BUSITEMA UNIVERSITY
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF MINING AND WATER RESOURCES ENGINEERING

DESIGN AND CONSTRUCTION OF AN URBAN STORM WATER TREATMENT SYSTEM

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A final year project proposal submitted to the Department of Water Resources Engineering as a partial fulfillment for the award of Bachelor of Science in Water Resources Engineering**.**

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ABSTRACT

The control of the increasing amounts of storm water runoff and its impacts on the surface and ground water sources is a serious problem faced by the many and rapidly growing urbanized areas in the world today. Storm water runoff refers rainfall that flows off the ground or impervious surfaces and is a major cause of ground and surface water pollution in urban areas nowadays; since most of them have been engineered with impervious surfaces like roofs, roads, pavements, drive ways, compounds and parking lots made of concrete, asphalt and tarmac. Unfortunately, in most cases, this runoff drains directly into streams, rivers or lakes directly carry everything along with a wide range of non-point source pollutants such as silt, rubbish, chemicals, total suspended solids, nitrogen, phosphorus, heavy metals (lead, zinc, copper), pathogens and organics such as petroleum hydrocarbons, oils and grease to the wetlands and surface water bodies. A case at hand is river Nabuyonga that passes through the city of Mbale. This river has been seriously polluted with one of the major causes of this dire situation is the immense amount of storm water that flows from the city particularly along Kumi road starting at the Clock Tower down to the Nabuyonga river. Bioretention systems were found to be most suitable solution. This was majorly attributed to the fact that they are retention and infiltration BMPs and can be retro fitted in urban centers of any side or shape as well as improving on the green spots in the urbanized areas. Bio retention systems are shallow landscaped depressions that utilize woody herbaceous plants like vetiver grass, shrubs and top soil, sand-gravel filter designed to remove pollutants and infiltrate storm water runoff.

Bioretention systems are usually designed for a design life not longer than ten years which requires establishing of a design storm of ten-year return period. The amount of runoff generated from the catchment area was estimated using the rational method and the time of concentration. The volume of runoff was later used to identify the size of the bioretention systems as well as the total number of the bio-filters required. A prototype was set up using appropriate linear scale factors to associate the actual extents of the bioretention cell and the prototype. The performance of the prototype was established basing on mainly two tests. The first one was testing of the difference in concentration of raw water sample from the catchment and the filtrate from the bioretention cell prototype. The percentage removal of the colour and the total suspended solids attained was over 80%. On the hand, the percentage removal of the other parameters was not as good as for the previous parameters mainly due to limited population of required plants species and organisms.

DECLARATION

I Kalule Jessy hereby submit this report and assure that it is my original work and has never been presented by any person or institution for an academic award.

Signature: …….

Date: …….....……

APPROVAL

This final year project report has been submitted to the faculty of Engineering for examination with approval of my supervisors mentioned below;

Main supervisor: Mr. Joseph Ddumba Lwanyaga

Signature……

Date…….

Co-supervisor: Mr. Okirya Martin.

Signature……

Date…….

DEDICATION

First, I would like dedicate this report to God almighty for making this possible and a total success because it was through him that I got the courage and determination to see this proposal report writing through from the beginning to the end. Then to my loving and caring parents Mr. Wasswa.S. James and Mrs. S. Nakiyemba Jennifer; brothers and sisters for all their support and facilitation in this period. My friends and colleagues who helped during that trying time.

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BMPs……Best Management Practices.

SWMS……. Storm Water Management Systems.

SWMM……Storm Water Management Model.

DEM……. Digital Elevation Model.

NARO……. National Agricultural Research Organization.

NRCS……... Natural Resources Conservation Service.

CN……Curve number.

HEC……. Hydrologic Engineering Centers**.**

HMS……. Hydrologic Modeling System

1 CHAPTER ONE

1.1 Introduction

This chapter briefly gives the general information relevant to the project topic while clearly showing the following: background of the study, problem statement, significance of the study, objectives, scope and the justification.

1.2 Background

Water is a basic requirement in the day today lives of all living things including both animals and plants. Fresh water usage can be categorized into mainly three forms, that is, domestic, agricultural and industrial use(Loucks *et al.*, 2005). The surface water resources are mainly recharged by direct surface runoff which at times called storm water.

Increased urbanization has led to enhanced volumes of storm water generated due to reduced rates of infiltration. The runoff carries with it a large amount of debris as it flows along its drainage channels. The debris carried with in the storm water include; sediments, litter, nutrients, chemicals, heavy metals and even gets mixed up with sewage networks that contain human wastes. The disposal of these debris in the surface water bodies may result to a number of effects such as death of aquatic plants and animals, reduction of the depth of water sources due to severe sedimentation and also outbreak of diseases like typhoid, cholera and dysentery attributed to presence of large amount of faecal matter in the surface water bodies(Hamner *et al.*, 2013).

According to an Environmental Impact assessment statement by Mbale municipal local government of February 2007, with records of National water and sewerage Corporation(NWSC), indicate that the raw water in River Nabuyonga on average contains 1500 CFU/100ml of total coli forms. The severe levels of pollution led to outbreak of cholera in Nakaloke sub-county, a suburb in Mbale along the downstream of river Nabuyonga; with cumulated number of infected up to 555 people and a case fatality rate of 6.2% (Disaster relief emergency fund Final Report for Uganda 2012). In the response to the problem, authorities facilitated the construction of six sets of 2-stance emergency pit latrines in the most affected village of Namatala in Mbale municipality, benefitting 363 households. These facilities have continued to facilitate safe disposal of human excreta away from the river hence reducing the incidence of cholera and other diarrheal diseases amongst the beneficiary communities. Furthermore, over the emergency period of one month, 120,000 water purification chemicals like safe guard were procured and distributed to 3,928 households to ensure safe water at home in addition to purification done at key water collection points with the

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