continuous effort to control flooding in the Rwenzori region specifically in the Nyamwamba catchment since 2013 (Noble and Kingsland, 2019), Kasese has experienced several other flash floods (Thawite, 2020), which raises concerns not only about the

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