THE STATUS OF WATER AND SANITATION IN NEWLY PLANNED RESIDENTIAL AREAS IN LUSAKA: A CASE OF KWAMWENA VALLEY

BY

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DECLARATION

I, Beene Chipuwa holder of computer number 514700204, hereby declare that this dissertation is my own work. It has not previously been submitted for any other degree or examination at the University of Zambia or any other University. It has therefore been submitted in partial fulfillment of the Master of Science in Spatial Planning at the University of Zambia.

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APPROVAL

This dissertation has been approved as fulfilling the requirements for the award of Master of Science in Spatial Planning by the University of Zambia.

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DEDICATION

I am dedicating this dissertation to the Almighty God for giving me strength, wisdom and good health throughout my term as a student.

To my children for being my source of inspiration, my husband, family and friends for the support and encouragement rendered to me every day.

ABSTRACT

Zambia is among the most urbanized countries in Sub-Saharan Africa and is faced with urban development challenges in the provision of basic infrastructure such as water and sanitation to an ever-increasing urban population. Lusaka has over the years undergone a rapid urban expansion in the growth of residential areas without a corresponding expansion in the provision of water and sanitation. The study is aimed at analysing the nature of challenges faced in the provision of water and sanitation services in newly planned residential areas in Lusaka. The study sought to assess the nature of water and sanitation provision in Kwamwena Valley, challenges faced by the residents in accessing water as well as the challenges faced by the residents in accessing sanitation services in the area. The study was based on data collected from 120 household questionnaires conveniently sampled and supplemented by seven key informants purposively selected from institutions with a stake in water and sanitation. The results obtained show that there is on-site provision of water and sanitation in Kwamwena valley. For water provision, the results indicated that the main sources of water for the residents are private boreholes with elevated tanks and submersible pumps (58.3 percent), hand pumps (20 percent), communal taps (3.3 percent) and shallow wells (3.3 percent) while others did not have onsite water (13.6 percent). For sanitation, results indicated that the main sanitation facilities included pit latrines which accounted for 45 percent, flush toilets 35 percent and Ventilated Improved Pit-latrines (VIP) toilets at 20 percent. Out of 120 households interviewed, 56.7 percent of the residents reported that they faced challenges in accessing water while 43.3 percent did not, and the main challenges included costs of installing boreholes and drawing water among others. For sanitation, results showed that the main challenges faced are septic tanks filling up within short periods, the cost and poor pit latrine emptying services, poor construction of pit-latrines among other things. This study concludes that the inadequacy in the provision of water and sanitation by LWSC given the population increase and growth of new settlements leads to on-site provision of water and sanitation by residents. This is however unsustainable and may cause both environmental and health problems due to the increase in the number of boreholes drilled and septic tanks built. As such there is need to come up with a more sustainable way of providing these service to residents as areas are planned.

Key words: Water, Sanitation, Urbanisation, Settlements

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ACRONYMS

CBD	Central Business District
CSO	Central Statistics Office
CU	Commercial Utility
DHID	Department of Housing and Infrastructure Development
DMAs	District Metered Areas
GRZ	Government Republic of Zambia
JICA	Japan International Cooperation Agency
LCC	Lusaka City Council
LWSC	Lusaka Water and Sewerage Company
MCA	Millennium Challenge Account
MCC	Millennium Challenge Corporation
MCDSS	Ministry of Community Development and Social Services
MMD	Movement for Multi- Party Democracy
MWDSEP	Ministry of Water Development, Sanitation and Environmental protection
NWASCO	National Water and Sanitation Council of Zambia
NRW	Non Revenue Water
PPHPZ	People's Process on Housing and Poverty In Zambia
SDG	Sustainable Development Goals
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
UWSS	Urban Water Supply and Sanitation
WARMA	Water Resource Management Authority
WATSAN	Water and Sanitation
WHO	World Health Organization
WSS	Water Supply and Sanitation
ZHPPF	Zambia Homeless and Poor People's Federation

CHAPTER ONE: INTRODUCTION

1.1 Background

In many parts of the world, population growth and urbanization are increasingly becoming major challenges to governments (World Health Organisation (WHO)/United Nations International Childrens Emergency Fund (UNICEF), 2012). According to the United Nations (UN)(2014), 52 percent of the world's population now resides in urban areas, with 90 percent of the world's population growth occurring in cities located in developing countries. The rapid urbanization confronting developing countries is placing tremendous pressure on service delivery, in particular, of water and sanitation and clearly represents a major challenge for those responsible for the provision of the basic water and sanitation services (Ress, 2006). This task is made even more difficult because of predicted dramatic global changes such as; climate change which is likely to cause significant changes in precipitation patterns and consequently affect the availability of water. Further population growth, urbanization, industrial activities could lead to a dramatic increase in water consumption and wastewater discharge (Zhou, *et al*, 2008). Hence the provision of safe drinking water and basic sanitation is very critical for achieving sustainable development in line with Sustainable Development goal (SDG) 6, whose aim is to ensure availability and sustainable management of water by the year 2030 (United Nations(UN), 2016).

Zambia is one of the most urbanized countries in sub-Sahara Africa with about 39.5 percent of the total population of approximately 5,173,450 million people living in urban areas, while 60.5 percent of the rest of the population is scattered throughout the rural parts of the country (Central Stastics Office, 2012). According to CSO (2012), the country had an average growth rate of 4.2 percent from 2000 to 2010 and 2.8 percent in the year 2010. This situation has brought about major urban development challenges such as provision of land and services to an ever-increasing urban population. Nationally, approximately 18 percent of the population has no access to any form of sanitation facilities, 34 percent of households have access to unimproved sanitation facilities and about half the population approximately 48 percent, has access to improved sanitation facilities (WHO/UNICEF, 2012).

Lusaka as the country's capital city, like many of Africa's capital cities according to (Wragg and Lim, 2015), is in the throes of change as such; rapid urbanization, globalization, migration and recent economic growth are having a transformative effect on the city spaces. The challenges facing Lusaka city are those typically associated with urban development, such as population growth, urban sprawl, high and rapid levels of urbanization and lack of serviced land (UN-HABITAT, 2007). The 2010 census report estimated the population of Lusaka District at 1.7 million while that of Lusaka Province was estimated at 2.2 million (MCC, 2011). Lusaka has also seen an increase in the construction of housing especially by the private sector to cater for the growing population. Further, due to rapid urbanization, Lusaka is physically expanding into adjacent district beyond its legal boundaries but people in these areas have continued to receive their services from Lusaka.

In Lusaka, the Lusaka Water and Sewerage Company (LWSC) is the service provider responsible for provision of water and sanitation as prescribed by The Water and Sanitation Act no. 28 of 1997 which gives Local Authorities the mandate to establish a water supply and sanitation utility as a company under the Companies Act. The water sources of the LWSC system consist of approximately 58 percent groundwater sources equivalent to 130,000 cubic meters per day. The other sources of water such as satellite systems and private boreholes use groundwater with a supply of approximately 80000 cubic meters per day (Lusaka City Council (LCC), 2008).

However, LWSC has over the years been faced with many challenges in adequately providing the services to its customers. According to LCC (2008), the total amount of water supplied by LWSC in 1990 was between 200,000 cubic meters (m^3) and 220,000 m^3 per day. In 1993, the total water supplied was 210,000 m^3 per day but by 2005, the company was still supplying the same quantity of water. By 2012, the average amount of water produced per day had increased to 258,000 m^3 against an estimated average daily demand of 370,000 m^3 (LWSC, 2013). In terms of sanitation, as of 2009 out of the estimated 1.2 million inhabitants in Lusaka, about 35 percent had access to a sewer system, about 20 percent were using septic tanks, and the rest (45 percent) relied on pit latrines to dispose of

their sewage and waste water (Japan International Cooperation Agency (JICA), 2009). The increased pressure on the resource not only affects the capacity of LWSC to meet the demands of communities but also corporate water. Indications from the MCC report suggests significant levels of incapacity of LWSC to provide the service that is commensurate to the demand arising from the population increases in the City.

It is worth noting, that although the deterioration of urban services and infrastructure is mostly associated with urban populations living in the high density low-cost Peri-urban and informal settlements, this situation is also common to planned residential areas. For most planned settlements, exploitation of ground water has become a more accessible and comparatively cheap source of water thereby exerting enormous pressure on the Lusaka's aquifer through drilling of private boreholes or hand-dug wells.

In light of this background, this study therefore sought to analyse the nature of water and sanitation provision in newly planned residential areas in Lusaka with a focus on Kwamwena Valley. Further, the study seeks to determine the challenges faced by the residents in accessing water and sanitation in the area.

1.2 Problem statement

The increase in the urban population in the city of Lusaka, has among other things led to the increase in housing demand hence leading to an increase in housing projects by various institutions such as;- National Housing Authority (NHA), National Pension Scheme Authority (NAPSA) and various private investors. With the current increase in privately-driven housing developments in Lusaka, provision of water and sanitation is a paramount requirement, but LWSC has been unable to adequately expand its services to meet the growing demands. As a result, these areas are either subject to reduced hours of access to water or on-site provision of the services. This may, however, have a negative effect on the health of the residents and on the environment because of the increased number of boreholes sank and septic tanks in close proximity to each other. The observation above necessitated the need to establish the nature of the provision of water and sanitation in newly planned residential areas in Lusaka and challenges that that the residents face in accessing the service. Further, it brought the need to look at the future implications on the

service delivery to the existing and future residential areas which are now are on the increase in Lusaka and the possible effects on the environment and health of the residents.

1.3 Aim

The aim of this study is to analyze the nature of challenges faced in the provision of water and sanitation services in Kwamwena Valley.

1.4 Objectives

The following are the specific objectives of the study;

i. To analyze the nature of water and sanitation provision in Kwamwena Valley.
ii. To determine challenges faced by the residents in accessing water in the area.
iii. To determine challenges faced by the residents in accessing sanitation services in the area.

1.5 Research questions

The following are the research questions;

i. How is water provided in Kwamwena Valley?
ii. How is Sanitation provided in Kwamwena Valley?
iii. What are the challenges faced by the residents in accessing water in the area?
iv. What are the challenges faced by the residents in accessing sanitation in the area?

1.6 Significance of the study

With the increase in the development of privately driven residential areas, it is inevitable that the provision of services such as water and sanitation will be demanded in these areas yet the availability of the water resource is under threat and decreasing whilst the LWSC has been unable to adequately expand to meet the demands. The provision of safe drinking water and basic sanitation is among the most critical challenges for achieving sustainable development. This study will act as a guide to Urban Planners and other professions involved in WATSAN in formulation of policies that will inform provision of water and sanitation in residential areas in order to achieve a functional and efficient water supply and sanitation system. The study will also be important to other scholars and researchers

as a foundation for further research on how provision of water and sanitation can be improved given the limited resources as little research on provision of water and sanitation in urban areas has been done.

1.7 Organisation of Dissertation

This dissertation is structured into six chapters, with the first chapter providing the introduction and basis for the study. Chapter Two provides literature on the water and sanitation sector by reviewing the status of water and sanitation, the challenges faced in the sector at an international level, in Africa and also the performance of the sector in Zambia. The chapter further looks at the institutional arrangement and legal frameworks in terms of the regulations and policies guiding water and sanitation provision in the country. Chapter Three looks at the research methods used in the study. In Chapter four, looks at the study area, its location and climate. Chapter five presents the findings of the study regarding the nature of water and sanitation provision in Kwamwena Valley and the challenges faced by the residents in accessing water and sanitation in the area. Chapter Six of this dissertation provides the conclusion and recommendation.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The literature, which has been reviewed, provided relevant information on the water and sanitation sector and its challenges world over. It has been argued that "clean water and adequate sanitation would be humanity's best investment to achieve development and sustainability" (Tipping et al, 2005). Research has revealed that rapid urban growth at early stages of development has meant that, people have concentration in urban areas without the accompanying investment in physical structures such as water, sanitation, electricity and human capital needed to reap the expected economic benefits of agglomeration; and governments have been less able to manage these negative externalities *(*Maria *et al*, 2014).

The chapter gives brief definitions on water and sanitation, the effects of rapid urbanization on water and sanitation services and its challenges. Further the chapter looks at alternative water and sanitation services, where they have been successfully applied in other countries in the world and sustainability of the ground water source. The chapter also reviews the status of water and sanitation in Zambia and Lusaka at large as well as the regulatory and policy framework that guides the sector through the use of journals, official water reports, approved dissertations, reports and books.

2.2 Water and Sanitation (WATSAN)

An improved drinking-water source is defined by World Health Organisation (WHO) joint monitoring programme ()as one that, by nature of its construction or through active intervention, is protected from outside contamination, in particular from contamination with faecal matter (WHO/UNICEF, 2012). On the other hand, Sanitation is defined as safe collection, storage, treatment and disposing in a hygienic way of waste, including human excreta (faeces and urine), household waste water and rubbish at an affordable rate in a sustainable manner (Van Dijk 2012). This study will deal mainly with water supply and sanitation service as it only concerns the supply of drinking water and the collection and treatment of wastewater by authorised water supply and sanitation service providers (Schouten, 2009).

At the basic level, every community and individual requires access to clean water and sanitary waste disposal (Mensah and Antwi, 2013). Likewise, it has been argued that "clean water and adequate sanitation would be humanity's best investment to achieve development and sustainability" (Tipping et al, 2005). Every year, unsafe water, coupled with a lack of basic sanitation, kills at least 1.6 million children under the age of five years (Zhou et al, 2008). However, despite the intensive efforts of many institutions at the national and international levels, nearly 1.1 billion people still remain without access to improved sources of water, and about 2.4 billion had no access to any form of improved sanitation services. As a consequence, 2.2 million people in developing countries, most of them children, died every year from diseases associated with lack of safe drinking-water, inadequate sanitation and poor hygiene (WHO/UNICEF, 2012).

2.3 Rapid urbanization and Basic Service Provision

Africa is urbanizing fast. Its rate of urbanization soared from 15 percent in 1960 to 40 percent in 2010, and is projected to reach 60 percent in 2050 (UN Habitat 2010). As such, urban populations in Africa are expected to triple in the next 50 years, changing the profile of the region, and challenging policy makers to harness urbanization for sustainable and inclusive growth. Rapid urban growth at early stages of development has meant that people have concentration in urban areas without the accompanying investment in physical structures such as water, sanitation, electricity and human capital needed to reap the expected economic benefits of agglomeration; and governments have been less able to manage negative externalities *(*Maria *et al*, 2014).

Rapid urban growth is occurring throughout the continent, but access to water varies from country to country. In Uganda, the proportion of the urban population with access to improved water sources increased from 78 percent (1.5 million people) in 1990 to 91 percent (3.7 million) in 2008. During the same time, in Nigeria, access to water in urban areas fell from 79 percent (27 million) to 75 percent (55 million). Both countries managed to double the number of people with access to safe water, but in Nigeria the expansion could not keep up with population growth (WHO/UNICEF, 2012). Utilities operate with aging infrastructure aimed at supplying the city as it once was. About two-thirds of Africa's

urban population is served by water utilities (Africa Infrastructure Country Diagnostic (AICD, 2011). Adequate funding is not available to utilities for expansion or renewal of aging infrastructure in African cities; compared to the rest of the world.

Access and service quality vary between countries in Africa. In middle-income countries such as South Africa, utilities reach about 99 percent of the urban population, the vast majority through private piped water connections. In low-income countries, 49 percent of urban areas receive water from utilities and less than half of these are through piped connections. Informal sharing of connections between neighbours accounts for 15 percent and communal standpipes account for 19 percent of water distribution (Morella et al, 2008). In Maputo, Mozambique, one-third of unconnected households purchase water from their neighbours, and in Maseru, Lesotho, household resellers provide water to 31 percent of the population, including almost half of the unconnected households (AICD, 2011).

It is also critical to acknowledge the fact that the massive inflow of migration towards urban areas in developing countries has resulted in the over-population in urban areas. Population is increasing at higher rates than the national government's ability to provide services for sustainable, healthy living environments (UN, 2014). It is a known fact that rapid urbanization has various implications for the infrastructure and service needs of cities. Tsepiso (2015) suggests failure of government to expand water supply, sanitation, energy resources, security, social amenities, aesthetics, and transportation to the unplanned settlements in the urban periphery where most of the urban poor live has resulted in misery and urban decay. With the growing population expanding between planned and unplanned urban residential areas, the demand for additional and improved services from the increasing population is emphasized in terms of infrastructure and service provision to these settlements (Jacobsen *et al,* 2013).

UNHSP (2016), argues that there remains a substantial number of urban settlements that are neither budgeted for nor planned in the cities as such many mishaps are experienced as governments do not feel the need to provide these places with the required services and most of them are not easily accessible, thereby increasing the cost of transferring services

to these areas. According to (Wragg and Lim, 2015), urbanisation is not a very complicated matter if plans and budgets go hand in hand. This is unfortunately not always the case in the developing countries. The sheer magnitude of some urban problems leaves city planners in utter despair and somewhat hesitant to embark on efficient urban planning and development (UNHSP, 2016)

2.3.1 Challenges of Water Supply and Sanitation due to Urbanisation

Conventional urban water supply and sanitation management is generally characterized by an unsustainable use of water and nutrients. This represents important environmental, economic and social challenges, which are intensified by the process of urbanization.

2.3.1.1 Pollution of surface water sources

Urban settlements are the main source of point source pollution (UNESCO, 2004). It is estimated that more than 90% of sewage in the developing world is discharged directly into rivers, lakes, and coastal waters without treatment of any kind (Luethi *et al.* 2009). In low and middle-income countries, leaking on-site sanitation facilities together with the absence of sewerage pipes that dispose the wastewater, result in large volumes of local wastewater soaking into the soil, and eventually seeping into aquifers and polluting groundwater (Groenwall *et al*. 2010).

2.3.1.2 Depletion of groundwater sources

In urban settings, the use of groundwater sources is an especially common feature of many low-income communities in low and middle-income countries. More than half of the world's megacities depend on groundwater (WHO/UNICEF, 2012). According to Beekman (2016) abstraction of groundwater from an aquifer results in a decline in groundwater levels, which causes induced recharge. Beekman (2016) further explains that when the pumping rate is larger than the total recharge (natural recharge plus induced recharge), groundwater levels will continuously decline, and groundwater storage will eventually be depleted.

2.3.1.3 Waste of resources

Water treated to potable water is used for non-potable purposes such as toilet flushing, garden use and industry. When water is heavily subsidized or charged based on a fixed rate, users have little financial incentive to use it sparingly (Howe *et al*. 2011). This is also supported by Ress, (2006) who notes that this is commonly the case in Agriculture, were irrigation water is provided at zero or highly subsidised rates and farmers have little incentive either to irrigate using water efficient technologies or to curb the production of water intensive, low value crops.

2.3.1.4 High water demand

The concentration of a great quantity of population and activities on a small area involves the need of a great amount of good quality water (Chocat, 2002). Urban areas usually have a higher per capita consumption of water compared to rural areas. In developing countries, rapid population growth and urbanization has created an added demand for water services (Zhou *et al*, 2008)

2.3.1.5 Cost-intensive infrastructure for water supply and wastewater collection

The increase of urban population asks for a continuous expansion of water networks and wastewater networks. Centralized networks are very cost-intensive in terms of construction, operation and maintenance. If the networks are not sufficiently maintained, leakages lead to a loss of valuable resources, unreliable or irregular water supply and low revenue collection for the utilities. Many large cities suffer from chronic water shortages due to over-exploitation of raw water resources, and to losses of water, which sometimes reach up to 60% of the volume of water supplied (UNESCO et al. 2004).

There are several other challenges with regard to water and sanitation globally. While the water sector as a whole suffers from capital investment scarcity , funding for sanitation has been particularly problematic (Ress, 2006). This could explain why the world did not met the Millennium Development Goals (MDGs) on water, according to the WHO Joint Monitoring Programme update, released in March 2012, which estimated that the goal on basic sanitation would be missed by almost 1 billion people (WHO/UNICEF, 2012). Further, Rijsberman and Zwana (2012) argue that the sanitation challenge proved so

elusive for many countries and the simplest answer is the cost of current technologies. The authors further state that for about two hundred years the water closet – the flush toilet with its smell-limiting water seal that brought the "outhouse" indoors – and the associated sewer networks have been the technology of choice for all who can afford it. Faced with such costs and the potential to decouple water and sanitation services, many governments and households have prioritized water over sanitation (Rijsberman and Zwane, 2012).

Whittington et al., cited in (Rijsberman and Zwane, 2012) argued in 2008 that the cost of flush toilets and sewers limited their reach to the top one or two income quintiles. Conventional waste water treatment plants are not only expensive to construct, but costly to operate because of their high energy requirements. Further, the Authors indicate that as a consequence, in a typical country in Sub-Saharan Africa, sewers serve only a small core of large cities as is the case in Lusaka. The sanitation that serves those household's not in the sewered core is not networked; it is on-site sanitation, with mainly the use of latrines or septic tanks, an investment for which the owner of the house bears primary responsibility.

2.4 The International Scenario of Water and Sanitation

Globally, significant progress was made to increase access to water and sanitation during the Millennium Development Goals (MDG) era. Over the last two decades, more than 2 billion people have gained access to improved drinking water and almost 2 billion to sanitation (UNICEF, 2015). However, UNICEF (2015) further reports that 663 million people still lack access to improved drinking water, and questions remain about both the sustainability and safety of drinking water supplies. Of great concern is the fact that some 2.4 billion people do not use improved sanitation facilities, and almost one billion people practice open defecation. Notably, many countries in Africa were unlikely to meet the MDG targets for either water or sanitation which has been the case (UNICEF, 2015).

According to Annamraju et al (2001) water and sanitation shortage is a problem that was there many years ago and even today the problem still remains, for example at the beginning of the Unites Nations water decade in 1981, 1.9 billion of peoples lacked access to safe water and some 2billion lacked adequate sanitation. Nearly two decades later, in

2000 more than 1.1 billion still lacked access to water and some 2.5 billion lacked adequate sanitation. Access to safe water and to sanitary means of excreta disposal are universal needs and, indeed, basic human rights. They are essential elements of human development and poverty alleviation and constitute an indispensable component of primary health care (WHO/UNICEF, 2002).

Inadequate sanitation, hygiene and water result not only in more sickness and death, but also in higher health costs, lower worker productivity, lower school enrolment and retention rates of girls and, perhaps most importantly, the denial of the rights of all people to live in dignity (WHO/UNICEF, 2002). The majority of these people live in Asia and Africa, where less than half of all Asians have access to improved sanitation and two out of five Africans lack improved water supply. Moreover, rural services still lag far behind urban services. Sanitation coverage in rural areas, for example, is less than half that in urban settings, even though 80% of those lacking adequate sanitation (2 billion people) live in rural areas – some 1.3 billion in China and India alone (WHO/UNICEF, 2002).

2.4.1 Water and Sanitation management

According to Pinerhughes (2004), urban water management involves the fields of water supply, water purification, prevention of flooding, urban drainage, wastewater treatment and sludge handling. He further states that in most developing countries, water management services are the responsibility of the public sector for which access to internal funding to create a water supply and disposal infrastructure is severely limited.

Studies have shown that population growth and improving standards of living, coupled with dramatically increased urbanization, are placing increased pressures on available water resources and sanitation facilities, necessitating new approaches to urban water management (Balint, 1999; WHO/UNICEF, 2012 ;Glen, 2009). Today, the urban water and sanitation system is being challenged on several sustainability fronts, for example, excessive use of chemicals and energy in treatment processes, and growing operation and maintenance costs, primarily due to aging networks and more stringent treatment demands (Krantz, 2012). Further, Pinerhughes (2004) also adds that in most cities, factors such as urban sprawl, the expansion of agricultural production into peri urban areas, and the

inefficient design and management of domestic water supply systems have induced profoundly unsustainable patterns of groundwater use, and authorities are facing serious problems related to water supply, water quality and waste water treatment.

Glen (2019) suggests that adopting new approaches to urban water and sanitation resource management can lead to more sustainable solutions, defined as financially stable, using locally sustainable water supplies energy neutral, providing responsible nutrient management and with access to clean water and appropriate sanitation for all. Mitchell (2006) states that in order to reorientate urban areas towards sustainability, it is recognised that the different aspects of urban water systems should be viewed in relation to each other, which requires the adoption of an integrated approach to urban water system planning, provision, and management. Krantz (2012) claims that policies and policy instruments may be important drivers when systems come into being or change. However Pinerhughes (2004) suggests that Planners must turn their attention to the problematic effects of urbanization, industrial processes and inefficient irrigation on water demands and usage. In addition, Pinerhughes (2004) noted that water conservation and waste minimization planning and implementation policies and measures must be developed and immediately implemented among the multisectored interest that use freshwater resources.

Despite the challenges experienced by many countries in the provision of water and sanitation, some countries have risen above these challenges by improving the management of the service. According to Pinerhughes (2004), the ability of municipal authorities to provide populations in their jurisdictions with access to sufficient and clean water supply and wastewater services depends heavily on the material and economic resources public authorities have to allocate to this challenge. Some countries have done exceptionally well

Singapore is said to be one of the few countries to have addressed its water supply in its totality (Tortajada, 2006).The Country's significant investments in water Research and Development (R&D) enabled Singapore to develop a world class innovation-driven water industry that is increasingly exporting innovative technologies and best practices in water management to the world, and contributing to the socio-economic prosperity of the country (INSEAD, 2013). Singapore did this through adopting an innovative four-pronged

approach to establish a robust, diversified and sustainable water supply known as the 'Four National Taps', Singapore's water supply is based on four sources of supply: 1) local catchments; 2) imported water from Malaysia; 3) recycled water, brand named 'NEWater'; and 4) desalination (Tortajada 2006). Thus, in addition to import of water from Johor, it made a determined attempt to protect its water sources (both in terms of quantity and quality on a long-term basis), expand its available sources by desalination and reuse of wastewater and stormwater, and use technological developments to increase water availability, improve water quality management and steadily lower production and management costs (INSEAD, 2013).

In Sweden, the government and parliament agreed that environmental issues would inform all political decisions (Krantz, 2012). According to Hellstro et al (2000), in order for Sweden to improve and raise the knowledge with regard to sustainable water and wastewater management, the Swedish Foundation for Strategic Environmental Research (MISTRA) in 1999 initiated a 6-year Swedish research program entitled "Sustainable Urban Water Management" .The vision of the program was defined as: "Every human being has a right to clean water. For urban areas, their vision was water management where water and its constituents can be safely used, reused and returned to nature." according to Krantz (2012), the improved wastewater management not only helps Sweden achieve the phosphorous target but also advances other national environmental objectives.

The most important lessons offered by the Singapore and Sweden case, is the need for research and development in developing lasting solutions to the challenges encountered in the provision of water and sanitation. This gives an opportunity to develop systems that can work for that particular environment. Further, the case of Sweden further demonstrates the need to develop strong supporting legislation and policies that will create an enabling environment for innovation.

2.5 The African Scenario of Water and Sanitation

Most African countries have acute water scarcity and inadequate provision of sanitation recorded; among them are Rwanda, Uganda, Democratic Republic of Congo (DRC), Ethiopia, Central African Republic, Angola, Burundi, Sierra Leone, and Zambia (UN,

2016). These are countries with more than half of the citizens living without sufficient water supply. Some of the identified causes of water scarcity and sanitation problems in these African countries mainly include pollution and depletion of available resources through human activities.

It is clear that about 80% of untreated domestic wastewater in Africa is released into surface water bodies, thus depleting available freshwater (Longe, 2012). This is besides wastewater from agricultural and industrial activities. In addition, insufficient finances for the development of water resources infrastructure have proven to be a capital-intensive venture for most countries in the global south. This is so because it requires huge investments and subsequent maintenance efforts. Most African countries cannot afford the required investments, thus, limiting their water developmental projects and distribution capacities (Longe, 2012). Furthermore, there are noticeable water losses through infrastructural facilities, such as pipelines that are often vandalized by people seeking illegal connections to public water services. Such activities lead to water wastages and financial losses (Olaosebikan,1999; Ajai, O. 2012) in (Harhay 2011).

It is also imperative to acknowledge the fact that weak water governing institutions in most of these countries are operationally limited by factors such as lack of data, incompetent personnel, energy shortages, and limited finances (Harhay, 2011).

2.5.1 Malawi

In these African countries, people develop their own water technologies because of water and sanitation shortage, for example an assessment done by Edwards *et al*., (2007) showed that in Malawi people use a technology called gravity systems. The gravity system water supply is derived from intakes in streams in the hill then the water flows from the intakes, which are located at approximately elevation 1,440 metres, through an open canal to a sedimentation tank. Water is then transported from the sedimentation tank to the village though pipelines. The gravity system serves approximately 1,600 households and 8,000 people. Water in Malawi was also accessed through boreholes, shallow wells and from natural sources such river and streams. A study by Diemand *et al*., (2010) showed that the use of boreholes was also common in Tsumkwe Otjozondjupa Region of Namibia where

water was pumped from four boreholes into an elevated reservoir and then distributed to community taps and personal storage tanks.

2.5.2 Zimbabwe

Domestic water supply also continues to be a serious challenge in Zimbabwe's towns and cities and research has lagged behind in addressing domestic water scarcity problems. The provision of houses to urban dwellers has not been matched with an increase in the number of water reservoirs. Most of the major water sources in many cities of Zimbabwe were built during colonial times when the population was far less than the current trend. Recent studies have focused more on problems associated with water shortages, assessment of water services and water demand side management (Matsa & Tapfuma, 2015). These challenges are said to be caused by breakdown of pumps; poor rainfall; vandalism of infrastructure (pipes) by newly resettled farmers along Gwenoro-Gweru road and also high population. These causes are not peculiar to Mtapa intrinsically, but almost all high density suburbs which are supplied by Gwenoro dam like Mambo, Ascot, and Mkoba among other areas (Matsa & Tapfuma, 2015).

In Malawi, while studies have shown that people innovated ways of providing water, there is still potential to employ better and safer means of providing water to its people. Both cases of Malawi and Zimbabwe demonstrate gaps in research and development which is necessary for the development of innovative and sustainable management of water and sanitation as demonstrated by the case of Singapore and Sweden. Literature reviews that the case of Malawi and Zimbabwe is common to most African countries and studies have shown that this is so because the water and sanitation sector requires huge investments and subsequent maintenance efforts. According to Longe (2012), most African countries cannot afford the required investments, thus, limiting their water developmental projects and distribution capacities.

2.6 Main Source of Drinking water in African cities

An improved drinking-water source is defined as one that, by nature of its construction or through active intervention, is protected from outside contamination, in particular from contamination with fecal matter. Table 1 gives classification of water drinking sources.

Table 1: Classification of water sources

Improved drinking water sources	Unimproved drinking water sources
Piped water into dwelling, plot or yard Public tap/standpipe Tube well/borehole Protected dug well Protected spring Rainwater	Unprotected dug well Unprotected spring Small cart with tank/drum Tanker truck Surface water (river, dam, lake, pond, stream, channel, irrigation channel) Bottled water

Source: (UNICEF and WHO,2008)

Studies have revealed that most African water utilities provide water through stand taps and household taps (UNICEF, 2015), (WHO/UNICEF, 2012). The utilities are known to deliver poor continuity of water service and inadequate water quality (Tipping et al, 2005). Utilities report providing from 6 to 24 hours of service daily, and just over 80 percent of their samples pass chemical tests. The reliability of service varies greatly as does the water consumption per capita, from 240 litres per capita per day in Johannesburg to 7litres per capita per day in the Central African Republic.

The number of households relying on boreholes and wells has increased by 22 million over the past decade, but infrastructure dilapidation and lack of well and borehole maintenance has rendered many of these sources unsuitable to secure safe drinking water (Mensah et al, 2013). For instance, in the Central African Republic only 10 percent of the wells and boreholes provide safe water despite these being the main source of water for urban dwellers. Poor cost recovery and governance limits expansion of service coverage (Dominguez-Torres and Foster, 2011). Nauges and Whittington,(2009) argues that a better understanding of household water use in developing countries is necessary to manage and expand water systems effectively. However, he further notes that such an analyses is difficult to do in developing countries because conditions surrounding water access often

vary across households and that households often rely on a variety of water sources including piped and nonpiped sources with different characteristics and levels of services such as price, distance to the source, quality, reliability and so on. A study done (Corbella and Pujol, 2009) suggests that there are several factors that influence a household's water demand such as income, household size, gender and the age structure in population. The author argues that income affects thee responsiveness to price mechanism; thus, while low income families may not respond to price because they are using water mostly to fulfil basic needs, well-off individuals or households fail to respond because the price signal is not strong enough to curb their consumption, further the author states that in principle, the higher the number of people living in a household, the larger the aggregate of demand is supposed to be. Similarly, a study done by (Nauges and Whittington, 2009) on analysis of demand for water in developing countries shows that households in all three groups (medium to high cost households in the city, households in slums and rural areas) have access to and may use more than one of several types of water sources, such as in-house tap connections, public or private wells, public or (someone else's) private taps, water vendors or resellers, tank trucks, water provided by neighbors, rainwater collection, or water collected from rivers, streams, or lakes. In addition, the Authors continue to indicate that that some households whoutilize more than one source may indicate that their use of a particular convenient source is rationed (implying that additional water must be taken from an alternative source); or that it is relatively cheap to take some water but not all from a particular source (for example the household may have limited capacity to haul cheap water from a given source and may prefer to obtain the rest more expensively from another source); or that waters from different sources are used for different purposes (drinking, bathing, cleaning, and so on). The choice determined upon, as well as the conditions of access, can vary significantly across households. Contrary to these studies, a report done by WHO,UNICEF (2006) indicates that access to water and sanitation services is unequal: piped water is available primarily to upper-income residents, while the poor rely on untreated wells and surface water.

2.6.1 Types of Sanitation facilities

Studies have shown that sanitation services are dependent on income, with upper-income groups serviced with water-borne sewers, and the poor resorting to open defecation or traditional latrines (Tipping et al, 2005). Further, the authors state that urban sanitation services serve fewer people than those served by piped water. A little more than half of the households with piped water also have flush toilets, which are often connected to septic tanks rather than to sewers. Namibia, Senegal, and South Africa report universal coverage by sewerage but in most other African countries, sewerage serves less than even 10 percent of urban areas (AICD, 2011). There are various types of sanitation systems available which include, Sewer, Septic tank, cistern flush toilet or water closet, Pour-flush, VIP latrine and the Simple pit (UN-Habitat, 2006). In India, septic tanks and pit latrine common modes of on-site sanitation systems used although the septic tanks said to have problems of like periodic cleaning and disposal of sludge (Shivendra & Ramaraju, 2015).

In the large cities of Africa, septic tanks are not as common, but a larger proportion of the population uses pit latrines, or ventilated improved pit latrines, than in other regions. There are certainly cities in Asia and Oceania that could make greater use of dry pit latrines, particularly in settlements where the water supply is limited, expensive or unreliable (Tipping et al, 2005). On the other hand, in parts of Africa and in Latin America and the Caribbean there is an unexploited potential for the use of pour-flush toilets, which can give a service that is aesthetically little different from a flush toilet, at a more modest cost (WHO/UNICEF, 2008).

However research work has been carried out by various authors on the assessment of impact of on-site sanitation system on groundwater contamination (Pujari et al. 2007; Lu et al. 2008; Banerjee 2011, Sudhakar .M Rao, et.al 2013) in (Shivendra and Ramaraju, 2015). In their studies they used installed observation wells or existing wells on the downstream side of on-site sanitation system for collection of water sample or soil samples or both during wet and dry seasons (Shivendra and Ramaraju, 2015). According to Banks et al (2002) in (Shivendra and Ramaraju, 2015), the extent of groundwater pollution, depends on hydro geological and soil condition of surrounding Environment, depth to water table and distance between groundwater source and onsite sanitation system.

Studies on impact of septic tank system on groundwater quality carried out in India, and China by Pujari et al (2012), found increased concentration of nitrate and bacteria in groundwater near onsite sanitation system. In his studies he observed safe distance between on-site sanitation units and groundwater supply sources is 10 meters. The study concludes that geological setting also plays in groundwater contamination in addition to other parameters. The groundwater pollution due to on-site sanitation system relates primarily to unconfined and, to a lesser degree, to semi-confined aquifers. If groundwater supplies are drawn from deep and confined aquifers, on-site sanitation does not pose a significant hazard. Hence the hydro geological characteristics plays a role in groundwater contamination due to onsite sanitation systems (NEERI 2005).

In the case of house connections for water supply, regions where the populations of large cities are growing fastest are also those with the lowest coverage with conventional sewers. Africa and Oceania have the lowest coverage, while Latin America and the Caribbean and Asia lie between them and the industrialized regions of Europe and Northern America. Asia has done better than the other regions of the developing world in extending use of septic tanks and pour-flush systems. Septic tanks are also widely used in Oceania, where on average serve nearly half the population of the largest cities, and in Latin America and the Caribbean, where they serve one-quarter (Tipping et al, 2005).

The extent of contamination of Groundwater wells is poorly recognized in many developing countries because of lack of monitoring (Shivendra & Ramaraju, 2015).

2.7 Alternative Sources of water

With the challenges that Zambia faces regarding the construction and the maintenance of water related infrastructure, alternative water systems may be part of the portfolio of options the government has to consider to achieve its water policy objectives with consideration of the effects of global warming on the environment today. According to Mensah and Antwi(2013), Global warming has been noted to contribute to reducing the availability of water in developing countries. At the same time, population growth, urbanization and intensive irrigation practices have significantly increased competition for water in cities.

Traditionally, water has been used on a once through and discharge basis. Although planned re-use began in the early 20th century, it is only in the last 30 or so years that it is potential has been widely recognized. Unplanned re-use has, of course, been a fact of life for many centuries. Planned re-use can occur at various scales, from the individual household to the large scale river basin (Ress, 2006). According to a report by Leflaive (2007), alternative water systems have been used in rural areas for decades. They can also be used as an option in new urban areas where no central infrastructures pre-exist, and in extra-urban urban areas. In addition, alternative water systems might be considered in city centres with decaying water infrastructures or with infrastructures meeting diseconomies of scale or capacity constraints, and in projects of urban renewal. Leflaive(2007) defines alternative water systems by one or two of the following features; the recycle and re-use water for a variety of uses; or they can be based on decentralized infrastructures, producing water where it is consumed. He states that alternative sources of water include: rainwater, which can be harvested and treated locally; grey water, i.e. non-industrial wastewater generated from domestic processes and reclaimed water, i.e. former wastewater that has been treated to remove solids and certain impurities. It is only intended to be used for non-potable uses such as irrigation, dust control, fire suppression; with more advanced treatment, it can be used for indirect potable reuse (i.e. discharged into a water body before being used in the portable water system).

Rainwater harvesting as an alternative source of water requires that tanks be installed, in existing or new homes, to collect run off from the roof area; these tanks can be connected to indoor end uses (such as toilet flushing and washing machines) and outdoor (watering the garden). Wastewater re-use requires retro-fitting systems in houses so that grey water from the house can be collected, treated and re-used (for the same end uses). In the case of new homes, grey water systems can be integrated in the initial planning, saving investment costs (Leflaive, 2007). According to Ress (2006), by far the most common form of planned re-use is the use of minimally treated reclaimed water for a whole range of non-potable purposes – in industrial processes, for toilet flushing, street cleaning and the watering of urban parks, landscaped areas, recreational spaces (such as football pitches or golf courses) and gardens. She further adds that this not only saves water but can also

reduce water supply treatment costs by cutting the use of expensively treated potable water for purposes not requiring that level of purity. However, clearly costs are incurred in developing a separate reticulation system and in ensuring effective controls over industrial pollutants not compatible with re-use. Such costs can be significantly reduced if the potential for re-use becomes an element in urban design, land use zoning, development control and building regulations; for this to happen cooperative relationships would be needed between the water service providers, local planning and development control authorities, and other key stakeholder groups (Ress, 2006). Similarly, Leflaive (2007) also adds that public involvement, and transparency are critical when alternative ways of providing water are considered, because public acceptance is topical, especially in cases of water re-use for (direct or indirect) potable uses. According to Rees (2006) planned re-use for potable purposes is still rare but improved technologies are likely to make this a more widely considered option in water shortage areas as long as the issue of public acceptability can be addressed. Rees (2006) cites an example of Windhoek in Namibia which was the first in (1968), and is still the only city to employ direct, or pipe to pipe, re-use; where treated waste water is mixed with fresh water on a 25/75% basis and is then fed back directly into the water distribution network. Leflaive (2007) explains that the regulatory framework has to be adjusted, to allow exploring the benefits of alternative water systems. While a variety of technical options exist to provide water, options in use are limited by planning regulation, norms for the quality of the product or service, standards for grey water reuse and for the techniques to be used. In addition, water sector regulators need to be prepared to monitor water quality from a variety of different sources (e.g. fresh water abstraction, harvested rainwater and water treated) in multiple settings (in central plants, commercial and industrial buildings, and private houses). This requires capacity, financial and human resources.

Leflaive, (2007) cites an example of China, where a number of developments treat water at the level of a house, or of a commercial building. In Beijing, it is required that newly developed residential buildings with construction area over 30,000 m2 build on-site wastewater reuse facilities.

2.7.1 Water Reclamation in Namibia

Namibia, a country where more than 80% of the country consists of desert or semi-desert. Windhoek, the capital, is located in the Central Highlands approximately 1,540m above mean sea level (Lahnsteiner & Lempert, 2005). According to Jacobsen *etal* (2013), Namibia has an annual rainfall of only about 370 millimetres, high surface evaporation rates, and a distance of 750 kilometres to the closest perennial river, Windhoek faces severe challenges in securing its water supply. All potable water resources within a radius of 500 kilometres have been fully exploited. And the city is growing rapidly. Driven by these pressures, Windhoek now relies on four main sources of water: surface water from dams; groundwater from 50 municipal production boreholes; reclaimed water from the New Goreangab Water Reclamation Plant (NGWRP); and reclaimed water from the Old Goreangab Water Reclamation Plant (OGWRP). While the NGWRP reclaimed water contributes to the potable water consumption of the city, the reclaimed water from OGWRP is used to irrigate parks, golf courses, and cemeteries. Windhoek is one of the few systems in the world that recycles treated wastewater for drinking water (Jacobsen *etal,* 2013).

Namibia gives a good demonstration on innovative ways of utilizing the limited water resource to supply to a growing population. Namibia provides an important lesson to developing countries on how to be sustainable by using alternative means to providing water through recycling. This is an insight for Zambia as a lot of water is wasted as runoff especially during the rainy. The use of water reclamation also reduces the over reliance on ground water and water bodies.

2.7.2 Centralized Rainwater Harvesting in Germany

Rainwater utilization in Germany is widespread since the 1980s (Khoury-Nolde, 2007). Typically, the water is collected from the roof and is filtered stored and primarily used for toilet flushing, garden watering and household laundry. Khoury-Nolde presents a novel approach; instead of using only the water from the roofs, he suggests that rainwater draining from the streets and courtyard surfaces could also *be* re-used. This could be a viable option for densely populated urban areas and reduces drinking water consumption and wastewater production. It also minimizes the entry of pollutants into the surface waters, without the need for a sewer connection. He found that 70% of the toilet-flush demand can

be replaced by treated storm water without any comfort loss. In one pilot application about 11,770 m2 of sealed surface area is connected to a rain water reservoir situated in the cellar of the pilot building of which 63% of the collection surfaces originate from the roof, 35% from courtyards and sidewalks and 12% from traffic surfaces. Rainwater is first discharged into the existing rainwater sewer of the Berlin water company, and from there it drains into the rainwater reservoir until the reservoir reaches its full capacity. The 190 m3 rainwater reservoir is filled with rainwater until the water level in the reservoir reaches the sewer.

The case of Germany is very essential to the Zambia scenario especially for Lusaka which experiences a lot of flooding during the rainy season even in the streets. This however requires policies that will promote the use of gutters during construction of buildings. As such there is need to review legislation that guides construction as well as the environment.

2.8 Alternative ways of providing sanitation services

2.8.1 The Brasilia Condominial Model

The condominial system developed in the 1980s to serve low-income communities has become the standard system employed by government entities to provide urban sanitation. The condominial model has evolved over time and the Water and Sewage Company of Brasilia (Brazil's capital) has employed the latest version for 8 years (Ress, 2006).

Rees (2006) explains that in conventional sewage systems individual houses are connected to the public sewer, which limits the private element of the sanitation to property boundaries. The condominium (city block, square or its equivalent) model extends the private infrastructure to the boundary of the residential block, where the condominal branch sewer joins the public network. All the infrastructure costs within the condominium are borne by the residents, investments in the public network are the responsibility of the public service provider but the costs are recovered from sanitation charges. Community participation is very much part of the condominal model, with residents defining the block boundaries, being able to select different types of service, and having responsibility for monitoring jointly owned resources such as the condominal sewerage.

Not only is the condominal system cheaper to install than conventional house connections but the investment cost sharing increases the capacity of government to expand coverage. Phased system development is also aided by the practice of dividing the public network into a number of parallel micro-systems, based on small natural drainage basins, which receive waste from the condominial blocks. These micro-systems may operate independently, purifying the wastes within the drainage basin, but where necessary and financially feasible they can be connected to a citywide system. The condominial model is, therefore, a decentralized system operating within a clear broader planning framework. It has the advantage of demand-responsiveness but with controls over the individual communities to reduce the costs of their own sanitation provision by passing these on to others in the urban area and in downstream localities (Ress, 2006).

2.8.2 The use of seawater for toilet flushing in Hong Kong

The growth in population and of the economy of Hong Kong has caused a significant increase in the demand for fresh water. To secure sufficient water supply and to reduce reliance on imported water from Dongjiang (East River) in Mainland China, the Hong Kong Special Administration Region (HKSAR) government has implemented a wide range of water conservation measures which include the use of seawater for toilet flushing. During 2007, about 0.74 hm3 of seawater was used for toilet flushing every day, equivalent to some 28% of the daily fresh water consumption. The seawater is firstly screened by strainers to remove solid particles. It is then disinfected with chlorine or hypochlorite before being pumped to service reservoirs for distribution to consumers. Nearly 80% of the population is now supplied with seawater for flushing.

This practice saves energy as seawater is extracted near the consumer centres, whereas most fresh water supplies in Hong Kong are pumped through long distances and go through sophisticated treatment processes (Makropoulos et al, 2012).

2.9 The Water and Sanitation sector in Zambia

Zambia has a population of 13,046,508 (Central Statistic Office, 2011) with a population density of 17.3 people/kilometer. Like most countries in Africa, Zambia is faced with rapidly urbanizing cities with a majority of cities having water and sanitation. Nationally,

approximately 18 per cent of the population has no access to any form of sanitation facilities, 34 per cent of households have access to unimproved sanitation facilities and about half the population approximately 48per cent, has access to improved sanitation facilities (WHO/UNICEF, 2012). The regulation of the water and sanitation sector, in particular for provision of water and sanitation to urban areas is done through the Ministry of Local Government and Housing. The Ministry of Local Government and Housing oversees the commercial utility companies and the Local Authorities.

Commercial Utilities (CU) are the main providers of water and sanitation services in urban areas. To better ensure cost recovery, most local authorities in urban areas created CUs such as Lusaka Water and Sewerage Company (LWSC) to provide services. 50 CUs were formed by local authorities some of which have subsequently been merged. Approximately 20 local authorities still provide water and sanitation services through their works departments. The local authorities have a particularly bad service record, with coverage levels actually declining (LWSC, 2013). An independent regulator for water and sanitation, National Water and Sanitation Council of Zambia (NWASCO), was established in 1997. The NWASCO regulates the provision of water supply and sanitation service delivery to the urban and Peri-urban areas of Zambia (NWASCO, 2014).

According to NWASCO (2016), there are about 6.55million people living in the CUs' service areas, of which 1% are serviced by Private Schemes (companies that provide water supply and sanitation services to their employees as a fringe benefit). Table 2 shows the urban water supply and sanitation coverage for 2015 and 2016 respectively.

In the urban areas, sanitation has not received sufficient attention; groundwater contamination and inadequate drainage continue to cause widespread outbreaks of cholera. The vast majority of the population depends on pit latrines which are often government implemented through the Water, Sanitation, and Health Education (WASHE) concept in rural areas to better incorporate affected populations into system planning and development and thus to improve the delivery of WSS services(UN-HABITAT, 2012)

Table 2: National Urban Water Supply and Sanitation Coverage

Urban water supply and sanitation coverage	2015	2016
Total Urban Population	6,270,425	6,545,693
Total Urban Population Served with Water	5,232,698	5,463,632
Total Urban Population Served with Sewerage	3,847,996	4,096,005
National Urban Water Coverage	83.5%	83.5%
National Urban Sanitation Coverage	61.4%	62.6%

Source: NWASCO (2016)

While Zambia has made important advances in regulatory and institutional reform, there must be a continued implementation of national policies and expanded financing and cost recovery strategies. Furthermore, institutional separation between water resource management and regulatory functions need to be completed. Increased institutional capacity of WSS service providers, and improved financial management, will allow increases in efficiency, expanded coverage and better financial viability. In addition, local service providers need the authority and financing to carry out sanitation duties in case urban access to improved sanitation erode further.

2.9.1 Water Supply in Lusaka

2.9.1.1 Brief background to the water sector

The functions for WSS service delivery are the responsibility of Local Authorities under the overall guidance of the MLG Act 22 of 1991 which gave Local Authorities prime responsibility for the provision of water supply and sanitation services. The Water and Sanitation Act initiated the setting up of the regulator – (NWASCO) which began its operations in 2000. The primary accomplishment of the reforms was the commercialization of water and sanitation provision through creation of Utility companies. Therefore, Water and Sanitation provision in most urban areas in Zambia is generally the responsibility of Commercial Utility (CU) companies and private sector schemes;

LWSC is responsible for WSS in Lusaka province. The company was established in 1988 but started its operations in 1990. LWSC leased assets from the Municipality of Lusaka City up until 2008. In 2008 LWSC was requested by GRZ to take over operations in the whole of Lusaka Province (LWSC, 2013). In 2002, LWSC was transformed into a CU as assets were transferred into the utility. The company is now charged with the refurbishment and expansion of services in Lusaka as well as smaller municipalities within the Lusaka Province (LWSC), 2013).

2.9.1.2 Water supply in Lusaka

LWSC provides potable water and sewerage services to the metropolitan areas of Lusaka. Water in Lusaka City and the surrounding district such as Chongwe, Chilanga, Kafue, Luangwa and Chirundu district is supplied by LWSC, and several water trusts. LWSC has two types of water supply systems, namely, bulk water supply system and satellite water supply system. LWSC has 72 boreholes and one surface water supply system called Iolanda Water Works, which utilizes Kafue River by collecting surface water which is connected to distribution networks in the city through the water treatment plant using the rapid filtration method (LCC/ECZ,2008). There are also 12 water trusts supplying to unplanned urban settlement, which are supported by donors and NGOs (JICA, 2009). The bulk water supply system is the main system and consists of Iolanda Water Works with several boreholes in the City that supply the distribution network. The satellite water supply system is operated for mainly peri urban areas and is not connected to the major distribution network; there is only a limited supply to the surrounding area from the boreholes (JICA, 2009).

The average daily water production of approximately 200 million litres is supplied from 2 sources: 50% from surface water of the Kafue River (50kilometres away) and 50% from boreholes (about 50 wells) in and around Lusaka City area. Consequently, there are two main treatment processes being utilized by LWSC. Simple on-site chlorination facilities at bore hole sites and Conventional treatment facilities at the Iolanda Water Treatment Plant, Kafue (MCC, 2011).

According to LWSC (2013), there are about 30,000 connections on the main distribution system. There are several large self-standing piped systems serving up to 100,000 consumers. However, about 40% of the city's residents are provided with water through non-regulated systems including vending and resale from connected consumers. Figure 1 shows a map of the water supply system and distribution network in Lusaka which shows the types of water supply system and how they are distributed across the city (JICA, 2009).

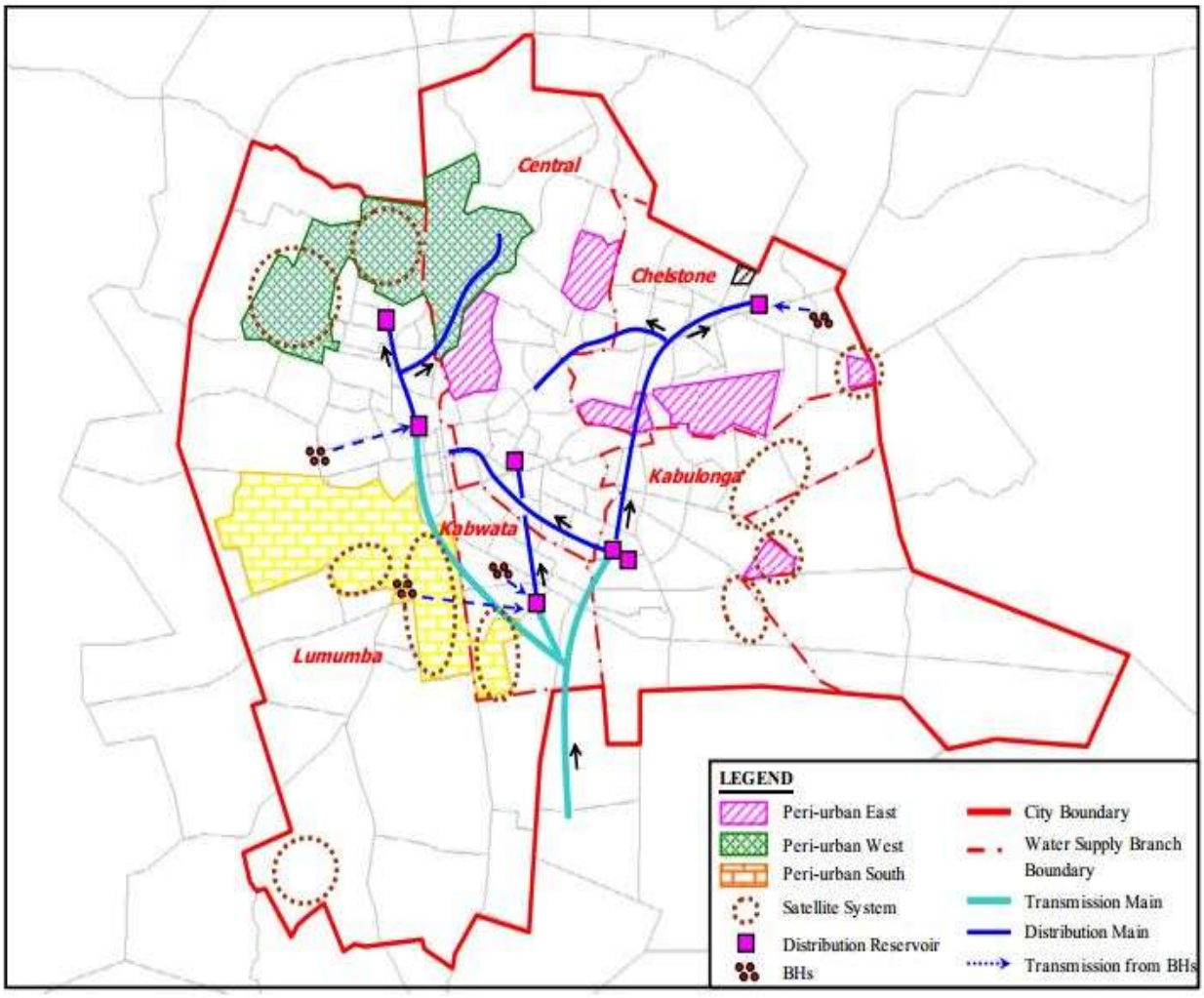

Figure 1: Lusaka water system and distribution network
Source: JICA(2009)

Lusaka, as earlier stated is fast urbanizing therefore the demand for water is also growing. According to a study conducted by JICA (2009), it was projected that the water supply

demand will continue to grow especially for domestic use. It is anticipated that by 2020, a total average of 605,800 cubic metres of water per day will be demanded by the year 2010 compared to a total average of 218,100 cubic metres of water per day that was previously demanded in 2007 as shown in Table 3.

Table 3: Water Demand in Lusaka

No.	Area Category	2007	2015	2020
1	Domestic	85,100	125,600	173,700
2	Public	20,300	24,700	28,400
3	Commercial	4,700	5,700	7,100
4	Industrial	108,000	130,200	172,200
Total daily average demand		**218,100**	**286,200**	**381,400**
Total maximum daily demand		**272,600**	**357,800**	**476,800**

Source: JICA (2009)

2.9.2 Sewerage System in Lusaka

Lusaka has primarily three main types of sewage disposal methods that are utilized, these are: the Water Bourne method, which comprises a network of pipes and sewerage treatments plants, the on-site sanitation method which comprises of septic tanks and soak ways and pit latrines where sewerage is left to accumulate in dug out pits (Wamukwamba and Share, 2001). Figure 2 shows the sewerage network system in Lusaka.

2.9.2.1 The Water Borne method

The coverage ratio of sewerage system managed by LWSC is only about 35% of the City, including adjoining area of Central Business District (CBD), industrial area, and middle and high- density areas in the southern part along Burma and Chilimbulu roads (JICA, 2009).The sewer network system in Lusaka is divided into several catchment areas and there are seven Sewage Pumping Stations (SPS) in the sewer network. This sewer network consists of approximately 450km of mainly Asbestos Cement (AC) pipe ranging in size from 150mm to 825mm. The sewage treatment facilities have two conventional treatment plants namely Manchinchi and Changa sewage works and five non-conventional plants in the form of waste stabilization pond sand these are; Matero, Ngwerere, Kaunda Square,

Chelstone stabilization ponds and Garden maturation ponds. The conventional sewerage treatment plants use the trickling filter method of treatment whereas the non-conventional plant uses waste stabilization ponds (Wamukwamba and Share, 2001).

2.9.2.2 The on-site sanitation system

The on-sanitation system can be divided into two methods; the septic tanks and soak-away and the pit latrines. The septic tanks and soak-aways are mainly used in low density suburbs and small and large farm settlements with coverage of about 20%. When the septic tanks are filled, the owners then hire vacuum tanker operations in the private sector to empty them. The sludge is then taken to Manchinchi Sewage treatment plant. The pit latrines cover about 45% and are mostly used in high density residential areas. When they are filled, some are emptied by the local authority, the Lusaka City Council or just back filled by the owners and new ones are constructed (Wamukwamba and Share, 2001).

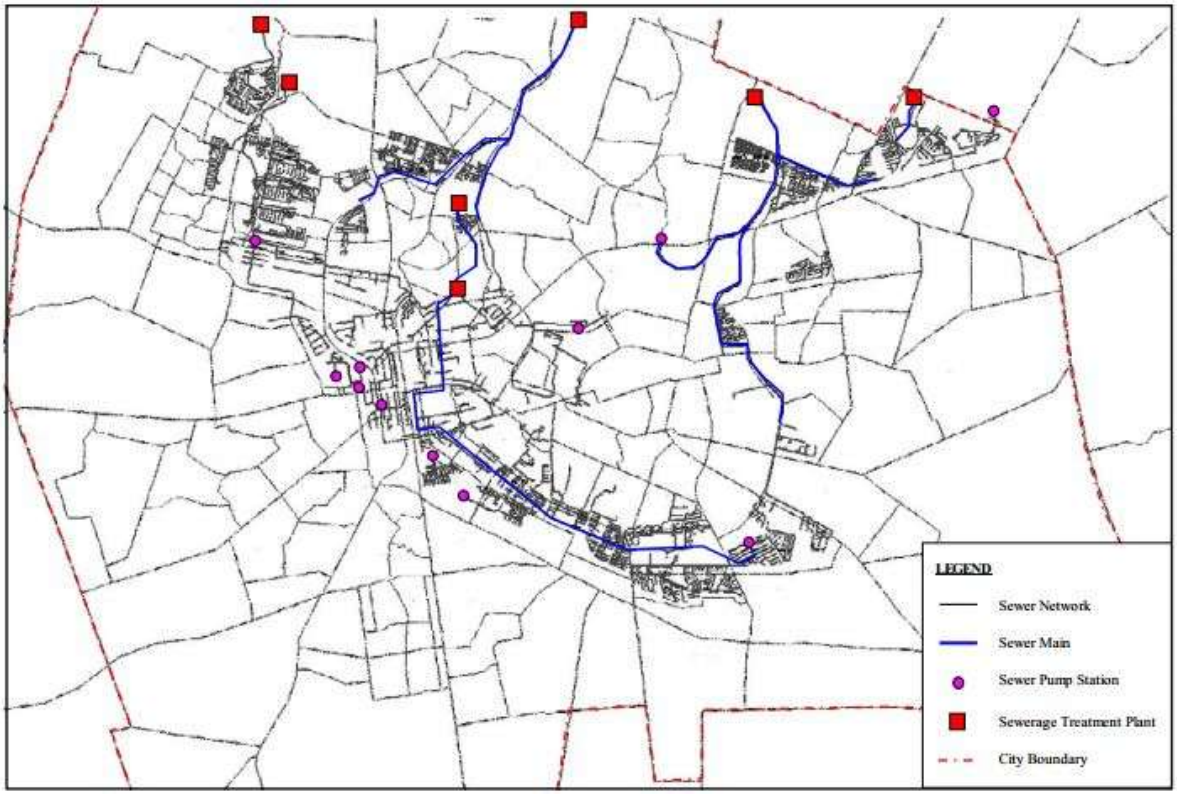

Figure 2: Sewer network in Lusaka
Source: (LWSC), 2013)

2.10 Policy and Legal framework for Water and Sanitation provision

Water and Sanitation provision in Zambia is the mandate of Government through the Local Government Act 281. Water and sanitation provision is anchored by three pieces of legislation: the Water Supply and Sanitation Act 28 of 1997, the National Water Policy of 1994 and the Local Government Act 22 of 1991 which gives local authorities prime responsibility for the provision of water supply and sanitation services. The Water and Sanitation Act gave rise to the National Water and Sanitation Council of Zambia (NWASCO) in the year 2000, who are mandated to regulate and coordinate the water and sanitation sector. Water and sanitation provision in most urban areas in Zambia is generally the responsibility of Commercial Utility (CU) companies and private sector schemes;

2.10.1 Local Government Act No 22 of 1991

The Local Government Act provides for functions of Local Authorities that include the prohibition of pollution of watercourses. Local authorities are empowered to make by-laws, set standards and guidelines for provision of services. The Local Authorities operate under the control of the minister responsible for Local Government.

2.10.2 The Water Supply and Sanitation Act No. 28 of 1997

This Act specifies how local authorities may provide urban water supply and sanitation services, and it also provides for the establishment of an autonomous Regulator for the water supply and sanitation sector, NWASCO. The NWASCO is a statutory body established under the National Water Supply and Sanitation Act, No. 28 of 1997 that governs the functions and operations of NWASCO. In part III, number (9) of the Water and Sanitation Act provides that: A local authority may resolve to establish a water supply and sanitation utility as a company under the Companies Act as; as a public or private company; as a joint venture with an individual or with any private or public company; as a joint venture with another local authority or several other local authorities, provided that the majority shares shall be held by the Local Authority (GRZ, 1997).

2.10.3 Water Resource Management Act No. 21 of 2011

The Act provides for the establishment of the Water Resources Management Authority and define its functions and powers; provide for the management, development, conservation,

protection and preservation of the water resource and its ecosystems; provide for the equitable, reasonable and sustainable utilization of the water resource; ensure the right to draw or take water for domestic and non-commercial purposes, and that the poor and vulnerable members of the society have an adequate and sustainable source of water free from any charges; create an enabling environment for adaptation to climate change; repeal and replace the Water Act, 1949; and provide for matters connected with, or incidental to, the foregoing.

The Water Resource Management Act also states in part one, section 5; that water has an economic and a social value and this shall be reflected in its use, but all domestic and non-commercial use of water shall not be required to obtain a water permit;

2.10.4 The Policies that guide Water and Sanitation

2.10.4.1. The Decentralization Policy (2002)

The policy is aimed at decentralizing government responsibilities and functions to lower level government through "devolution" among which include rural water and sanitation to lower level government such as Councils through devolution. Devolution of authority from Central Government to Local Authorities was implemented by the Zambian Government, as one of the measures put up to improve performance of the water sector. This involved the separation of the service provision of Water Supply and Sanitation from Water Resources Management (GRZ, 1994). The Rural water and Sanitation are now a responsibility of the Local Authorities in all districts. This resulted in the decision to transfer all small towns' water supply schemes from the Ministry of Energy and Water Development to the Local Authorities under the supervision of the Ministry of Local Government.

2.10.4.2 The National Water policy (2010)

The Water Policy includes seven key principles that also give guidance to the institutional framework for the sector as indicated in Table 4below:

Table 4: Key Principals of the Water Policy

Key principles of the water policy
1. Separation of water resources functions from water supply and sanitation 2. Separation of regulatory and executive functions within the water supply and sanitation sector; 3. Devolution of authority to local authorities and allowing participation of the private enterprises; 4. Achievement of full cost recovery in the long run for the water supply and sanitation services through user charges (with due regard for fairness and equity by providing a minimum level of services to persons who are unable to afford the full cost of services); 5. Human resources development leading to more effective institutions; 6. Technology appropriate to local conditions; and 7. Increased priority and budget spending by the Government of the Republic of Zambia to the sector.

(GRZ, 1994)

2.10.4.3 Other pieces of legislations

Other pieces of legislations that guide the provision of Water Supply and Sanitation in Zambia include the Water Act, Cap. 198 which controls the development and management of water resources throughout the country; the Environmental Protection and Pollution Control Act of 1990 This Act prohibits water pollution and provides for permits for discharge of waste or effluent into the environment; the Public Health Amendment Act of 1995 which mainly deals with the prevention and suppression of diseases in the general public environment and has provisions for management of sanitation and prevention of pollution to water bodies by Local Authorities.

Zambia has a number of legislation and policies that address the water and sanitation sector, however, the available studies have shown that the available legislation does not adequately address the challenges faced in the water and sanitation sector in Zambia.

Only until recently was the Water Resource Management Act No. 21 of 2011 amended to ground water and borehole regulations to include registration and charge for drilling of

boreholes for domestic use. Before now, the same act provided for the right to draw or take water for domestic and non-commercial purposes without any charges in order to ensure that the poor and vulnerable members of the society had an adequate and sustainable source of water free from any charges but this lead to an increase in the number of boreholes drilled for domestic use even in places where LWSC is providing services. However, this amendment no longer addresses the poor and vulnerable as every person is now required to pay for drilling a borehole.

As much as the decentralisation policy provides for the devolving of water supply and sanitation to local governments in that local governments may have appropriate knowledge of local needs necessary for improvement of the service, but appropriate knowledge of local needs may not always be sufficient to engage lower levels in service provision because inefficiency still sets in if not adequately equipped with required human and financial resources. The decentralisation policy presents some weakness as only functions and not the financial resources have been devolved to local government. According toHarhay (2011), Iit is imperative to acknowledge the fact that weak water governing institutions in most of these countries are operationally limited by factors such as lack of data, incompetent personnel, energy shortages, and limited finances.

2.10.5 Institutional Arrangements for Water and Sanitation Development in Zambia

In accordance with the Local Government Act, the National Water Policy and the Water Supply and Sanitation Act, the Local Authorities and the Ministry of Local Government and Housing, have main responsibilities over Water and Sanitation Supply, both in the urban and rural areas. The Ministry of Local Government (MLG) provides policy guidance, technical and financial control, and facilitates mobilization of foreign and local funds for capital development. The Local Authorities have the legal mandate to provide water supply and sanitation (WSS) services in their administrative rural areas under their jurisdiction. MLG, through its Department of Housing and Infrastructure Development (DHID), provides WSS services through donor funded projects, and some projects are implemented through D-WASHE committees. The Ministry of Health has some responsibility over sanitation and hygiene promotion, whilst the Ministry of Education has responsibility over

school sanitation as part of school infrastructure. Ministry of Community Development and Social Services (MCDSS) identifies the need for water and sanitation development from a community development and social welfare point of view, assesses communities, and assists in raising awareness and mobilizing communities at the grass root level. The Ministry of Energy and Water Development (MEWD), through the Department of Water Affairs (DWA) is responsible for water resources management (JICA, 2009).

2.10.5.1 National Water supply and Sanitation (NWASCO)

The National Water Supply and Sanitation Council (NWASCO), which begun its operations in 2000, is a regulator created for the purpose of ensuring efficient and sustainable Water Supply and Sanitation services through the enforcement of the Water Supply and Sanitation Act No. 28 of 1997(NWASCO, 2013). NWASCO also regulates the provision of Water Supply and Sanitation service delivery to the urban and peri-urban areas of Zambia while the responsibility to provide water supply and sanitation services to the urban areas is the mandate of the Local Authorities which have established Commercial Utility companies (CUs) to perform this function (NWASCO, 2014).

2.10.5.2 Water Resource Management Authority (WARMA)

WARMA is an autonomous body established by the Water Resource Management Act No. 21 of 2011. Its purpose is to exercises control over all water resources in Zambia as stipulated in the Water Management Act. The Act set out provisions to regulate the use of water in Zambia by considering or issuing of water permits with the exception of internationally shared water bodies. Its mandate is to preserve and protect Zambia's ground and surface water resource and regulate the abstraction, allocation, use, development and management of water resource in a sustainable manner. The authority gives permits to farmers, hydropower producers, industries, mines and water utility companies as well as domestic and non-commercial users (GRZ, 2011).

2.11 Summary of Chapter Two

Literature in this chapter reviewed various types and sources of water and sanitation used in urban areas, common challenges faced in the sector and alternative methods that have been employed in some countries to overcome some of the challenges. Literature showed that due to rapid urbanisation, most cities in the world face a number of challenges in the provision of water and sanitation to its citizens such as pollution of surface water sources, high water demand, cost intensive infrastructure for water supply and waste water collection and dilapidation of infrastructure. Although the literature does not reveal how these challenges maybe avoided at the planning stage of cities, it however reviewed how some countries have managed to improve the provision of water and sanitation by employing alternative sources and methods of water and sanitation that can be exploited in urban areas such as water harvesting and water reclamation. Further, literature review that with strong legislation and planning, commercial utilities and local authorities are able to benefit from using alternative water and sanitation methods and these methods are able to sustainably improve water and sanitation provision as well as increase revenue in the sector.

CHAPTER THREE: DESCRIPTION OF THE STUDY AREA

3.1 Introduction

This section presents the description of the study area, its location, size, climate, geology and hydrology of the area.

3.2 Study Area

The study area is Kwamwena Valley, a medium cost privately owned residential housing area covering an area of about 590 hectares located at the fringe of Chongwe district bordering with Lusaka district. However, residents in Kwamwena Valley get their services from Lusaka and area now falls under the approved Lusaka Master plan Great city of Lusaka boundary. Hence this study considered Kwamwena Valley as part of the Greater city of Lusaka as shown in Figure 3.

The area was previously part of farm 32a owned by Galaunia farms limited and Meanwood Housing Development Corporation then re-planned into a residential area and sold to the public for development. The change of land use from Agriculture to residential was done in the year 2005, after which the sub-division was done. The area comprises of about 7,500 plots, ranging from 400 square metres (20m x 20m) to 600 square metres (20m x 30m). The area has provision of various land uses, ranging from residential, commercial, health facilities, schools and areas for play parks. Kwamwena Valley shares boundaries with Chamba Valley and Foxdale as depicted in figure 4.

3.3 Population

According to the CSO (2011) report, Lusaka is the fastest growing city in the country and has the highest population. The population of Lusaka Province increased from 1,391,329 in 2000 to 2,198,996 in 2010. This means that the annual average population growth rate for the province was 4.7 percent in the 2000 – 2010 inter-censual periods (CSO, 2011).

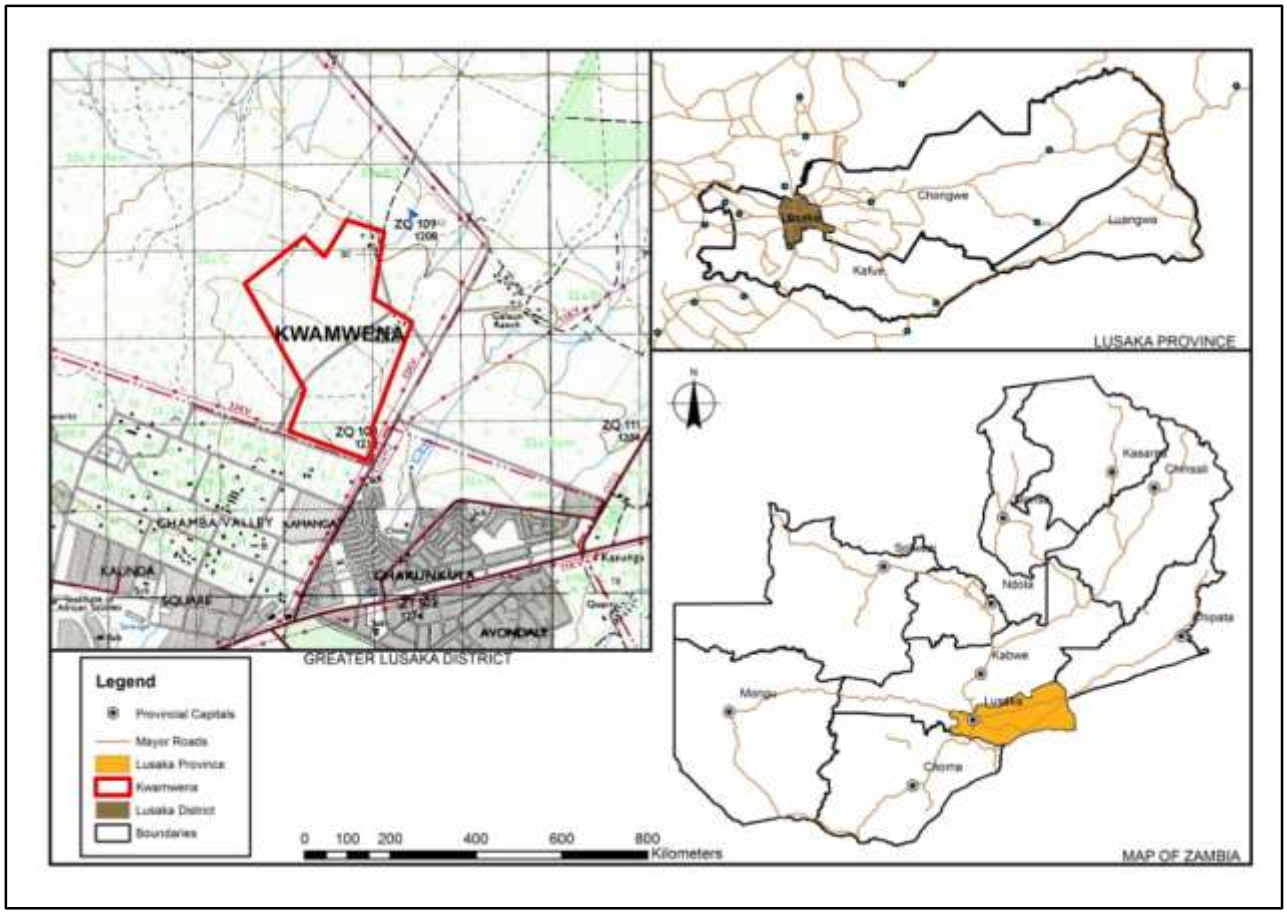

Figure 3: Location of Kwamwena Valley
Source: Author 2016

Figure 4: Arial view of Kwamwena Valley
Source: Adopted from Google Earth (2015), Author 2016

3.4 Climate

Lusaka is a fairly flat inland city at an altitude of about 1300 m above mean sea level, with no major rivers. Lusaka‘s climate is humid subtropical, and is characterized by three distinct seasons: the cool dry season, which extends from May to August; the hot dry season (August to November); and the rainy season (November to April) (MCC,2011). The average temperature throughout the year is 20.7℃. The average maximum temperature reaches the highest of 30.6 ℃ in October, and drops to a minimum of 10.1 ℃ in July. There is no rain in the City between May and September. In the rainy season from October and April, the monthly average rainfall is 114 mm. The 30-year average annual rainfall for Lusaka is 857mm with 77 rainy days per year (MCC, 2011).

3.5 Selection of Study Area

The study area was chosen by nature of it being a recently planned residential area, with consideration of the size of the plots and settlement of which Kwamwena valley covers an area of about 590 hectares with approximately 7500 plots that definitely demand the provision of water and sanitation to its residents hence making the nature of the provision of water and sanitation in the area very important. Further, it was selected due to convenience in its location and also the availability of time and financial resources.

CHAPTER FOUR: RESEARCH METHODS

4.1 Introduction

This section describes the methods that were employed in the study to collect and analyze data. The general purpose of this section is to outline the procedures and methods used for obtaining information regarding the provision of water and sanitation services by the utility company and other service providers in the Kwamwena Valley area by specifying how the research was conducted and the data analyzed. The chapter describes the research design, sampling techniques, methods of data collection and techniques employed in the analysis of data. The Chapter concludes by highlighting the limitations faced in the field.

4.2 Research design

This is a case study where both quantitative and qualitative research methods were used. Quantitative data was collected by use of questionnaires and qualitative information was collected through key informant interviews and observation methods.

The advantages lie in the fact that case studies show a complete approach when used to a particular context as opposed to experiment and survey. Stake (1998) holds that exploration and explanation are the hall mark of case studies. Whereas Yin, (2003) contends that a case study is a practical inquiry which explores a phenomenon within its real-life context. Furthermore, the case study method involves rigorous and exhaustive analysis of both the unit of analysis and specific study elements occurring and influencing the phenomenon under the study.

Therefore, the approach was used to carry out an intensive analysis of the water and sanitation provision in its real context. Since the Case study approach answers ‘how’ and ‘why’ questions, it will be useful in finding out the sources of water settlement.

This research is based on a case study of Kwamwena Valley residential area in Lusaka city which is a private housing development. The study will investigate the provision of water and sanitation services by the utility company and other service providers in the area. The reason for employing the case study approach is in order to avail an in-depth understanding on the system used to provide water and sanitation in the area and the challenges faced by

the utility companies as well as the residents in accessing the services. As other private developments are opened up, this study may provide valuable guidelines on the provision of water and sanitation services.

4.3 Sampling

The sample of study was drawn from the residents of Kwamwena Valley and Key officers from various institutions with a stake in water and sanitation (WATSAN) and drilling companies. The study had a total sample size of 128, which included 120 households from Kwamwena Valley and 8 institutions as follows; Officers from LWSC; an officer from Kwamwena site offices; officer from Lusaka Planning authority; officers from Lusaka City Council, an officer from MCC and two drilling companies. A sample size of 120 was chosen and this is because despite Kwamwena Valley having approximately 7,200 plots, at the time of study most of the plots were either undeveloped or had incomplete structures that were unoccupied, hence the 120 households selected were estimated to be the optimum number necessary to enable valid inferences to be made about the population. While the 8 key informants were representative of the main stakeholders in the sector.

4.3.1 Sampling techniques

The sampling strategy employed was purposive sampling for households within the selected study area and institutional respondents.

The selection of household respondents was purposive, targeting respondents who had been living in the community for three or more years, though the sampling was more biased to picking respondents who had been in the community for five years, in order to measure real change in terms of performance in the water supply and sanitation situation over time.

Eight (8) key informants were selected purposively from different institutions dealing in water and sanitation issues in Lusaka District. Purposive sampling was used to select respondents from water relevant institutions targeting informants vested with information of importance to this study. Two (2) officials were selected from LWSC, LCC, the department of Lusaka Physical Planning and Housing, officers at Meanwood Kwamwena site office and one drilling company.

This is because purposive sampling allows the researcher to hand-pick certain groups or individuals to include in the sample on the basis of their relevance to the problem under study (Tichapondwa, 2013). According to Patton (1990) the logic and power of purposeful sampling lies in selecting information rich cases for in-depth study.

4.4 Data collection

To achieve the stated objectives of this study, two types of data was collected using two different methods. These are Primary and Secondary data for a period of one month.

4.4.1 Primary data

4.4.1.1 Household questionnaires

For primary data collection methods, data was obtained by administering household questionnaires to residents of Kwamwena Valley in order to obtain first-hand information from the residents on how they access water and sanitation. The questionnaires were administered to residents found in livable and occupied houses as some houses were still under construction and not yet inhabited by the owners. A copy of the questionnaire is provided as Appendix A

4.4.1.2 Semi-structured interviews

Semi-structured interviews were conducted for key informants at LWSC, Meanwood site office, Department of Physical Planning and Housing, MCA. The selection of interviewees was done using purposive sampling. Semi-structured interviews were used as they provided flexibility during the interviews and allowed for addition of more questions to the conversations with the informants. Saunders et al (2003), explains that the order of questions in a semi-structured interview may be varied depending on the flow of the conversation and that additional questions may be required to explore the research questions and objectives. Appendix B to F shows a copy of the interview schedule used to interview key stakeholders.

4.4.2 Secondary data and observation

Secondary data was collected through the review of various literature on WATSAN, these included articles, journals, publications and reports on performance of the water supply and sanitation sector. Literature was obtained from libraries and archives of the government Ministries and Government Departments, NWASCO and also from online sources.

4.5 Data analysis

Data analysis was done using quantitative and qualitative methods. All information obtained from the questionnaires was recorded in excel sheets to analyze quantitative data. Excel was used to analyze all responses from the questionnaires to create statistical representation of data in frequency tables and figures. However, all information was linked to field observations during the time of research

Descriptive analysis was used to calculate and to describe the responses from the questionnaires, for descriptive analysis, data was analyzed through the use of software packages such as Microsoft Office Excel 2013 and Minitab 17.1.0.0. Content analysis was used to analyze texts of various types including writings, documents, and recordings and field observations. Narrative analysis will also be used to analyze data obtained through interviews with residents from Kwanwena Valley and the official from the institutions.

4.6 Limitations of the study

Firstly, financial difficulties constrained the researcher from hiring field assistants that would have assisted in data collection. Also looking at the sample size of 120 households used, given that the estimate number of plots in Kwamwena Valley of about 7500, the sample size of 120 households seemed too small to provide sufficient data to make inductive conclusions and generalizations on the issues of water and sanitation because of the vastness of the area which was formerly farmland and was still being developed by the plot owners at the time of the study. Therefore for this academic research, such a small percentage of the household size used is expected optimum number necessary to enable the study to reach its saturation.

While in some selected households the owners were present at the time of interview, most households had either the workers or children present even though some households were replaced; finding workers was common because most of the plots were still under construction. This presented a limitation in finding out what challenges most households faced in accessing water and sanitation in the area.

4.7 Ethical consideration

In conducting this research, informed consent of participants was considered during data collection, individuals participating in the research study were informed of the nature of the study so that they may choose whether to participate or not. The participants were also assured that privacy, confidentiality and anonymity would be mentioned to ensure that no identifying information about the individual would be revealed in written or other communication in this study without their consent. The researcher ensured that the research was undertaken with integrity at the highest standards by ensuring that data was precise and presented fairly.

CHAPTER FIVE: RESEARCH FINDING AND DISCUSSION

5.1 Introduction

This chapter presents research findings and discussions of the study on the status of water and sanitation in Kwamwena Valley. Presentation of the results is done in three parts; the first part gives an overview of the status of water in Kwamwena Valley. The second part covers the status of sanitation in the area while the third and last part brings out the challenges faced by the residents in the area in accessing water and sanitation services.

5.2 Characteristics of Households

The study looked at the characteristics of the households in terms of the number of people living in each house, this was in order to have an overview of the demand for water and sanitation in the area. Figure 5 below shows the number of people per household in Kwamwena Valley.

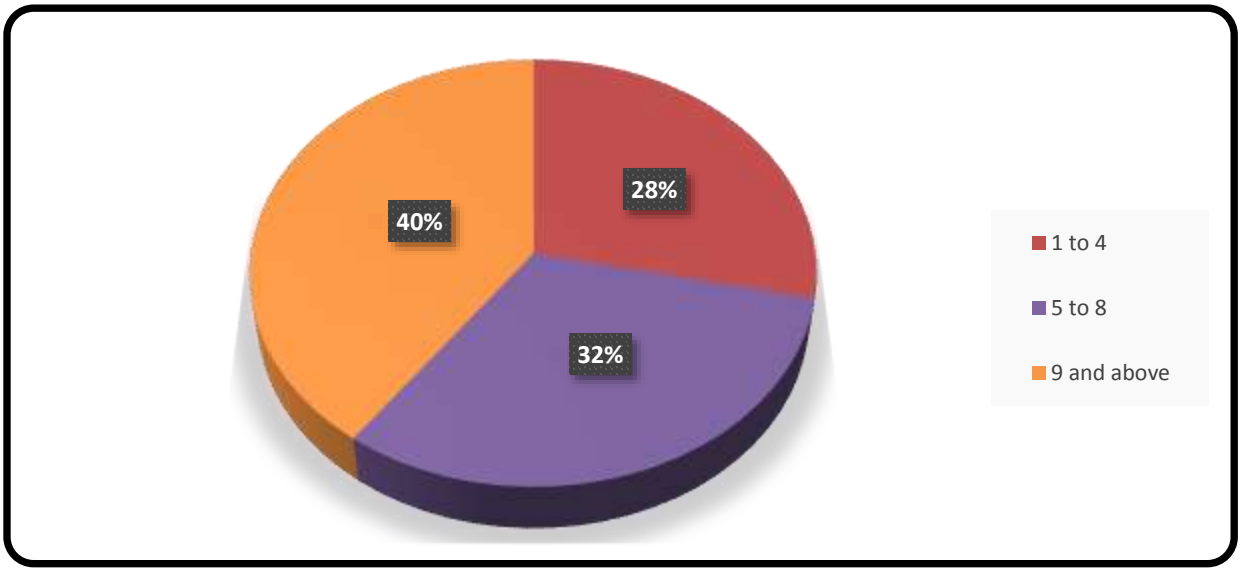

Figure 5: Number of people per household in Kwamwena Valley
Source: Field data (2016)

According to the results presented in figure 5, 40 percent of the residents had at least nine or more people per household, 32 percent had between five to eight people while 28 percent had one to four people per household. It was also observed from the study that a number of households which fell in the 40 percent bracket were occupied by care takers who lived

and looked after the houses on behalf of the owners before they were complete. Most of the care takers found fell in the low income groups and had extended families.

From the results, we can also conclude that over 70 percent of the households have at least five or more people residing in them. The number of people per household can be one of the factors that can be used to estimate the amount of water demanded in the area. As the results give an indication that the demand and usage of water and sanitation in the area is relatively high with referrence to the number of people per household. This is confirmed by (Corbella and Pujol, 2009) who suggests that household size is one of the factors that influence water demand. similarly studies by Zhou *et al*, (2008) suggested that urban areas usually have a higher per capita consumption of water compared to rural areas.

Even though some homes had care takers occupying them, it is not expected that the household numbers will decrease since most home owners are expected to have at least one worker and sometimes with his/her family residing on the same property. In order to draw an estimate amount of water demanded in Kwamwena Valley, the estimated water used is drawn from a report by WHO,UNICEF(2006) which states if an adquate quality of life and sanitary conditions shall be achieved, the estimated water requirement by an individual is between 20 to 40 litres per capita per day. For the purpose of this study, 20 litres per capita per day will be used because only one factor that influence water demand is being considered.

Calculation of water demand in Kwamwena Valley

Total Population x demand per person (estmated to be 20 litres per person per day)

Estimated total population for Kwamwena (7500 households x 9 people per household) x 20lt/day

Estimated Daily demand is 67, 500 x 20lt/day =1,350,500lt/per capita per day

Estimated Annual demand is 1,687,500 x 365 days = 492,750,000 Litres/Year

This calculation is mainly to show the estimated amount of water that used in Kwamwena Valley on a daily basis and yearly. The actual totals are expected to be more or less than estimated because of several other factors that influence water consumption as earlier

shown in a study by (Corbella and Pujol, 2009) who suggests that there are several factors that influence a household's water demand such as income, household size, gender and the age structure in population. In addition, because Kwamwena Valley is a medium to high cost residential area, it is expected that for some households, water is used for more than basic needs but also for other uses such as watering of lawns, gardens and cleaning of vehicles thus increasing water consumed

5.3 The status of Water in Kwamwena Valley

In order to determine the status of water in Kwamwena Valley, a survey was conducted to find out how many people where connected with LWSC. Figure 6 below show the results from the study as follows;

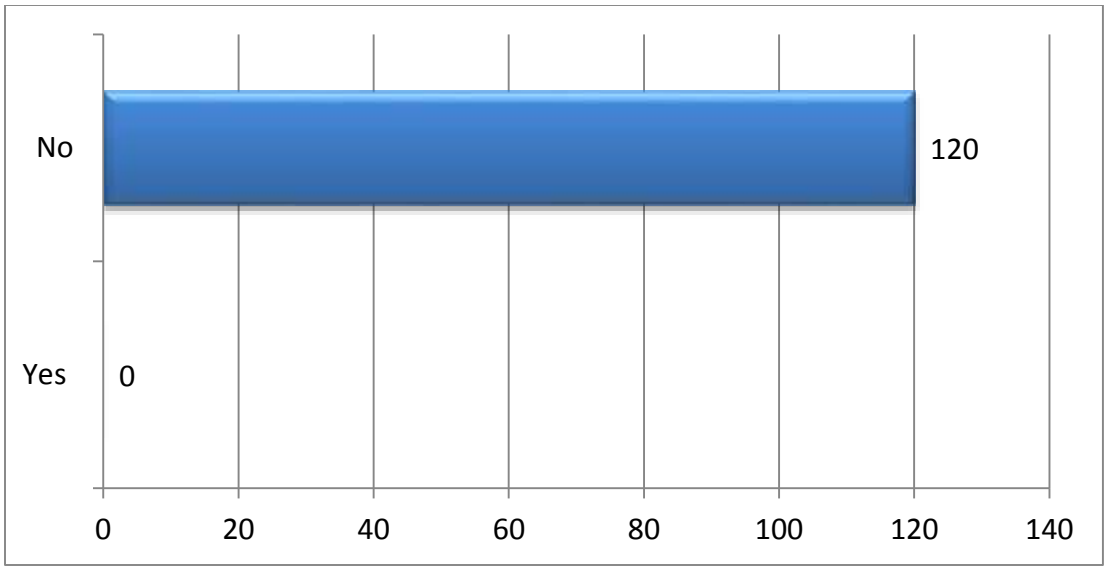

Figure 6: Number of Households connected to LWSC
Source: Field data (2016)

The results from the study show that Kwamwena Valley none of the household were connected to LWSC. All respondents interviewed representing 120 households confirmed that they were not getting any services from LWSC. Hence the results show that residents in Kwamwena Valley have on-site connections to water on various other sources. This implies that residents of Kwamwena valley provide their own water for their daily usages because the developers of the housing complex did not facilitate for the provision of water

in the area as was indicated in its initial plan. This is according to an interview with the Provincial Planner (2016), (Lusaka Physical Planning and Housing conducted on 20th May 2016), which indicated that the approved plan for Kwamwena Valley by the project developer (Meanwood) showed that the area would be supplied with communal water facilities for all occupants to access, although the map was not availed at the time of the interview. In a separate interview with the Infrastructure Planning and Design Manager on (March 24th 2016) confirmed that LWSC was not providing water services in the area this also supported by statistics given by LWSC (2013) which indicated that LWSC had only 30,000 connected to the conventional system and these were mainly in the areas surrounding the CBD. The failure of Mean wood to facilitate for water in the area has led to individual property owners to installing onsite water facilities.

During the study, it come to light during an interview held on 25th August 2016 with a key informant from MCC, that Kwamwena Valley was amoung the areas selected for the implementation of the Lusaka Water Supply, Sanitation and Drainage Project (LWSSD). He further explained that;

> *The MCA-Zambia was established under the laws of Zambia as a company limited by guarantee as an entity to implement the Lusaka water supply, sanitation and drainage project funded by the United States of America. The project is for a duration of five years and it comprised of the implementation of the Lusaka Water Supply, Sanitation and Drainage Project (LWSSD) worth US$355 million. The objective of the LWSSD project was to expand access to, and improve the reliability of, water supply and sanitation, and improve drainage services in selected urban and peri-urban areas of the city of Lusaka in order to decrease the incidence of water-borne and water-related diseases, generate time savings for households and businesses and reduce non-revenue water in the water supply network. For Kwamwena valley, the project consisted of water extension, construction of six major boreholes and one large reservoir tank whose target was to improve access to water supply and sanitation and to*

Reduce Non Revenue Water (NRW) as Kwamwena Valley had on-site water and sanitation. Once successful done, it is expected that Kwamwena Valley will no longer have On-site water and sanitation system but will be connected to the LWSC (MCC, personal communication,2016).

According to the information released during the interview, it expected that residents will be connected to LWSC metered water once the projects is completed. Therefore there is need to conduct further studies in the area that will analyse how the residents will respond to the metered water from LWSC since most households have drilled boreholes.

5.3.1 Sources of water

The study took note of the various sources of water were available for the residents in Kwamwena Valley. Having established that the area was not being serviced by LWSC. Figure 7 below shows the various sources of water for the households in the area.

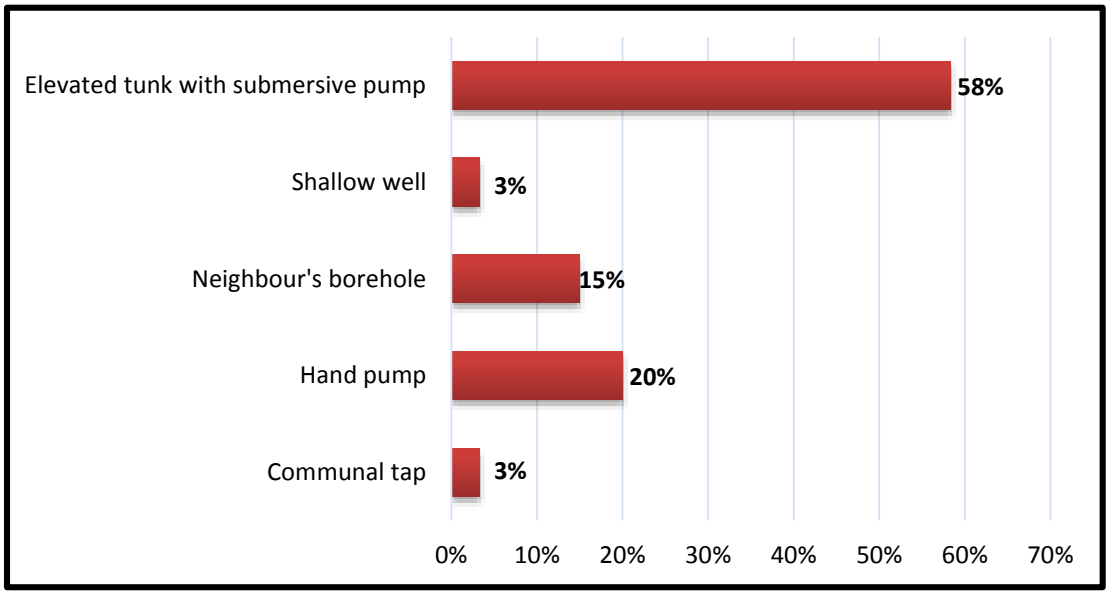

Figure 7: Sources of Water in Kwamwena Valley
Source: Field data (2016)

The results from Figure 7 show that 58 percent of the households had sank boreholes connected to over-head tanks, 20 percent were found to be using boreholes and hand pumps, 15 percent accessed water from their neighbour's boreholes, and 3 percent used

hand dug shallow wells, while the remaining 3.3 percent accessed their water from communal taps found at nearby schools or churches.

Taking into consideration that Kwamwena Valley is a middle income to high cost residential area, most residents find having a borehole connected to an over-head tank with a submersible pump to be more convenient. This is because residents prefer to have a more permanent solution to accessing water in their households as most residents have security of tenure to the pieces of land they are occupying unlike most residents in Peri-urban areas who usually depend on the availability of communal water or funded water projects. Therefore, it is anticipated that the 58.3 percent of residents that were found to have overhead tanks with submersible pumps is likely to increase in the near future. This is because most houses are owner occupied and also the ones that were found using hand pumps were still occupied by caretakers of which some indicated that the owners of the houses were in the process of installing overhead tanks.

Although the results were categorized to show the various sources of water for the residents, the most commonly used source of water in the area is groundwater through the sinking of boreholes and a few shallow wells that are manually done. The wide use of boreholes in Kwamwena Valley is also highlighted by Mensah et al (2013) who indicates that the number of households in Africa relying on boreholes and wells has increased by 22 million over the past decade. However, the high rate of extraction of ground water might have a negative effect in the future on the underlying aquifer and the environment as it is likely to compromise the quantity and quality of groundwater. This is also supported by Beekman (2016) who notes that abstraction of groundwater from an aquifer results in a decline in groundwater levels, which causes induced recharge. Apart from the failure of LWSC to provide water in the area, the gaps that existed in the Water Resource Management Act which did not require domestic and non-commercial use of water to obtain a water permit; could have attributed to the high rate of borehole drilling in the area hence people were at liberty to use water under these categories without regulation. However, with the recent introduction of the Government Statutory Instrument (S.I) No. 20 of 2018 under the Water Resource Management Act No.21 of 2011 cited as the Water

Resource Management (Groundwater and Boreholes) Regulation, 2018. It is hoped that through this S.I, which now provides that, '*any person who intends to drill a borehole shall apply to WARMA and that such a person shall pay a fee to drill the said borehole once the application is approved*', the drilling of boreholes shall be regulated. Figure 8 gives a depiction of the presence of overhead tanks in the area hand dug well found in other parts of the area.

a. Boreholes with overhead tanks

b. A hand dug shallow well as a source of water in Kwamwna Valley

Figure 8: Sources of Water in Kwamwena Valley
Source: Field data (2016)

5.3.2 Households with challenges in accessing water in Kwamwena Valley

An assessment done in Kwamwena Valley to find out how many households were finding challenges in accessing water having earlier highlighted that the area was not connected by LWSC. The study showed that there were more residents faced with challenges in accessing water than those who did not face any challenges as indicated in Figure 9. According to the results, 62 percent of the residents faced challenges in accessing water while 38% reported not to have challenges.

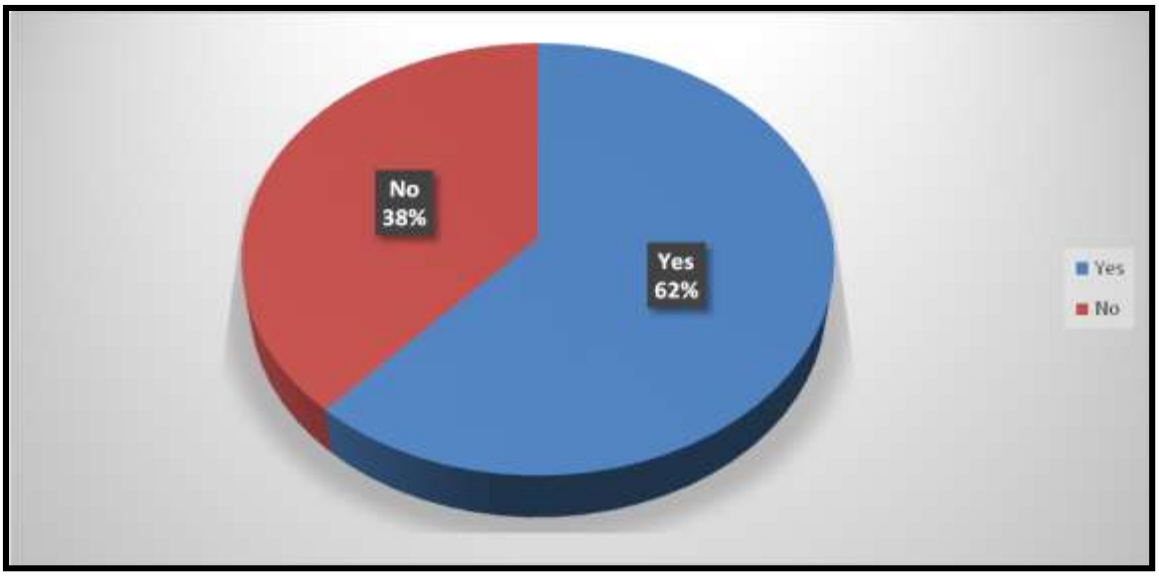

Figure 9: How many households faced with challenges in accessing water?
Source: Field data (2016)

According to the results, more residents were found to have challenges in accessing water is firstly; due to the fact that water is provided onsite by each household as earlier stated by the study. Other reasons are because by design, every planned area should have certain services such as roads and drainages, electricity, water and sanitation services provided to the residents in the area from the responsible Local Authority or Developer. But this is not the case for residents of Kwamwena Valley despite it being a planned private area as such it becomes a challenge for most residents as they would have paid the developer the service charge for services that they are now providing for themselves. Additionally, because of the irreplaceable importance of water, which cannot be substituted by other products residents have to provide water to their households by all means despite any added cost.

For the 38 percent of the resident that indicated that they did not experience any challenges in accessing water, the conclusion is that they are able to provide water to their households without necessarily straining their finances. This is supported by studies Corbella and Pujol (2009) who argue that income affects the responsiveness to price mechanism; thus, while low income families may not respond to price because they are using water mostly to fulfil basic needs, while well-off individuals or households fail to respond because the price signal is not strong enough to curb their consumption. However, other respondents revealed that they had no challenges in accessing water at their premises because they were renting the houses which they found had already been installed with Boreholes. The presence of boreholes is however common to most privately owned residential areas in Lusaka, as it is the most convenient source of water especially in middle to high income areas where the occupants are able to meet the costs of drilling boreholes and installing overhead tanks.

5.3.3 Challenges faced by residents in accessing water in Kwamwena Valley

The study showed earlier according to figure 9 that most residents faced some challenges in accessing water for their domestic use. Figure 10 shows the types of challenges the residents face.

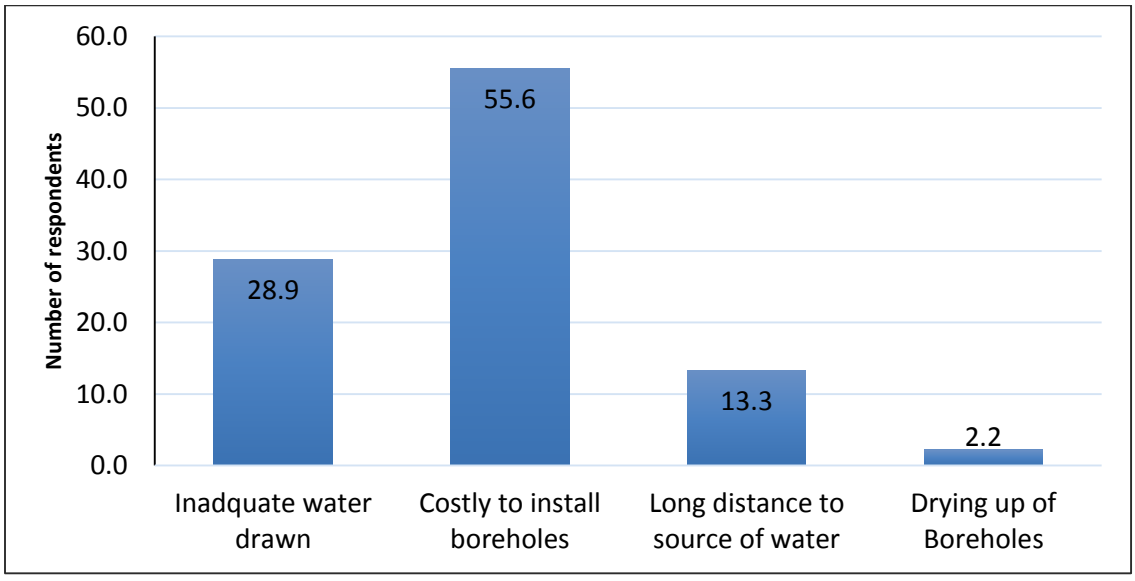

Figure 10: Challenges faced by residents in accessing water
Source: Field data (2016)

According to the results as presented in Figure 10 below, 55.6 percent of the respondents said they incurred high costs charged to install the boreholes, 28.9 percent of the respondents had inadequate water drawn, 13.3 percent said they covered long distances to source for water while 2.2 percent had experienced drying up of boreholes.

Arising from the results, over 50 percent of the respondents as shown in Figure 10 indicated that they had challenges in meeting the costs of drilling boreholes. This includes all respondents that indicated to be using overhead tank and submersible pumps and hand pumps. An interview with a drilling company on 11th December 2017 showed that the minimum cost of drilling a borehole in Lusaka was K7,500 for just drilling and K15,000 for a complete set, which included fitting the an electric pump, overhead tank and all pipe work while it cost at least K20,000 for the borehole to be fitted with a solar pump. The results from the interview show that installing of boreholes is generally costly for an average Zambian going by what is involved which normally includes, paying for drilling of the borehole services, procurement of a pump (electrical or solar), pipes, PVC tank with an average volume ranging from (500 to 5000 litres), a tank stand, electrical cables and other items that go with it not forgetting the energy required to run the pump. However, it is important to note, that as much as drilling of boreholes may be widely done in Kwamwena Valley and other similar neighbourhoods in Lusaka as a more convenient alternative source of water, the costs incurred to install boreholes cannot be compared to the likely future social, economic and environmental costs that the drilling of boreholes may cause to the environment. With the world wide campaign on the need for sustainable development coupled with the climate change, it becomes imperative to look into the drilling of boreholes in the area and other similar areas in Lusaka.

The results also showed that 28.9 percent of the respondents did not draw adequate water to meet their daily household usage demand. An analysis from the survey revealed that most of these respondents either had a hand-dug shallow well, a hand pump or they had to draw their water from a neighbour's premises or communal water source. Contributing to this challenge was because some respondents had to draw water in containers or drums which was very tedious, time consuming and also costly, hence the amount of water to be

drawn was limited as such water usage in the households had to be rationed to cater for various uses. Some respondents lamented that it was almost impossible to draw enough water to enable them sustain back yard gardens especially in the households that were occupied by care takers who are generally low income. 13.3percent of the respondents had challenges accessing water because of the distance they had to cover to draw water which ranged from 500m to 2km's depending on the source of the water. This made them limit the amount of water they drew in a day, as it was tiring and time consuming. While only 2.2 percent experienced drying up of boreholes especially in the dry season which in most cases was attributed by the depth of the borehole sank. Although this is represented by a small percentage of the respondents in the area, it is a challenge that is likely to pose as a potential environmental risk as the underground water in the area is under threat due to the increasing borehole drilling in the area. This is supported by studies by Beekman (2016) who explained that when the pumping rate is larger than the total recharge (natural recharge plus induced recharge), groundwater levels will continuously decline, and groundwater storage will eventually be depleted.

5.4 The Status of Sanitation in Kwamwena Valley

The study showed that LWSC was not providing sanitation services to Kwamwena Valley. This was confirmed during an interview with the LWSC Infrastructure Planning and Design Manager (March 24th 2016) who acknowledged that the utility company had challenges providing sanitation services because of the treatment plants that were already overwhelmed, and that sanitation projects were very expensive because most of the sanitation systems had to be run by gravity. This is also shown in a report by UNESCO et al, (2004) who noted that centralized networks are very cost-intensive in terms of construction, operation and maintenance. He further added that it had been observed that most people constructing houses quickly moved in and provided their own sanitation systems on-site and were not eager to engage the utility company, he noted that;

> "*This scenario is unlike that of water services, where people usually mobilize themselves and approach the utility company to provide*

> *the service to them hence for sanitation services, the demand is not that high.*" (LWSC, Personal communication, 2016).

A study done on Lusaka shows that the coverage ratio of sewerage system managed by LWSC was only about 35% of the City, including adjoining area of Central Business District (CBD), industrial area, and middle and high density areas in the southern part along Burma and Chilimbulu roads (JICA, 2009). This implies that the remaining 85% of the sewerage system in Lusaka is not covered by LWSC but handled by either the private sector or individual users. However, Studies have also show that the inadequate coverage of sewerage is also common in developing countries as stated by (AICD, 2011) who state that Namibia, Senegal, and South Africa report universal coverage by sewerage but in most other African countries, sewerage serves less than even 10 percent of urban areas.

However, the LWSC Officer also revealed that LWSC had a sanitation project running at a cost of ZMW 350 million for the expansion and rehabilitation of treatment plants in Lusaka. He explained that;

> *The Ngwerere pond will be upgraded to a large conventional waste water treatment plant in order to increase its capacity while the Chunga plant will be rehabilitated so that it can take care of the industrial and domestic affluent. This project will address the lack of capacity that the company has been faced with to enable it expand its sanitation system* (LWSC, Personal communication. 2016).

This means that two major project on water and sanitation will done in Lusaka, and it is expected that in the near future the coverage of water and sanitation provision by LWSC will increase and also improved.

5.4.1 Types of Sanitation facilities

The study earlier indicated that residents in Kwamwena Valley use on-site sanitation. Figure 11therefore shows the most commonly used sanitation facilities in the area.

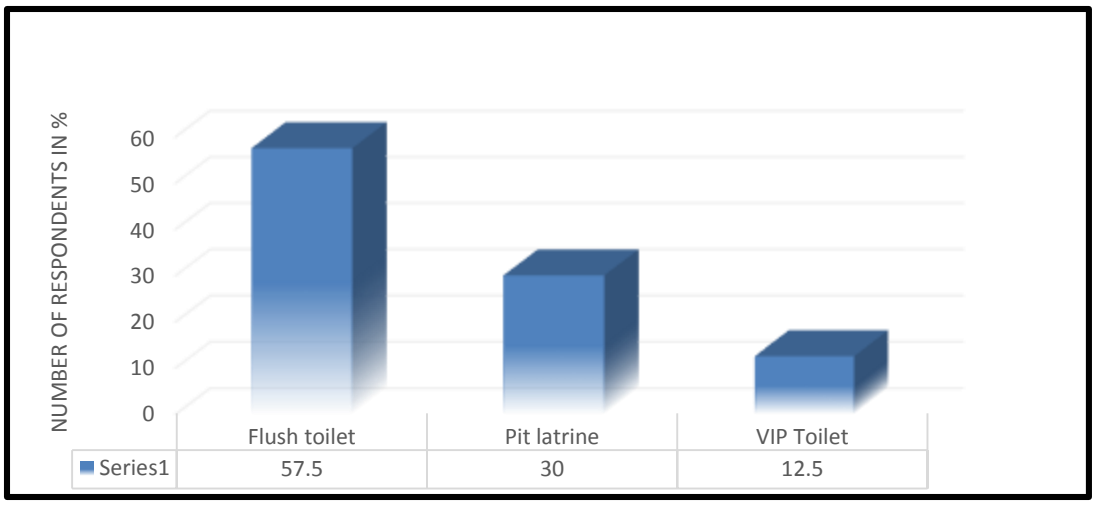

Figure 11: Types of Sanitation facilities in Kwamwena Valley
Source: Field data (2016)

Results from the study indicated that residents in Kwamwena valley use various types of sanitation facilities as shown in Figure 11. According to the results, 57.5 percent of the respondents used flush toilets, 30 percent used ordinary pit latrines, while 12.5 percent used VIP toilets. Most households were found to be using the flush toilets which are viewed as the ideal and the most convenient sanitary facilities in urban areas. The users of flush toilets were also found to be connected to boreholes, this is concurred with by a study conducted by (Tipping et al, 2005) who states that a little more than half of the households with piped water also have flush toilets, which are often connected to septic tanks rather than to sewers. The rest of the households used pit latrines which are also very common in most proportions of the African populations (Tipping et al, 2005).

It was observed during the study that most of the pit latrines were more temporary in nature as most of the houses with pit latrines were occupied by care takers who were only occupying the houses until the landlords were ready to occupy them. The study observed, also, that most houses that used pit latrines did not have running water but sourced their water from either hand pumps, shallow well or neighbours boreholes. As such, pit latrines tend to be easier to use with less water used to flush as some households do not manage to draw enough water for their daily domestic use. On the other hand, some VIP latrines were made with a flushing facility unlike the ordinary pit latrines. However, it is anticipated that

most of the residents using pit latrine and VIP toilets will in the future migrate to flush toilets as most households built pit latrines to use only during the construction period.

Due to the absence of a sewerage system in Kwamwena, all sanitation facilities in the area are connected to septic tanks. This is common for areas with on-site sanitation but has potential to cause a negative impact on the environment. It was earlier observed in the literature review that studies on impact of septic tank system on groundwater quality carried out in India, and China by Pujari et al (2012), found increased concentration of nitrate and bacteria in groundwater near onsite sanitation system. Further the same studies he observed safe distance between on-site sanitation units and groundwater supply sources is 10 meters. For Kwamwena Valley, where most households occupy plots measuring 30x20 metres, with over 50 percent of the households using boreholes, the possibility of ground water contamination becomes a concern. This is because it is questionable if households observed a safe distance between the septic tank and borehole. Figure 12 below shows some of the sanitation facilities used in the area.

a. The outside and inside of a pit larine as a sanitation facility in Kwamwena Valley

b. Flush toilet in Kwamwena Valley

Figure 12: Types of Sanitation Facilities in Kwamwena Valley
Source: Field data (2016)

5.4.2 Households with Sanitation Challenges

A survey was taken to find out how many households experienced challenges associated with providing their own sanitation services. Figure 13 shows the responses from the households.

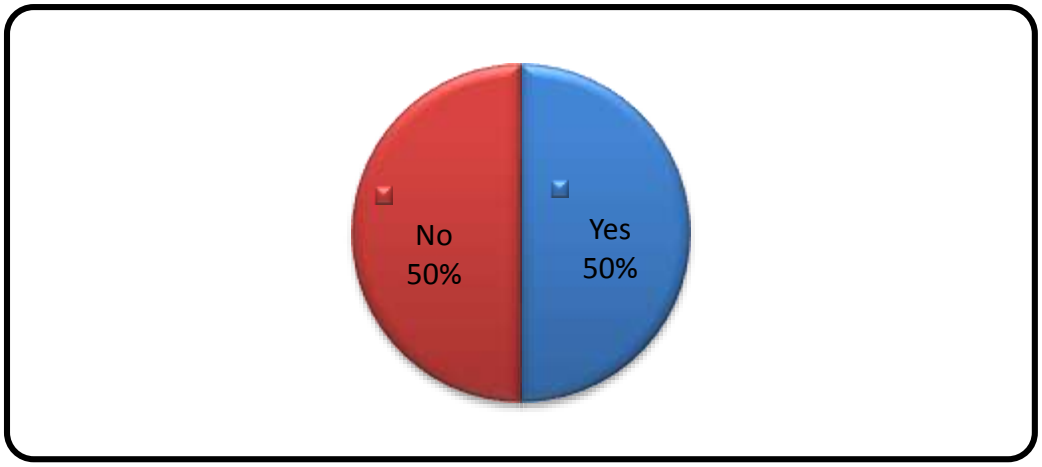

Figure 13: How many Households are faced with Sanitation challenges?
Source: Field data (2016)

Results from the study show half of the respondents experienced some challenges in providing their own sanitation while the remaining half did not. This maybe because most

of the residents felt providing their own sanitation was not as expensive as providing their own source of water. Because once the septic tanks are built, not much attention is given to them until they are full and usually this takes at least two years or more to be filled when it has been properly built. It was indicated during an interview with the LWSC manager that residents rarely approached the utility company to provide sanitation facilities for them unlike the case with water. He also said that most of the sanitation facility in Lusaka was based on a decentralized system hence most people were accustomed to providing their own sanitation facilities. For most of the households, sanitation is also not viewed as important as the provision of water for most people as such they give more priority to accessing water than sanitation. In order to have a better understanding of the challenges faced by some of the respondents in providing sanitation, Figure 14 gives an elaboration of the challenges

5.4.3 Challenges of on-site Sanitation facilities in Kwamwena Valley

The study showed in figure 13 that at least 50 percent residents in Kwamwena Valley faced challenges in providing sanitation to their homes, while the other half did not face any challenges. Figure 14 below shows the various challenges faced by the residents.

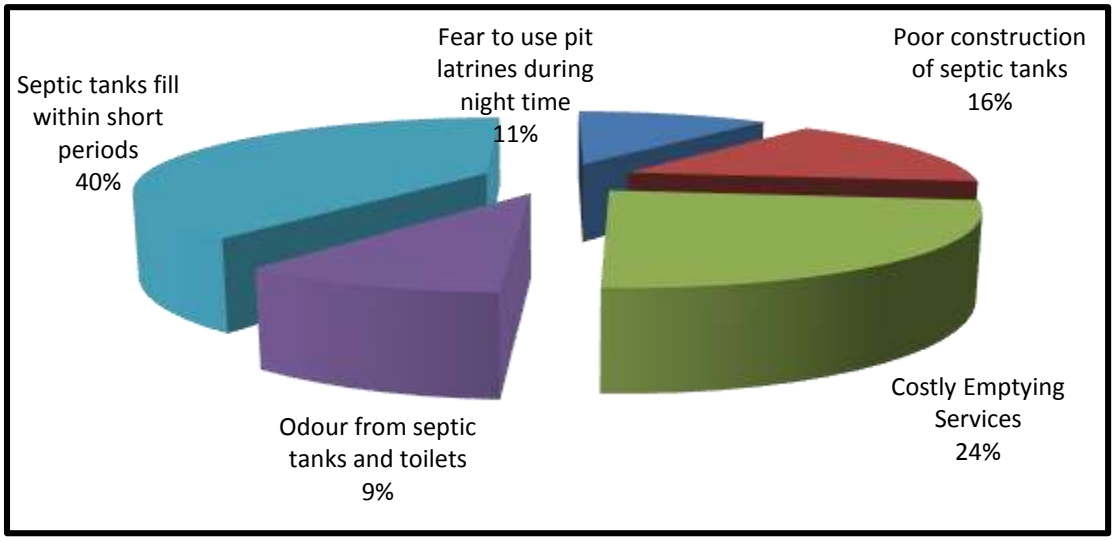

Figure 14: Challenges of on-site sanitation facilities in Kwamwena Valley
Source: Field data (2016)

According to the results, 40 percent of the respondents indicated that their septic tanks filled up within short periods, 24 percent said that septic tank emptying services were costly, 16 percent indicated that they suffered from poor construction of septic tanks, 11 percent of the residents indicated that they feared using pit latrines at night while 9 percent complained of the odour that came from the septic tanks and toilets.

The study revealed during an interview with the Provincial Planner conducted on 20th May 2016 that Kwamwena Valley has a high ground water table which contributes to the septic tanks filling up within shorter periods of time especially during the rainy season hence they have to engage septic tank emptying services this is an added cost to the residents. This could be attributed to the septic tanks not being constructed to good standard as residents do not consult the Utility company hence they are usually built by builders who are not experts. As such, septic tanks allow percolation of water. However, this may pose a possible threat to underground water contamination as stated in a study by Banks et al (2002) in (Shivendra and Ramaraju, 2015), that the extent of groundwater pollution, depended on hydro geological and soil condition of surrounding Environment, depth to water table and distance between groundwater source and onsite sanitation system. The filing up quickly of septic tanks may also be because of some of the sizes of plots in Kwamwena Valley which are medium cost plot but some residents have constructed high cost houses, meaning that less space is services like the septic tanks.

A number of residents faced challenges because of the cost they incurred in engaging sewage empting services when their septic tanks fill up. As earlier showed, this is as a result of septic tanks filling up quickly. However, this is only common with on-site sanitation.

The residents with pit latrines indicated that using the toilets during night time was a challenge as they were afraid of being attacked. Although the residents did not record any attacks, they were still apprehensive because a number of household were under construction and unoccupied, hence the possibility of them harboring criminals. Some residents indicated that they experienced odour from pit latrines at their houses or that from the neighbours' because of not having adequate less water to clean the pit latrines thoroughly and also due to lack of proper maintenance of the facilities.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the conclusion of this study using the research findings on the provision of water and sanitation in Kwamwena Valley. Further, the chapter presents recommendations that that can be adopted to address the situation in Kwamwena Valley and other residential areas in similar predicaments as well as give recommendations that can inform future developments and give guidance to government policies on planning for water and sanitation in urban areas.

6.2 Conclusion

The study has revealed that the provision of Water and Sanitation in Kwamwena Valley is mostly on-site characterized by extraction of groundwater through drilling of boreholes and using decentralized on site sanitation systems such as pit latrines and septic tanks, this is however an undesirable situation for any area termed as 'a planned area'.

Some of the challenges that the residents of Kwamwena Valley faced due to the on-site water and sanitation included the costs of installing boreholes and drawing water, distance to the water source and inadequate water drawn. For sanitation, results from the study showed that the main challenges faced by the residents were the filling up of septic tanks within short periods, the cost and poor pit latrine emptying services, poor construction of pit-latrines among other things. It is however unfortunate to note that this scenario is common to most planned areas in Lusaka notwithstanding the increase in the number of housing complexes and residential areas of this nature either planned by the state or private developers. This is because of the incapacity of LWSC to meet the current demand for its services. In the absence of the utility company's inadequacies, there is still need to develop more sustainable means of providing water and sanitation to urban residential areas taking into account the global increased awareness on climate change and the need to develop our environment in the most sustainable manner possible; on-site water and sanitation can pose a threat to the environment especially with the unregulated water drilling that is currently happening in Lusaka.

The role of supplying water to residents should, therefore, be regulated and monitored closely especially if not provided by the utility company in order to encourage sustainability of the resource. In addition, the more people using on-site water and sanitation means the more revenue the utility company loses and the high the risk of contaminating underground water as well as depleting underground water sources.

It is however hoped that with the introduction of the S.I on groundwater and boreholes, borehole drilling will be regulated in the city despite there still been a gap in terms of sanitation. Also with the MCC LWSSD project, it is envisaged that Kwamwena Valley will no longer rely on on-site services. Given the size of many urban populations, their political importance and the role of major cities as growth engines for the economy as a whole, urban services management poses critical questions for all policy makers and managers concerned with sustainable development in the national economy and with the allocation of scarce physical, social and financial capital.

6.3 Recommendations

In order to improve water and sanitation service delivery in planned urban areas and to reduce unsustainable methods of on-site water and sanitation, there is need for collaboration between different institutions in order to develop technologies, systems and as well as policies that will improve water and sanitation provision. The study therefore recommends the following;

i. There is need to formulate policies in water and sanitation, planning and in infrastructure design that will encourage research and development of innovations and technologies that will apply to our local scenario.
ii. There is need for collaboration of various stakeholders up to the consumer level during the planning and implementation stage of urban areas, to ensure that the allocation of residential plots is done simultaneously with the provision of necessary services such as water and sewerage reticulation systems.
iii. There is need for urban Planners and LWSC to encourage households to also employ alternative methods in the water sector such as rain water harvesting and

storm water reuse that can be stored and used for gardening and flushing toilets. This is to encourage sustainable use of the water resource.

i. Government to put more efforts in decentralising not only functions but finances to the Local Authorities and Utility Companies in order to build capacity in water management. This also includes increasing financial support to institutions such as WARMA to enable them effectively carry out regular compliance monitoring and enforcement of the water management act.

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Interviews

a. Provincial Planner., Lusaka Physical planning and housing, 20th May 2016
b. Infrastructure Planning and Design Manager, Lusaka Water and Sewerage company, March 24th 2016
c. Officer, Millennium Challenge Corporation, 25th August 2016
d. Officer, Meanwood Kwamwena Valley, 29th August 2016
e. Engineer, Zambezi drilling company, 3rd September 2017

APPENDICES

APPENDIX A

The University of Zambia

School of Natural Sciences

Department of Geography and Environmental studies

Masters of Science in Spatial Planning

Household Questionnaire on: Provision of water and sanitation in planned residential areas in Lusaka. A case of Kwamwena Valley

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The purpose of this questionnaire is to collect data on the provision of water and sanitation in planned residential areas in Lusaka using Kwamwena Valley as a case study. All responses will be used for academic purposes only and will be treated as strictly confidential. Your responses will be highly appreciated.

PART A: Personal Information

1. Respondent: 1) Male [ ] 2) Female[ ]
2. Are you the head of the household? 1) Yes [ ] 2) No [ ]
3. Respondent Age
   1) 15-25 [ ]
   2) 26-35 [ ]
   3) 36-45 [ ]
   4) 46-55 [ ]
   5) 56 and Above [ ]
4. How many people reside within the premises/plot?
   1) 1-4 [ ]
   2) 5-9 [ ]
   3) 10 and Above [ ]

PART B: Provision of water

5. Is your house connected to LWSC?

1) Yes [ ] 2) No [ ]

6. What are your sources of water?

1) Elevated tank submersible pump [ ]
2) Neighbour's Borehole [ ]
3) Communal tap [ ]
4) Hand pump [ ]
5) Shallow well [ ]
6) Other, (Specify)----------

7. Do you face any challenges in accessing water?

1) Yes [ ] 2) No [ ]

8. If yes to question 8, what kind of challenges do you face?

1) Inadequate waterdrawn [ ]
2) Costly to install borehole [ ]
3) Contamination of water [ ]
4) Long distance covered to source water [ ]
5) Drying up of boreholes [ ]
6) Other, specify----------

PART C: Provision of sanitation

9. Is your house connected to a sanitation facility?

2) Yes [ ] 2) No [ ]

10. What sanitary facility do you have in your home?

1) Water closet [ ]
2) VIP toilet [ ]
3) Pit latrine [ ]

11. What is the method of sewage disposal used at your home?

1) Septic tank
2) Communal septic tank
3) Water borne sewerage system

12. Who is responsible for sanitation provision?

1) Self [ ]

2) Meanwood [ ]

3) LWSC [ ]

4) Other, (Specify) [ ]

13. Do you face any challenges in accessing sanitation facilities?

1) Yes [ ] 2) No [ ]

14. If yes to question 8, what kind of challenges do you face?

1) Poor septic tank empting services [ ]

2) Difficulty to flush and keep toilets clean [ ]

3) Odour from toilets [ ]

4) Other, specify----------

15. What are your general opinions/perspectives on the provision of water and sanitation services in this area? ----------
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Thank you for your participation…..

APPENDIX B

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AN INTERVIEW GUIDE FOR MEANWOOD

Date of interview: …… …….

1. Institution:
2. Name of respondent:
3. Designation of respondent
4. How many houses have been occupied so far?
5. What is the range for plot sizes in the area?
6. Who is mandated to provide water and sanitation in the area?
7. How is water provided in Kwamwena Valley?
8. How is sanitation provided in Kwamwena Valley?
9. What was the initial plan on how water and sanitation would be supplied in the area?
10. Do you take note of how many boreholes are sunk in the area and its possible implication on the environment?
11. What regulations are guiding the development of Kwamwena Valley housing?
12. What challenges does the company face in providing water and sanitation to the area?
13. What other constraints are the company faced with?

APPENDIX C

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AN INTERVIEW GUIDE FOR LUSAKA WATER AND SEWERAGE COMPANY

Date of interview: …….

1. Institution:
2. Name of respondent:
3. Department :
4. Designation of respondent
5. How is water provided to newly planned areas?
6. How are sanitation services provided to newly planned areas?
7. What is the procedure for supplying water to newly planned residential areas?
8. What is the procedure for providing sanitary services to newly planned residential areas?
9. What is the procedure for providing water and sanitation services to already existing areas?
10. Is the institution able to provide these services adequately to the customers?
11. What challenges does the institution face in providing water and sanitation?
12. What are the institutions future plans to ensure that its services cover its catchment area?

APPENDIX D

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AN INTERVIEW GUIDE FOR MILLENIUM CHALLENGE COORPERATION

Date of interview: …… …….

1. Institution:
2. Name of respondent:
3. Designation of respondent
4. What is the main function of the Organisation?
5. How was Kwamwena Valley picked for the water and sanitation project?
6. What is the cost of the project?
7. What is the nature of the project being undertaken in Kwamwena Valley?
8. What is the duration of the project?
9. What is the water and sanitation situation in Kwamwena Valley?
10. Are there any challenges the organisation is facing so far in implementing the water and sanitation project in the area?
11. Will residents be expected to contribute to the project in any way i.e. connection fees?
12. Has the project done a survey on willingness to pay?

APPENDIX E

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AN INTERVIEW GUIDE FOR LUSAKA PHYSICAL PLANNING AND HOUSING

Date of interview: …… …….

1. Institution:
2. Name of respondent:
3. Designation of respondent
4. What is the role of the planning authority in approving housing projects like mean wood Kwamwena?
5. What does the planning authority consider when approving such projects?
6. What controls are put in place to make sure that developers build according to the plans approved?
7. What role does the planning authority place to make sure water and sanitation are provided in the area?
8. Does the planning authority do follow up inspections to make sure that the developer followed the approved plan?
9. What is your advice for such projects to have sustainable water and sanitation provision?

APPENDIX F

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AN INTERVIEW GUIDE FOR DRILLING COMPANIES

Date of interview: …… …….

1. Name of company
2. Name of respondent:
3. Designation of respondent
4. How much do you charge for drilling?
5. Do you charge for transport to get to the premises?