CHALLENGES IN SEWAGE MANAGEMENT IN URBAN AREAS OF ZIMBABWE. A CASE OF GWERU URBAN

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APPROVAL FORM

The undersigned clearly attest that they have read and recommended to the Midlands State University for acceptance a dissertation entitled: **Challenges in sewage management in urban areas of Zimbabwe. A case of Gweru urban**

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Declaration

I declare that this is my own work and material used from other sources to compile this dissertation has been fully acknowledged.

Dedication

This dissertation is dedicated to my beloved father, mother, brothers and sisters whose concerted efforts and ever ending sacrificial love throughout my studies have made my dream a reality. May the Almighty God add in abundance from where you were deducting.

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Abstract
The scope of sewage management has evolved throughout history with changes in the socio-economic conditions, city structures and the environmental concern. The major thrust of this paper is to assess challenges faced in sewage management in urban areas of Zimbabwe using Gweru urban as a case study. The researcher employed cluster sampling to distribute 60 questionnaires in two clusters. In gathering information the researcher used questionnaire, interviews, observations and secondary data. Questionnaires were used to gather information from the residents relating to effects of improper sewage management and all other relevant data on challenges faced in sewage management. Semi structured interviews with key informants were conducted to compliment information obtained using questionnaires as interviews were done with specialists in the field of sewage management. Observations and discussions assisted the researcher to expose the evidence on the ground. Major findings from the research include obstacles like sanitary pads, pampers, condoms as key cause in sewage blockages. Furthermore, the research also confirms that, most of the residents are not aware of the effects of improper sewage management. Such data is supported by information from direct observations where litter was found everywhere. The research also highlighted some of the major challenges faced in sewage management which vary from individual household to the local authority. Most individuals' challenges are shortage of capital and lack of bins for proper waste disposal. The local authorities also suffer from transport shortages and capital. Environmentally sustainable solid waste management practices guided by the principles of the integrated approach and revitalized by environmental education must be fully adopted. The researcher edged residents to avoid ignorance especially on issues like sewage management which actually affects them directly or indirectly. The researcher however, recommends for multi-stakeholder participation and contributions if challenges faced in sewage management are to be contained.

Contents

Acronyms

DEFRA	Department for Environment Food and Rural Affairs
EMA	Environmental Management Agency
EPA	Environmental Protection Agency
ISWM	Integrated Solid Waste Management
MLGRUD	Ministry of Local Government, Rural and Urban Development
SPSS	Statistical Packages for Social Sciences
UK	United Kingdom
UN	United Nations
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme
USD	United States Dollar
USEPA	United States Environmental Protection Agency
UWWTD	Urban Waste Water Treatment Directive
WISA	Water Institute of Southern Africa

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CHAPTER ONE: INTRODUCTION

1.1 Background to the study

According to Merriam (2013), sewage can be defined as waste material such as human urine and faeces that is carried away from home and other buildings in a system of pipes or refuse liquid or waste matter carried off by the sewers. Inaddition, Tevera (1995) defined sewage as running waste water that is deposed of either from homes or industries. Sewage is normally transported inform of small liquid with suspension of small solid particles in large pipes called sewers. The waste water may either be directed to a specific place to be recycled or to be exposed off far from people as it can cause or lead to the spread of water borne diseases like diarrhoea, cholera, among others.

Sewage management had a long history as to when it started and why it became an area of specialization worldwide. According to Robert and Garry (2004) and Donovan (2010) sewage collection started in the city of Venice. Venice developed one of the first sewer systems to be implemented in the world that is, the unique gravity driven system of underground channel which they call fognatura. The system of fognatura replaced the system which was initially used like throwing waste by the road side and the waste were to be carried away by the sea tides. The issue of tides had a problem in sewage management especially when tides are not strong as they will leave other wastes which will then cause menace on the environment and risk human health.

According to UNEP (2010), the scope of sewage management has evolved throughout history with changes in the socio-economic conditions, city structures and the environmental concern. After people had realized that proper sewage management is directly related to the rate of socio-economic development, a system to manage sewage was implemented known as the sewerage system. The Department for Environment, Food and Rural affairs (2002), also noted that, the countries in Europe agreed on what they call Urban Waste Water Treatment Directive (UWWTD) in 1991. The directive has requirements for sewage to be established and set standards for sewage management and treatment. All this information service to better acknowledge that a lot of challenges had been noted in sewage management way back in developed nations and they tried to come up with integrated waste management approaches meaning there are a lot of problems or issues which needs to be addressed.

According to UNISA (2013), developing countries mostly in Asia also pioneered sewage management among other developing countries. Mesopotania for example used vertical shafts to carry away wastes into cesspools. Wastes collected into cesspools were periodically emptied by workers known as rakers. Collected wastes were sold to farmers who would use them as manure which resulted in the production of contaminated foods from contaminated wastes. This degrades both the wellbeing of people as well as the environment.

According to Zandaryaa (2011), with the discovery of gold in Johannesburg the population around the area started growing and South Africa become the first African state to replace traditional waste management practices with sewerage system. Prior to 1930s, the Klipspruit sewage farm was the only facility in Johannesburg possessed for handling the area's sewage in a better way by replacing compositing and blair toilets. According to Water Institute of Southern Africa (WISA) (2013), most African countries were using compositing present day pit latrines in sewage management. Only a few countries in North Africa were using Blair toilets to manage their wastes. This however has detrimental effects to the health of the Africans as the region suffered recurrent impacts of diseases like cholera, diarrhoea, dysentery and other respiratory diseases and environmental degradation.

According to Bere (2013), the major challenge Zimbabwe is facing in sewage management is as a result of the type of sewer and sewerage system we have which is worn out and aged. The aged system is not being expanded so as to meet the needs of the growing urban population. Currently Zimbabwe in a bid to deal with the problems arising from sewage management had signed a 144 million US dollar deal with the Chinese government with the money targeting to rehabilitate the dilapidated reticulation system in Zimbabwe's urban areas.

1.2 Statement of the problem

WISA (2013), states that sewage treatment in Zimbabwe is still below 50% of global required standards. The document further states that, in Zimbabwe 80-90% of urban wastes are discharged inefficiently treated or directly untreated. According to Mudyazhezha and Ngoshi (2014), argued that problems of sewage are severely attacking mostly developing countries. This is because in developing countries, the municipalities are mainly responsible for waste management so if the municipality faces economic downfall the whole sector will be affected. Mukundi (2012), states that during a decade of economic recession in Zimbabwe, sewage

management problem was and is still a common phenomenon. This is because local authorities were not able to fully regulate movement and disposal of wastes. Sewer system often bursts and raw sewage flooded streams and rivers unmonitored for example a case of Gweru River where raw sewage is found flowing. Andrew and Jackson (1998), suggests that the major problem with little attention paid to sewage management is or resulted in environmental contamination. Thus when taking all this into consideration, the researcher decided to look or carry out a research on challenges faced in sewage management.

1.3 Objectives of the study

1.3.1General objective

- To assess the challenges faced in sewage management in urban areas of Zimbabwe with special reference to Gweru urban.

1.3.2 Specific objectives:

- To identify the nature of waste obstacles found in sewer systems
- To assess residence awareness on the effects of improper sewage management
- To analyse the general challenges faced in sewage management

1.4 Justification of the study

Little had been known about the dangers of sidelining different stakeholders in policy implementation across the globe. In recent years, there is a growing realization that stakeholders and different organisations should be involved in decision making especially on issues which directly or indirectly affect them. Involvement of multi-stakeholders in decision making guarantees the acceptance of policies and easy implementation of policies.

Gweru is found in the watershed area of Zimbabwe hence, if the area is left contaminated it will destruct not only the activities in Gweru but the whole nation. This is because water flows irregardless of political boundaries. Therefore, if sewage management is nicely practiced in Gweru urban the whole nation will benefit from the restoration of clean water sources. Mostly people in Midlands will be at lower risk from health problems caused or resulting from water borne diseases like diarrhoea, dysentery, cholera among others.

The environment is actually degrading as a result of poor sewage management as it will affect soil alkalinity resulting in increased species depletion. Therefore proper sewage management will lead to the restoration of the natural environment and maintenance of the natural

ecosystems. Moreso, the council will benefit from proper sewage management because instead of channelling resources to sewage management it will embark on other developmental activities which will see the City of Gweru growing and developing.

Geography and Environmental Studies students will also benefit from the research results in further carrying out researches in both the management of sewage works and resultant impacts if sewerage facilities are poorly managed. Little data has so far been gathered in the management of sewage hence, the research will also help or used as a model in sustainable sewage management

Furthermore the students will bequeath themselves on the worth of various methods which can be employed in sustainable management of the sewerage system. Finally if the results are published, they will act as a model to other studies which will be carried on sewage management and act as a platform for stakeholder involvement in the planning and management of wastes in their localities. The results of the study if published will act as a footprint which other cities and towns in the country and even across the globe will adopt and implement and a health environment will be restored.

High costs incurred in water treatment can also be reduced if sewage which has become the major contaminant of our water resources is nicely dealt with. Reduction in water treatment costs will ensure reduction in budget by the nation and resources forwarded to other sector of the economy which needs attention. Hence a benefit to the planners, stakeholders and the nation at large. This can be exemplified by looking at the current deals which are being done by the government of Zimbabwe like the 144 million United States Dollar (USD) deal from China to be used in sewer reticulation rehabilitation. This entire amount can be used for some other business and development can be enhanced.

Urban areas in Zimbabwe usually inject lots of money to treat people suffering from health problems related to drinking of contaminated water and water borne diseases as a result of a number of challenges the municipalities are facing in sewage management. If sewage problems are solved, health related diseases in Gweru might be reduced and the whole City's population will be enjoying a health environment and life.

Lastly, the researcher will also benefit from the research through strengthening and deepening of the knowledge base. This is achieved as a result of willingness to produce a well documented research which is quite interesting.

1.5 Study area

Gweru was established in 1894 by Dr Leander Star Jameson and it became a municipality in 1914and attained City status in 1971(City of Gweru, 1994). According to Central Statistical Office (CSO), 2012), the City of Gweru had a population of 146 073 people distributed in 18 suburbs of the City. The City of Gweru is located at 19°25'S, 29°50'E. It is 168 km from Bulawayo and 280km from Harare along the major Harare-Bulawayo road and railway line. Gweru is the fourth largest urban settlement in Zimbabwe - after Harare, Bulawayo, and Chitungwiza - in terms of population size. It is the provincial capital of the Midlands Province, and is centrally located in the country.

According to Matsa (2007), Gweru straddles across 3 types of soils, namely black basalt soil, sands, and gravel. The City of Gweru lies on a watershed, which stretches from Rusape to Bulawayo and is at an altitude of about 1422 meters. Gweru urban lies on greenstone belt and are close to the great dyke who makes it rich in gold and chrome. The area has predominantly moderate slopes ranges from gently sloping slopes to rugged terrain. The Municipal area is dissected by numerous streams most of which drain into the Gweru River, a tributary of the Gwayi River as shown on Fig 1.1. The area is mostly affected by northeast prevailing winds, which are dominant from August to November during which their mean speed is in the range of 8.0 to 9.3 knots (MSD, 2014). The city covers approximately 26,113ha including the newly acquired land of Cambridgeshire and Clydesdale (City of Gweru, 1994).

It lies in agro-ecological region four experiencing tropical savanna climate. The mean temperature is 18 Degrees and mean annual rainfall for Gweru is 450-600mm. The area sometimes experienced rainfall shortages during the farming season resulting in periodic droughts.

Agricultural activities including crop cultivation (based on food crops, cash crops as well as few drought tolerant crops) and livestock rearing (dry resistant cattle) support an average of 300 000people, found within the city boundaries (Zimbabwe Vulnerability Assessment, 2010)

(Central Statistics Office).The main economic activity done is mainly subsistence and semi subsistence farming (agriculture) where crops which include maize, sunflower, groundnuts, roundnuts, beans are grown and almost all young and energetic generations are directly or indirectly involved in gold mining in Shurugwi and other surrounding areas. Figure 1.1 shows or illustrates the map showing the location of Gweru urban

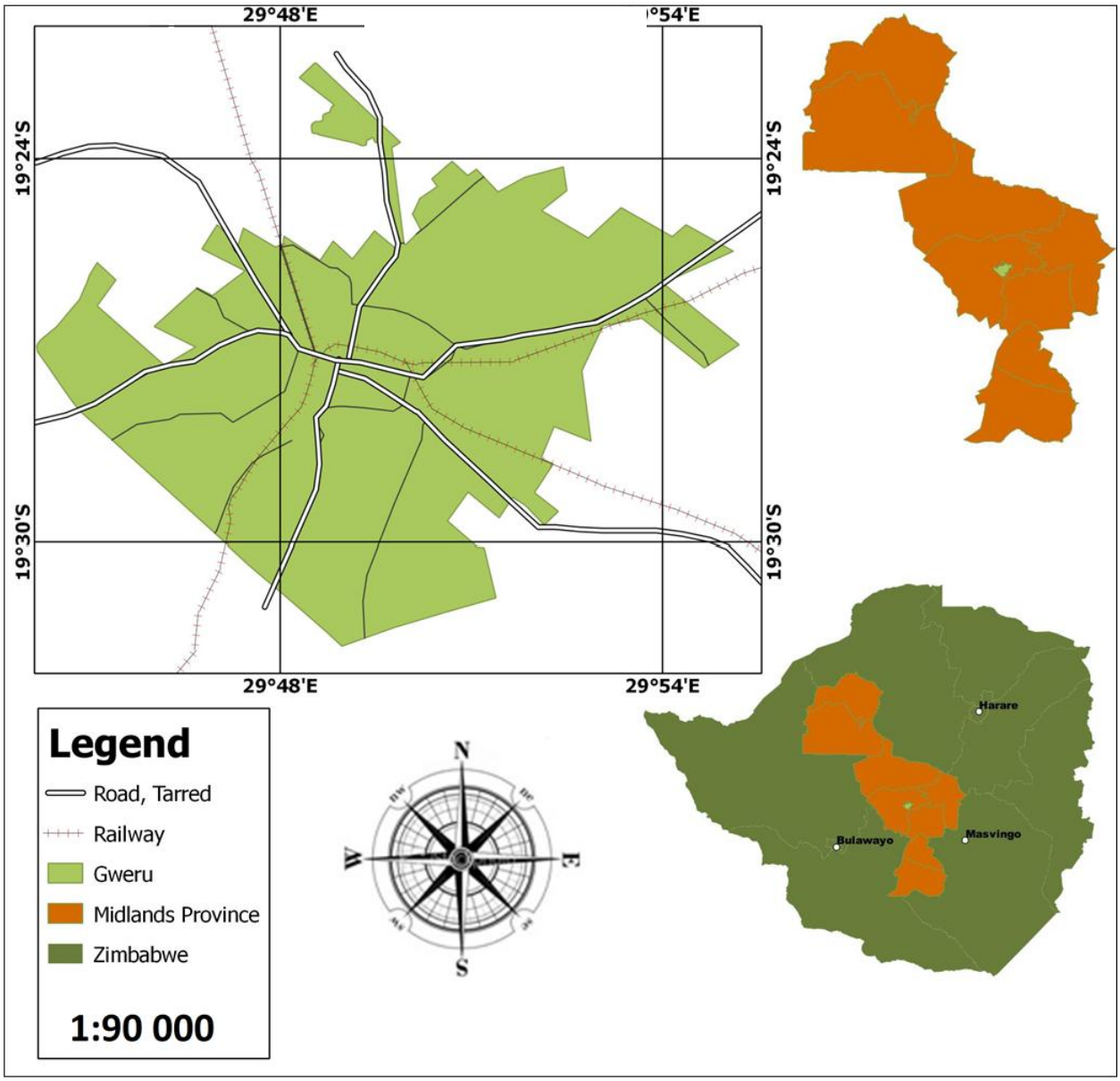

Fig 1.1: Description of Gweru urban

CHAPTER 2: LITERATURE REVIEW

2.1 Identifying nature of waste obstacles found in sewer system

Defining the term "sewage" remains one of the biggest challenges in the academic arena depending on how it is understood by the various schools of thought. Agere (2013) defined sewage as waste material such as human urine and faeces that is carried away from home and other buildings of pipes called sewers. Tevera (1995) also defined sewage as running waste water that is deposed of either from homes or industries. Here the question is, is waste water flowing in sewer systems responsible for existing sewer blockages or if a blockage is reported, is it waste water that will have caused that? According to Jenkinson (2009), solid wastes are the one responsible for sewer system blockages as portrayed by the nature or appearance of obstacle found when a blockage is reported. There are three major sources of such solid wastes which were found responsible for most of reported ill function of sewer systems namely municipality solid wastes, industrial solid wastes and wastes from agriculture (United States Environmental Protection Agency (USEPA), 2002).

2.1.1 Municipal Solid Waste

Mostly municipality solid wastes are generated from residential areas (households), food outlets, offices, hotels and other institutions among others. Yap (1999) identified some of the municipal solid waste and their sources which are normally witnessed when sewage blockage is attended to for example household wastes which include food scraps, diapers, sticks, toys paper towels and of recent used condoms all these are not meant to be used in the sewage system or flushed down because such products do not easily disintegrate or breakdown resulting in promoting a blockage in sewage line. In United Kingdom (UK), plastic containers, food wastes and yard wastes are the major obstacles responsible for sewer busts (Guardian, 2012). Using the case of UK, the article in the Guardian (2012) states that most people suffer sewage related problems from recreation and consumption of contaminated foods mostly from fisheries.

Another source of wastes usually found when sewer systems are maintained are from street sweepings and these include sticks, mud. Mud, these do not decompose resulting in debris accumulation and a blocked sewer line. Institutions that include hospitals are also responsible for blockages as the produce found in sewer system products like food waste, papers, plastics,

metals, rags, glass, and sanitary residue among others. According to USEPA (2002) India also experienced high sewer blockages as a result of waste dumping without care. In India waste are poorly collected hence people turn to dump wastes on street sides and when rainfall comes all the wastes will be directed into sewers resulting in system blockage. Sewer bursts then resulted in sewage related problems like cholera, diarrhoea which turn to threaten the health and claim lives in India. The collection of this category of waste is usually done by the Local Authority which has that mandate as enshrined in the Urban Councils Act. The amount of municipal solid waste generated is mainly promoted by extensive urbanization and changes in lifestyle and consumption rates.

According to USEPA (2002) Egypt also suffers inadequate coverage of collection services and the general dirty appeared in the streets. 90% of the residents in small cities in Egypt where not receiving any assistance in waste collection resulting in wastes being dumped in opened up manholes. Wastes like plastics, sanitary pads, and paper towels are the chief sewer blockers in Egypt resulting in sewer bursts. Like in India and UK sewage related problems will be experienced. EPA (2012) also highlighted the importance of proper waste management as a way of curbing disease outbreak in Zimbabwe. Most of low income residential suburbs in Zimbabwe at one point recorded cholera outbreak as a result of drinking sewage contaminated water like the case of Marondera and Epworth in Harare.

The Global Waste Management Market Report of 2007 revealed that an estimated 2.02 billion tonnes of municipal solid waste were globally generated and this amount represented a 7 % annual increase since 2003.According to UNEP (2009) the global municipal waste generation was projected to increase by 37.3% between 2007 and 2011. EPA (2012) noted that cities and towns in India in 1947 generated an estimated 6 million tonnes of solid waste and in 1997 it rose to 48 million tonnes and from all these statistics and water shortages or rationing that is done it clearly shows that such obstacles will continue to be a common phenomenon. In Harare about 1.1 million tonnes of municipal solid waste are generated annually and organic waste such as vegetables, fruits, flowers, leaves and kitchen waste constitutes 80 % of the total solid waste quantum (Muza, 2006).The World Bank (1999) highlighted that about 1.5 million tonnes of municipal solid waste are produced daily in the Asian and Pacific Region and it is projected to double by 2025. In this regard sewage and wastes infrastructure failed to keep up with urban

expansion leaving most of Cities in developing nations with a major sewage challenge which most governments are failing to address.

2.1.2 Industrial Solid Waste

The World Bank (1999) indicated that industrial solid waste responsible or found in case of blockage consist of a wide range of particulates similar to household and waste produced from commercial areas. This is composed of a wide range of materials such as plastics, papers, packaging materials, food waste, ceramics, rubber, abrasives and metals just to mention a few. According to Patwardham, (2013) Japan starting from the mid 20^{th} century it expanded its industrial sector resulting in mass waste production. Illegal disposal of wastes become widespread. Sludge, soot, dust and grease adds strain to the country's waste disposal capacity and that contributed to sewer burst in Japan and resultantly its population suffers from sewage related diseases. Such wastes are common in most blockages as they are sometimes flushed down the reticulation system.

Central Public Health and Environmental Engineering Organisation (2000), Industrial solid waste can be categorized as hazardous or non-hazardous in relation to the type of industries and variations in environmental toxicity from the substances produced. Hazardous industrial waste is composed of chemicals and infectious substances generated during production or manufacturing process. EPA (2012) pointed out that various sources of industrial hazardous solid waste include metal, chemical, paper, agro-industrial, dye, refining and rubber industries. Of all those wastes seen during operations and maintenance grease had been left out, hence it is one of the major causes of sewer system failure. Solid wastes management problems in developing countries like Zimbabwe, Botswana, Gabon among others are aggravated by the malfunctioning of traditional waste management systems due to rapid development and population concentration.

Grease cling to the sides of sewer pipes and built up over time. Built up grease will end up attracting some particle to stick on it and the result of over abundance of fat is that sewage system will become dogged with grease and become firmly entrenched (Patwardham, 2013). EPA (2012), quantifying industrial solid waste is a major challenge facing most Local Authorities in Sub-Saharan Africa and this is attributed to the absence of regularly updated and systematic databases on industrial solid waste which depict the exact rates of waste generation rather than assumptions or approximates used. Hence in this regard, the rates are unknown since

the variations in industrial solid waste generation exist between countries at different stages of development.

2.1.3 Agricultural solid wastes

This is waste produced from agricultural production and this result in increased quantities of livestock waste, agricultural crop residues and agro-industrial by-products. Different crop residues are generated from sugarcane, wheat, maize, sunflower stalks, among others. Hoornweg and Thomas (1999) pointed out that various sources of agricultural waste include orchards, vineyards, dairies, feedlots, farms and croplands. Most reported sewer bursts in countries like Armenia, Bangladesh, and Brazil are as a result of wastes from crop residues and USA, New Zealand, Russia and Switzerland, reported sewer blockages are as a result of wastes from animal produce (World Bank, 2010). In most urban areas of Zimbabwe large quantities of agricultural waste are generated in market places such as Mbare, Sakubva, Egodini and Kudzanai in Harare, Mutare, Bulawayo and Gweru respectively during the rainy season. Thus the most common obstacle found when sewage system blocks are maize residues (maguri), dead animals like puppies and chickens that would have been flushed down the sewage system and dumped in main holes (Munochiveyi, 2001). Hence, agricultural solid wastes can be referred to as detrimental in sewage blockages and human health worldwide.

2.2 People's awareness on the effects of improper sewage management

2.2.1 Sewage

Sewage pollution is caused by several factors, including failing and outdated infrastructure that is compounded by rapid, sprawling development that paves over the farms, forests, and wetlands that naturally soak up storm water (World Bank, 2009). Therefore this section seeks to redress and wakening people who are the sole perpetrators and directly or indirectly affected by the effects of improper sewage management. Sewage pollution can be caused by natural or man-made factors. Irregardless of the cause what is important is that are people aware. Morison et al (2001) articulated literature on the effects of improper sewage management and the information is available but not all people who are affected are able to read, therefore this research seeks to come up with strategies to make the information available useful. Sewage pollution as a direct contributor to ground water pollution and environmental contamination as a result of sewer line bursts.

According to EPA (2012) Americans suffers serious illness untreated sewage seeps into water the use for recreation or drinking. Thus in America about 3.5 million people fall ill from swimming in water contaminated by sanitary sewer overflows and in California 1.5 million people get gastroenteritis (EPA, 2012). Therefore, such illnesses are as a result of people's unawareness of the effects of improper sewage management and sometimes ignorance. Hence the purpose of this study is to ensure that people a made aware of the effects of improper sewage management. Bursts are sometimes caused by what people are flushing down the sewer system or landslides or tree roots so people in this regard should be able to identify and notify the responsible authorities for the system to be attended to and restored than only to leave the burden to the local authorities.

According to EPA (2012), while the solutions include more funding, better planning, and enforcement of existing clean water requirements, the strategy of some in the regulated community is to decrease public health and environmental protections. This was the case with the proposed sewage dumping policy where EPA would have allowed sewage treatment plants to bypass secondary treatment by sanctioning the "blending" of fully and partially treated sewage during periods of heavy rainfall which circumventing the biological treatment that eliminates disease-causing germs or viruses since passage of the 1972 Clean Water Act. Fortunately, public outcry forced EPA to rescind this policy. All these policies are just footprints and are failing to address or air awareness to the people on effects of improper sewage management due lack of outreaches and awareness campaigns.

2.3 General challenges faced in sewage management

Sewage management has become an issue of concern to various countries in the world whether developing or developed. It is becoming complicated and long-term sustainable initiatives for its solution is a necessity. A number of literatures had been written pertaining to challenges associated with how sewage can be managed but with little emphasis. Thus therefore major challenges had been researched and grouped into three that is rapid urbanization, population growth and limited government resources and lack of policies follow up.

2.3.1 Rapid urbanization

Urbanisation is the emergence, growth and development of towns and cities (Muchuweti et al, 2006). The World Bank (2010) confirmed that due to increase in demand of scene environment

and better living standards most of the people had been for the past decade seen migrating from rural areas to nearby urban areas which had resulted in increased human needs like accommodation and employment opportunities. According to Nyarko et al (2013), urban growth is most rapid in developing world (Africa and Asia) where cities gain an average of 5million residents each month, the case of Ghana and Alexandria (Egypt). Ghana, 50% of the population does not have household or yard water connections implying that, there is disaster in solid waste management and it's due to rapid urbanisation. Resultantly most governments only targets areas like housing, opening up industries using the fast track approach only to meet the needs of demanding people (City of Gweru, 2012). Increased industries and housing resulted in increased production or generation of wastes which most governments had not factored in. Abbaster (2010) also noted that, Peru is also facing challenges in sewage management due to accelerated urban growth and non-planned urbanisation. Such an increase proved detrimental in sewage management in most countries in the world, thus urbanisation a force to reckon in major challenges faced in sewage management.

According to Strauss and Montangero (2002), waste production directly outweighs the capacity of the existing sewerage system. Thus, if the capacity of the sewer system is outweighed, the result is sewer burst. Urbanization also leads to production of different types of waste which cannot be carried using the system that is existing right now which is old and dilapidated hence sewer bursts becomes a common phenomenon as a result of urbanization. For the past decade Zimbabwe had been growing rapidly but under macroeconomic instability resulting in uncollected household, commercial and industrial wastes (Muchuweti et al, 2006). Most people will then nicodimusly dump wastes even in soakways and man holes and the end result will be sewer busts. UNDP (2010) articulated that, Gweru in particular is grappling with problems of high volumes of wastes lying everywhere.

2.3.2 Rapid population growth

According to UN-INWEH (2007), noted that rate of population growth versus sanitary infrastructural development had been poorly articulated. Population growth in most urban areas becomes a challenge to most governments due to its 5% growth per annum (UN-INWEH, 2007). Population growth help in straining already overburdened water systems and this can be clearly seen by excessive water rationing across the globe. The Guardian (2012) due to rapid population

increase in India, waste infrastructure has failed to keep up with population growth leaving India to 'drown in its excreta'. Thus management of solid wastes and sewage remains a problem. Leaking and incomplete sewage systems contaminate rivers and lakes resulting in threatening both the environment and human health.

Ruiz-Villaverde (2010), notes that about 150 000 tonnes of domestic waste are generated per year and food waste constitute about 70% of the total amount of waste. Looking at the rate of population growth and waste production and water shortages in most cities one can note that managing sewage is still an area of concern and it needs extra attention. According to Abbaster (2010), in developing countries population concentration is inextricably progressing at a pace that is much than was ever experienced by today's industrialised countries. Tunisia is typical examples of a developing nation were population is growing faster than development. Thus the sewer system will be always overloaded resulting in bursts and left people prone to sewage related health risks.

Whenever population growth demands attention, urban water supply will presents challenges in sewage management and monitoring which are unique. As a result of the co-disposal method used in waste dumps the bulky of waste is organic and plastics constitute about 20% of the urban solid waste stream (MLGRUD 1995). Extensive integrated waste management programmes are therefore required to reduce the sources and level of waste by establishing domestic recycling and sorting to counteract the challenges bedevilling local authorities. Thus some challenges faced in sewage management can be said to be exacerbated by irresponsible behaviour of residents and this is due to increase in population numbers in a locality.

The issue of waste management in developing countries therefore has emerged as a critical and impending disaster. Due to underdevelopment it is difficult for most of the developing countries to respond effectively to newly emerging challenges of solid waste management.

2.3.3 Limited Government resources

According to Jerie (2006), Section 83 of the Public Health Act of Zimbabwe of 1996 states that every local authority is mandated to take all lawful, necessary and reasonably practical measures to maintain clean and sanitary conditions in its district at all times so as to prevent accumulation of waste. Due to limited resources most municipalities lacks required human labour thereby a

blow if its mission is to be accomplished. In Zimbabwe the government is also failing to fund for the endorsement of policies due to financial crisis looming the country for the past decade, hence it means that nothing is being done to curb challenges emanating from sewage management.

In Zimbabwe the Urban Councils Act (Chapter 29:15) does not fully embrace the rights of citizens to participate and it is therefore pertinent to note that review of the Acts has to be undertaken so as to include their views and contributions thus covering the current gaps affecting full community participation in solid waste management. World Bank (2005) also highlighted on poor cost recovery in Zimbabwe, as it reduces capacity of responsible institutions to increase service coverage and thus burdening only the local authorities and therefore a challenge in sewage management.

CHAPTER THREE: RESEARCH METHODOLGY

3.1 Research Design

The research used a case study approach to assess the challenges faced by the urban areas of Zimbabwe in sewage management. Chiwawa (1995) defined research design as a deliberately planed arrangement of condition for the collection and analysis of data in a manner that aims to combine relevance to the purpose of the study with economy procedure. In this study, the researcher collected data using both qualitative and quantitative research designs to obtain information ranging from general to specific challenges resulting from poor sewage management in urban area of Zimbabwe. The major merit for employing both qualitative and quantitative designs in this research is to enable a triangulation of research findings and ensure the dissemination of accurate results.

Qualitative approach was also employed during the research because it is descriptive in nature hence filling the gap where the quantitative approach cannot do justice. Thus a qualitative approach enables the researcher to document real events and record what people say through the use of questionnaires and interviews. The qualitative method helped to obtain in-depth information about the targeted population to facilitate the main data collection exercise. In addition, qualitative research design was used because of its ability to inquire, seek, and build a holistic largely narrative description to inform on the researchers understanding of a social, natural or cultural phenomenon (Yin 2003).

Quantitative methods have been chosen because they allows for the use of representative sample from chosen sites as well as providing very dependable and helpful information (Munochiweyi 2009). In this research quantitative technique was employed to in comparing and generalizing data obtained from the clusters chosen. Furthermore, quantitative technique was employed as it leads to the production of legitimate results which lacked bias.

In collecting information, the research asked for permission from MSU's Geography and Environmental Studies Department. A letter was issued to the researcher by the department which enabled the research to be done and people to provide information without fear or bias. Moreso, in the field the researcher made it clear that providing information was voluntary. This was done in order to deal with people willing to share with the researcher exactly what they have.

3.2 Target population

Gary (2011) defined a target population as any group of individuals that has one or more characteristics in common that are of interest to the researcher. The researcher targeted the local people or residence of Gweru urban, the City Engineer, Civil Engineer and lastly the councillors from the selected clusters.

The reason for targeting the local people is to get information of their experience of the challenges arising from poor management of sewer systems and the likely impacts. Local people were targeted as they will provide the researcher with information on general challenges faced at household level in sewage management. Moreso, Councillors will also help the researcher with information relating to residence awareness on the effects of improper sewage management as they are directly from the same community they represent.

The reason for targeting the Civil Engineer is because of his ability to provide knowledge of sewage system management. Civil Engineer has also the knowhow on the operations of pump stations and the maintenance of sewage reticulation system as his duties are to design water and sewage systems of the City. All reports on sewer blockages are reported to the Civil Engineer's office therefore, information on nature of obstacles as part of the office's feedbacks will be acquired from either the engineer himself or from feedback reports in his office.

In addition to that, the City Engineer was targeted because is the one responsible for coordination of municipality infrastructure and services. The information he or she can provide involves specifying, designing, constructing sewers, municipality solid waste management and disposal. The City Engineer will provides the researcher with the overall information like population size of Gweru, distribution of the population among its residential locations, status differences amongst the residential locations and nature of waste they are likely to get during their operations, like when there is a blockage or when sucking wastes from septic tanks. Thus the information on residence awareness and general challenges faced by the local authority in sewage management will be provided.

3.3 Sampling Size determination and selection of participants

According to Arsham (2005), sampling is a process whereby subjects or objects are chosen from a large population and it is crucial part needed in carrying out a research. Sampling was used in this research because it enables the researcher to select study elements or subsets that could represent the entire population in the area of study. Another merit of sampling is that, it is fast and less costly when collecting data. It also avoids bias to the researcher when selecting study elements. This method is very simple to use when carrying out a research and it makes the researcher to obtain more realistic, quantitative and qualitative results.

In this case the researcher used cluster sampling method to collect all required and useful information. Cluster sampling is a sampling technique used when natural grouping are evident in a statistical population or may be used when it is impossible or impractical to compile an exhaustive list of elements that make up the target population (Creswell, 2012). The researcher used Gweru urban as the study area which had a population of 146 073 distributed in 18 suburbs of the City composed of 12 642 households found in 8 wards (ZimStat, 2012).

The researcher opted to use cluster sampling method because the area under study is relatively big. Moreso, the researcher used cluster sampling technique because it is quick, cheap and easy and the researcher was operating using limited resources. The researcher used existing wards as groups or clusters to carry out the study. Multi stage sampling technique was employed. At first the researcher considered the fact that clusters should be made up of homogeneous entities and the 8 wards were further fragmented into two that is, a cluster made of wards composed of high density residential suburbs (ward 2, 5, 6 and7) and the other cluster made of low and medium residential suburbs (ward 1, 3, 4 and 8). Random sampling was then used in each cluster to pick a cluster from the group of clusters for sampling. Ward numbers were put in a box and a volunteer was asked to pick one from each box thus how ward 4 and 5 were picked for sampling.

To determine and distribute the sample, the researcher employed the multi-stage cluster sampling technique. To come up with the number of questionnaires to be distributed in each cluster the formula below was used:

Number of households per cluster÷ total population per study area×100

For example calculations for ward 5 are:

Number of households in Nehosho, Senga and Bluehills÷ Total households in Gweru urban×100 that is, 4603÷12 642×100=36

The same formula was also used for ward 4 and 24 questionnaires were a result. Thus a sample size of 60 households from both clusters was achieved. As the components forming up wards are made of residential suburbs of different sizes in terms of households, a proportional representation of questionnaire to be distributed in each residential location was calculated using the formula below:

Number of households in a location ÷ number of households in a cluster × number of questionnaires to be distributed in that cluster for example, number of households in Nehosho over number of households in ward 5 multiply by 36:

2040÷4603×36=15.9=16

The same was done in all locations in ward 5. The same procedures were done in ward 4 and the only difference being that 24 was used in ward 4 as it represents the sample size in that cluster. All the results from the calculations done in this section are presented in Table 3.1

Table 3.1: Distribution of questionnaires on the target segments

Cluster	**Components of cluster**	**Households**	**Number of questionnaires**	**Total per cluster**
Ward 5	Nehosho	2 040	16	36
	Senga	1 976	15	
	Blue Hills and others	587	5	
Ward 4	Ivene	1 008	8	24
	Lundi Park	1020	8	
	Southview	1 004	8	

In distributing the questionnaires, the researcher employed simple random sampling technique. This is one of the most common forms of probability sampling. Sampling is done until a specific number of units for various sub-populations have been selected.

Simple random sampling was conducted basing on population proportions as illustrated in Table 3.1. Simple random sampling can be considered preferable to other forms of probability sampling (e.g., systematic random sampling) because it forces the inclusion of members of different sub-populations from different households. In this regard the questionnaires were distributed during the weekend basing on the assumption that most of the people employed or not will be in most cases available at their homes and a bit free to attend to the questionnaires. Thus, simple random sampling was often used in this research, because it is relatively inexpensive and easy to administer and has the desirable property of satisfying population proportions. However, it disguises potentially significant bias.

As with all other probability sampling methods, in order to make inferences about the population, it was assumed that persons selected are similar to those not selected. Such strong assumptions are rarely valid. Therefore, the researcher opted to use simple random sampling when distributing questionnaires to avoid bias as households were selected using Microsoft excel.

3.4 Primary Data Sources

The methods used to collect data are questionnaires, interviews, and field observations.

3.4.1 The questionnaire

Creswell (2012) defined a questionnaire as a form prepared and distributed to secure responses to certain questions and also as a device for securing answers to questions using a form by which respondents fill by themselves. The household questionnaire is of paramount importance in this research because they yield more information over a short period of time. Questionnaire in this research are used to solicit information about both socio-economic and physical impacts of this phenomenon as well as positive steps which households are taking in order to mitigate the problems of this phenomenon. In this research a combination of both open and closed ended set of questions were used to probe household information. Closed questions were used to gain factual information since they are very quick, easy to fill in as well as minimizing discrimination against the less literate as they were self-administered. Open ended questions were used mainly to gather information like challenges faced by both households and local authorities in sewage management as some explanations were needed. The first section of the questionnaire was prepared to gather personal details or information of respondents to find out if there is any

relationship between their levels of education and the issues pertaining to major impacts resulting from improper sewage management.

Open ended questions were further used to gather a variety of fully explained information as they do not restrict the participants' answers and they gave respondents no control over what they wish to say and how they wished to express it. The open ended format was used in order to allow exploration of wide range of possible themes arising from poor management of sewage in Gweru urban. Open ended questions have higher chances of yielding useful data since the researcher gives no limitations in answering the questions which are simple and easy to understand in order to meet the objectives of the study.

The researcher distributed 36 questionnaires to selected household members of Gweru, ward 5, and 24 questionnaires were also distributed to ward 4 in order to maximize and obtain accurate and relevant information concerning people's perceptions about the major challenges faced by most of Zimbabwe's urban areas to deal with sewage problems, its impacts and coping strategies.

3.4.2 Interviews

An interview is a dialogue that is initiated by the interviewer for specific purposes of obtaining research information from the informant and it involves the asking of questions orally by the interviewer and recording of the respondents' answers (Chiwawa, 2005). The advantage of an interview is that all questions are fully clarified thereby obtaining relevant responses. The main task in interviewing is to understand the meaning of what the interviewees say. Interviews were used in this research as they allow the interviewer to pursue in-depth information around the topic. Due to limited time, semi-structured interviews with municipality of Gweru were done; the City Engineer and the Civil Engineer were interviewed by the researcher so as to acquire information regarding the major challenges faced by the municipality of Gweru in sewage management. The City Engineer' department is where interviews were done to help with direct information on challenges faced in sewage management as they are the chief leaders of the City or the watching eye in sewage management. Thus interviews were of paramount significance in this research as they helped the researcher to obtain more relevant information on challenges faced in sewage management from the experienced personnel in that field. Moreso, ward 5 and 4 councillors were also interviewed as the researcher seeks to acquire information they have which

they get from their areas of jurisdiction on challenges people are facing due to improper sewage disposal.

Semi-structured interviews were conducted in order to give interviewee room to express themselves freely, expand answers and also provide information they thought was important. The interviews were conducted face to face with the interviewee and during the interview, notes were taken and a bit of tape recording was done especially on most critical issues. The researcher set the questions to guide the interview and all key informants were notified and booked in advance to ensure convenience. During the research interviews, the researcher kept a guard against the interviewee digression form the specific area of study to areas of interest to them.

3.4.3 Observations

Observations refer to a situation whereby the eyes perceive people and their environment, situations, interactions or phenomena and record the findings as data (Yin, 2003). The researcher employed observations to provide ground truthing and as a way to gather extensive information from direct and complex interaction with the study area. During the time the researcher was in the field, observations made include opened up man holes some almost field with mud, some were appearing to be dumping site of household garbage as remains of food stuffs, used condoms, diapers to mention a few were seen. In addition to that, the researcher also observed dry tapes a sign of water shortages which in turn affects or further challenges faced in sewage management. This is because for sewer system to function, water is the primary requisite. All what was observed saved as evidence or supplement on information relating to nature of obstacles found when a blockage is reported and some of the challenges faced in sewage management arising from people' unawareness of the effects of improper sewage disposal.

3.5: Secondary Data

Secondary data is defined as the extraction of information/data from the current or historical records (Arsham, 2005). The researcher undertakes a desk top study to familiarize others sources. In this regard the researcher confined himself with information from the progress reports obtained from the City council of Gweru. Only reports on sewage management, reported sewage blockages and services offered where used to provide or equip the researcher with baseline literature on challenges faced by the council of Gweru in sewage management.

3.6 Data analysis and presentation

By the end of data collection procedure, the researcher organised all the data which was obtained from the questionnaires, interviews, and direct observations and this was done through the collection of relevant information from the research instruments used. Questionnaire and interview responses were well arranged using Statistical Package for Social Scientist software (SPSS) and analysed to get information on the extent to which poor management of sewage impact both the environment and human health. Further analysis was made in order to come up with the nature of challenges faced and the ways that can be employed to reduce it at local levels. The researcher reorganized data gathered through interviews and analysed by grouping it into themes which are comments, complains and recommendations. Direct observations were complimented by the researcher from notes taken down during observations and these were analysed in the form of descriptions. Data cleaning was done manually.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Background information of respondents

Of the people from two wards who responded to the questionnaire, from ward four the percentage was 50% for both gender. Ward 4 constitutes of medium and low density residential suburbs where most of the population irregardeless of gender is involved in formal occupation. In ward five, 66.7% were females and only 33.3% were males. Ward 5 is composed of low income residential suburbs where most women appeared to be home keepers compared to ward 4. Therefore, from the study area or sample size, the responses revealed that females were the dominant respondents. Thus, evidence that women are still lagging behind in terms of formal jobs which may help to keep them away from home and stop blamed as sole contributors in sewage blockages. The average age or greater percentage of respondents appears to be in the range of 18-30years which had been in their respective wards for less than 10 years. This age contains more of economically active age which shows that most of the people are not employed as shown in Table 4.1

Table 4.1 Age of respondents in the wards

Age range of respondents	Ward 4		Ward 5	
	Frequency	%	frequency	%
18-30	10	41.7	17	44.7
31-40	6	25	8	21.7
41-50	1	4.2	4	10.5
51-60	6	25	7	18.4
61^{+}	1	4.2	-	-
Total	**24**	**100**	**36**	**100**

Most of the people in the two clusters which were sampled, nearly all of the respondents showed that they had at some point have access to school which made the research a bit easier because most of the respondents were able to read and write and even understand most of the questions. Table 4.2 shows that all respondents who were sampled were educated, thus 100% education.

The level of education the respondents showed helped the researcher to obtain useful information as it was provided by the people who were a bit understanding of the trends happening within their vicinity. Both quantitative and qualitative data on challenges faced in sewage management where provided from interviews which shows high percentage of literacy amongst the respondents.

Table 4.2 Level of education of respondents

Education level of respondents	Ward 4		Ward 5	
	Frequency	%	frequency	%
Primary	3	12.5	6	15.8
Secondary	14	58.3	15	39.5
Tertiary	7	29.2	15	39.5
None	-	-	-	-
Total	**24**	**100**	**36**	**100**

4.1 Nature of waste obstacles responsible for sewer system blockages

Varying amounts of wastes generated in ward 4 and 5 at household level depending on socio-economic factors such as household size, income levels, and most importantly the season of the year. Almost 90% of the obstacle responsible for sewage blockages within the two wards are the same but what differs are the frequency of blockages reported for each ward. Statistics from interviews revealed that in the month of September only 10 blockages were reported in ward 5 and only 2 in ward 4. The differences in frequency of blockages vary due to a number of reasons such as water woes in ward 5 compared to ever flowing water in ward 4. Frequency is also determined by social status thus ward 4 constitute low to medium densities and service provision favours them first unlike ward 5 made of low income or high density suburbs. More so, ward 4's Lundi Park had septic tanks which are constantly emptied and also help in reducing frequencies of sewer blockages. In addition to that, data gathered from questionnaires also revealed that on average in ward 5 sewage blockages are reported to be twice a week. This is because of increased population, absence of incinerators which left women with no option other than

dumping sanitary pads, pampers and diapers in the sewer system. In ward 4 the frequency of blockages are said to be very rare (37.5% of the respondents says so). From the questionnaires administered to the local people and the interviews with the key informants, it was established that there are a number of obstacles responsible for sewer system blockages. Apart from obstacles, other causes were also highlighted like water shortages which appeared to be of paramount significance in sewer blockages in most high density residential areas.

Deadly obstacles were listed by the local people as key or widely seen where ever a blockage is reported. These include sanitary pads, newspapers, diapers, naps, mops, pampers, toys and plastics (model toy cars, bicycles, plastic papers), kitchen utensils (spoons, cups, leads, knives) and of recent used condoms both male and female condoms as illustrated in table 4.3. Such findings tally with studies carried by Yap (999) where the results pointed out that household wastes are largely to blame for sewage blockages mainly experienced in Asia. According to Hoornweg and Thomas (1999), agricultural wastes are a major contributor in sewage blockages in East Asia and due to increase in urban agriculture in most Cities and towns in Zimbabwe, Gweru in particular, agricultural residues are also rising as a problem in Gweru as residents are replacing tissues with agricultural residues (maguri) and flash them down the system.

Table 4.3 Nature of obstacles

Nature of obstacles	Ward 4		Ward 5		Total	
	Frequency	%	frequency	%	Frequency	%
Sanitary pads	7	29.2	7	19.4	14	23.3
Condoms	5	20.8	9	25.0	14	23.3
Newspaper	2	8.3	4	11.1	6	10.0
Shoes	-	-	1	2.8	1	1.7
Braids	1	4.2	1	2.8	2	3.3
Pampers	2	8.3	4	11.1	6	10.0
Kitchen utensils	3	12.5	2	5.6	5	8.3
Toys	1	4.2	-	-	1	1.7
Sand	-	-	1	2.8	1	1.7
Agricultural remains	-	-	2	5.6	2	3.3
Dumped babies	1	4.2	-	-	1	1.7
Mops, Naps (pieces of clothes)	1	4.2	3	8.3	4	6.7
Tree roots	1	4.2	2	5.6	3	5.0
Total	**24**	**100**	**36**	**100**	**60**	**100**

4.1.1 Sanitary pads

From Table 4.3, used condoms and sanitary pads appeared to be the major causes of sewage blockages in either ward or cluster. Sanitary pads constitute a greater percentage because women are in most cases found at home especially in ward 5. Findings from the questionnaires and interviews confirmed that, women otherwise due to lack of education on proper waste

management they developed a tendency of flashing down sanitary pads, pampers, pieces of clothes (zvikorobho) in the system. Such wastes had risen complains from the people and the responsible authorities as they are appearing a norm in blockages.

Some of the reasons which were raised that leads to such practices of flashing down things which are even noted that 'not to be flashed' includes ignorance by the local people. During the study and through interaction with people the researcher also noted ignorance as a major factor in waste management as some people even noted that, 'we pay rates so council should accept everything and attend to it'. Such views actually shows that most of the blockages attended to are facilitated by the locals willingly and knowing.

As 58.7% of the respondents were women because most of them are not employed and spend much of their time at home taking care of children, kitchen utensils and toys became another factor in sewer blockages. One respondent from ward five noted that, she flashed down a toy when dumping water she had used to bath her baby mistakenly. Of interest, almost 41.1% of the total sample size admitted that they also contribute to sewage blockages sometimes directly or indirectly. An average of 58% of the population sampled denied being involved in causing sewage blockages. Of the 41.1% respondents who highlighted that they also contribute in sewage blockages suggested that, in a move to reduce such blockages in future people should be taught to reduce high levels of ignorance and also population densities especially in ward 5 should be controlled.

4.1.2 Condoms

Used condoms were also mentioned as major or vibrant upcoming cause of sewer system blockages. Estimates from interviews suggests that, if used condoms found in ward 5 were to be distributed each family member will get at least two condoms through the entire ward. This shows no doubts that condoms are greatly used which is okay but people needs to be educated on the effects they have when flashed down the sewer system. Residents in ward 5 mentioned that sewer blockages are a norm in their locality as the frequencies of blockages are as high as 4 times a month, twice a week and some noted as perennial blockages especially in Senga and Nehosho. Of all the blockages reported, the major sources of such obstacles are those from

households, leisure centres and institutions. But it was mentioned that household wastes constituted more than 70%, therefore key in most blockages encountered in the ward.

4.1.3 Population

Population increase as revealed from data collected from questionnaires and interviews appeared to be another reason why sewer bursts and blockages are increasing daily. This is so because population increase turn to increase pressure on existing and ill functioning sewer system and resulted in overloading the system and finally blocks the system and burst the outcome. Of recent a house that should accommodate a six member household is servicing between 20-30 members. From such estimates especially in ward 5, managing sewage became a problem.

4.1.4 Orchards

Also mentioned are tree roots from backyard orchards. Tree roots sometimes found their way into the system when they penetrate through system joins and develop and grow within the system. Wastes running down the system will then start to accumulate on such roots; such continuous accumulation will result in blocking the system and facilitates bursts. Moreso, roots from orchards tend to cause sewer system tilt and were it is tilted or burnt a reduced flow is experienced and wastes will start to accumulate from there and block the system and resultantly burst.

4.1.5 Water shortages

Water shortage was also raised as a major cause of sewer system blockage. Residents from both wards were not happy when we were discussing on water as they mentioned that they sometimes go for a week without water. Findings from interviews suggests that insufficient water supply will cause wastes in sewer systems to solidify which will make it difficult to flash everything when water comes. That means, wastes will start to accumulate at the bottom of the system from solidifying wastes and resultantly blocks the system.

4.1.6 Old sewer system

Apart from obstacles, sewer systems in Gweru's old locations like Senga among others are too old. On average 20% of the respondents especially in ward 5 revealed that old systems are no longer able to sustain volumes of wastes which are increasing on daily basis and they sometimes

leak due to age and contaminate the environment. Volumes of wastes generated will exert pressure on such aged system which will result in sewer bursts.

4.2 Residence awareness of effects of improper sewage management

The major reason why most of the people get threatened from sewage related diseases is because of lack of education on sewage management. Out of a sample size of 60 households which constituted this research findings revealed that 84. 6% of the residents are not taught on sewage management and proper ways of disposing wastes. Therefore lack of education had been a major blow in sewage management as people turn to dump and flash down wastes without knowledge of what will happen and who will be at risk. Of the 15.4% of the people who said they at other points attended meetings on sewage management were doubting the frequencies of such trainings where they said are done once a year on average. From such complaints one may easily agree with the 94.7% of the respondents who alluded that sewage management is a necessity if a health generation is to be set and a scene environment is to be achieved. Table 4.4 shows reasons why education on sewage management is necessary.

Questionnaires answered by the local people indicated that 91.7% of the effects of improper sewage management directly affect human health and 8.3% are environmentally linked. Answers from both questionnaires and interviews shows that, people within the locality where improper sewage management is practised are at great risk than others from sewage related diseases such as cholera, diarrhoea, dysentery and other respiratory diseases. According to EPA (2012), sewage management should be extensively done so as to reduce the rate at which people get illnesses related to improper sewage management and this actually correlates with the findings of this paper which suggests that for a scene environment to be achieved sewage and wastes must be properly managed.

Conflicting information between questionnaires and interviews arise when interviews revealed that training and awareness campaigns are done. Training and awareness campaigns were said to done as evidenced by the presents of anti-litter committees in every ward. Moreso, ward meetings are being held timely and on those meetings residents will be taught on sewage management and related outcomes from improper sewage management. So on frequency awareness campaigns and clean up campaigns are said to be a continuous process.

However, through discussions and field observations where the researcher identified litter almost everywhere tends to doubt on whether clean up campaigns are done or not. Some respondents highlighted that, meetings are done but not on sewage management and proper waste disposal but most of them are political meetings. Thus, the attendance is generally low.

Although no proper education is done on sewage management, residents sampled shows that they are aware of the effects of improper waste management but the problem is of no choice and need to maintain privacy especially the teenage. In this respect people tend to flash down used condoms and sanitary pads because they actually shy. More so, in all of the residential suburbs there are no incinerators to burn the waste thereby people simple flash them down the sewer system. However, there is great need to provide education to the residents as education will help to equip people with relevant knowledge and to help in reducing some of the impacts resulting from improper sewage management as shown in Table 4.4

Table 4.4 Is education a necessity in sewage management

Reasons	Frequency		Percent	
	Ward 4	Ward 5	Ward 4	Ward 5
maintain a healthy environment	10	12	41.7	31.6
reduces sewer bursts	12	23	50.0	60.5
not necessary	2	1	8.3	2.6

Table 4.4 shows that, with education provision a health environment that is human friendly may be achieved and sewer bursts maybe reduced. With reduced sewer overflow due to reduced bursts, disease outbreak such as cholera and respiratory diseases may be reduced as well.

4.3 General challenges faced in sewage management

4.3.1Challenges faced at individual households

The major challenges that the local people indicated that they encountered in sewage management are lack of education on proper sewage management, financial problems and shortage of bins. To start with lack of education, 63.7% of the respondents indicated that due to

lack of education they embarked in waste burning and resultantly EMA sued them because of pollution they caused. Due to such results people became stuck and started to dump wastes during the night everywhere and even in opened manholes. Because of lack of education people were justifying such practices by arguing that 'we pay rates so council should attend to that'. Thus residents should be taught that even when a blockage is reported and council attended, the consequences are mostly felt within the locality were improper sewage management is done. Therefore, education on sewage management is a necessity if challenges faced in sewage management are to be eradicated. Besides lack of education, most people as was observed during the research practises improper waste management in a bid to maintain privacy as most of the especially young ladies even shy to say information on sanitary pads and used condoms.

Almost 90% of the local people pointed out that the major problem they face is critical shortage of capital. According to Tevera (1995), most wastes responsible for sewage blockages are household wastes and the problem faced in sewage management is poverty, thus the same with the findings of this paper. This research confirmed that, even if the residents know exactly what should be done, they cannot put that into practice due to financial constraints. Respondents outlined that as long as you want to practise proper waste management and disposal money will limit. This was seconded by what was observed during the research as most of the households had one to no bins at all and the problem was lack of capital to purchase bins hence people dumped wastes everywhere outside their yards. Proper wastes disposal include wastes grouping and wastes grouped needs to be contained in different bins for collection and most of the residents especially in ward 5 were the average age ranges from 18-30 years who are not employed. Thus one can allude that for challenges they face in sewage management and to reduce health effects of improper waste management a lot has to be done.

4.3.2 Challenges faced by the local authority

Information obtained from interviews shows that there are a number of challenges the municipality of Gweru is facing in sewage management. Such problems include shortage of capital, shortage of transport, behaviour of residents and shortage of man power.

To start with shortage of capital, Zimbabwe had been hit by the financial crisis for the past decade which tends to affect almost every sector in the country. Municipalities were also hardly hit by such financial crisis as residents were no longer able to pay their rates and that left the

council at negative balance which affected almost all operations carried by the council or local authority. Even share from the national budget for council operations were reduced and that adds problems to the already shacking councils across the country.

Due to financial crisis, municipalities failed to continue offering same service they used to offer especially in collecting wastes as transport replacement and servicing declined. As of now only two trucks ferry wastes from 18 residential location in Gweru urban which makes it difficult for the council to provide the need service within the City in time.

The other problem faced by the council of Gweru is linked to resident's behaviour for example residents are vandalising manholes. Most manholes are opened up when residents stole cast iron which covers manholes to sell to companies which buy scrap metal. Opened up manholes will be left prone to dumping and sometimes receive all materials eroded during a storm. More so, people personalise manholes if in their stands which makes it difficult for the local authority to carry out its operation properly when a blockage is reported.

The other challenge faced by the City of Gweru is linked to population increase in the City. The rate at which population is increasing outweighs the rate of development within the City. Thus upgrading of reticulation system is also outweighed or plays a second fiddle after housing. According to World Bank (1999), population increase leads to increase in waste generation but the first priority will be given to issue of accommodation and waste management looked at later. This phenomenon applies or suits the major outcome of this research because when council is busy identifying land to accommodate people amount of wastes will be increasing in volume and become difficult to manage.

4.3.3 Mitigation measures on general challenges

4.3.3.1 Household level

Almost 78.3% of the residents in the two wards noted out that, in reducing the volumes of wastes they compost all decomposing wastes they generate. Composting reduced outside yards waste dumping by almost 49%. Outside yards dumping of waste played a crucial role in causing sewage blockages especially during the rainy season where all garbage will be eroded and some of the garbage will find their way into the sewer system through entry points like opened manholes. Thus, resulting in blockage of the sewage network. So compositing proved to be a

mitigatory measure of paramount significance in reducing pressure on sewer system which may lead to blocking of the system. Burning was also used but is proving or resulted in causing other problems like pollution so EMA campaigned to boot out burning by imposing fines.

4.3.3.2 Local authority

The local should team up with the residents and organise monitoring teams in every residential suburb so as to reduce the rate at which wastes are dumped improperly. More so, the local authority should increase service delivery through collecting wastes on-time before people resort in outside yards dumping and provide adequate bins to the residents.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Sewage management remains a problem especially in developing countries as their local authorities are failing to provide required services like bins, constant water supply and even transport to ferry wastes. Findings from the research study states that, the major causes of sewage blockages in ward 4 and 5 are largely household wastes which include pampers, sanitary pads and used condoms. Varying amounts of wastes generated in ward 4 and 5 at household level depending on socio-economic factors such as household size, income levels, and most importantly the season of the year. Differences in waste volumes generated per ward gives a difference in frequencies of blockages encountered per ward. Plastic bags are the storage method used by the residents before the waste is disposed or collected for disposal by the local authority.

Other causes on sewage blockages are resulting from home yards orchards because people are planting trees on top of sewer lines which either tilt the system or insert tree roots through the joints and as they develop and grows within the sewer pipes the cause leaking and ultimately blocks the system.

A close investigation on the effectiveness of local people's participation in solid waste management revealed that community participation is slightly effective in activities supported by EMA and Local Authority such as clean up campaigns, composting, waste collection, recycling and to a lesser extent educational awareness. Improvements in environmental cleanliness were noticeable in ward 4 than in ward 5 at household and community level. Currently, decomposing wastes are being composted and not to put them for collection by the council. This has drastically reduced the number of illegal dumps and quantity of solid waste generated in the residential area. However, full support from various organisations such as the private sector and local authority is paramount in enhancing full community participation since the merging of these three was acknowledged by the majority as a sustainable waste management option in solid waste management. In this regard, community involvement was appreciated as a realistic tool in solid waste management. However sewage management still remains a force to rethink of as shown by the findings of this study.

5.2 Recommendations

- The Local Authority and NGOs should assist residents to establish more community health committees and community monitoring team that will be involved in sanitation and hygiene programmes aimed at improving cleanliness in their localities and arrange with private sector to support them.

- The local people should adopt the 4Rs that is Reduce, Reuse, Recycle and Recover approaches that will help them to reduce the amount of solid waste generated as well as reducing collection and disposal costs to the local authority. The local authority and other stakeholders must give full support to make sure that such initiatives are a success.

- Gweru City council should practise excessive monitoring in the entire City so as to get information especially on emerging dump sites within residential locations and take action.

- Local Authority should embark on intensive environmental education and waste management so as to empower residents with reliable data on effects of improper waste disposal and general challenges they have on their livelihoods.

- The local authority and the community should come together and establish central waste collection points in the residential areas. Central collection points will be cheaper than the curb side collection strategy currently used which is expensive. The communities should in return be given a token of appreciation by the local authority for their service.

- Gweru City council should replace all old systems especially in Senga (ward 5) so as to tally with increasing population demands. Systems in ward 5 were set during the colonial era only to cater for few blacks in the City and up to now nothing had been done to improve such old systems.

- Water shortages must be improved through installation of more pumps so as to reduce water problems faced in the City.
- Increase the use of septic tanks especially in medium and low density suburbs to ease the pressure on existing sewer systems and make sure that they will empty septic tanks on time before they became a menace to the locals.
- Council should increase frequency of waste collection from once a week in every residential location to at least two or three times a week so as to meet residents' waste production exercise which are due to population increase.

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APPENDICES

Appendices 3.1 Questionnaire for local communities

Dear Respondent

My name is **Kwakukai Kelvin,** a final year **B.Sc. Honors Geography and Environmental studies** student at Midlands State University. This questionnaire is part of the research that assesses "The challenges associated with sewage management in urban areas of Zimbabwe with special attention given to Gweru urban". Your response to this study will be kept confidential and your contribution will be used for academic purposes only. No name or any form of identification is required on this form.

Do you consent to participate in this research? Yes ☐ No ☐

Gender: Male……. Female …….

1. Age of responded

18-30yrs	31-40yrs	41-50	51-60	61+

2. Period stayed in the ward

<5yrs	6-10yrs	11-15yrs	16-20yrs	21+

3. Household size

1-3	4-6	7-9	10+

4. Education level

Primary	Secondary	Tertiary	None

Section B: To identify nature of wastes or obstacles found in sewer systems

1. How often do you witness sewer blockages in this area? ……..

   ……

   ……

   ……....

2. Do you see yourself as a contributor to that? Yes ☐ No ☐

3. What do you think should be done to avoid that in future? …….

   ……

   ……

   ……....

4. What is the nature of waste or obstacles responsible for sewage blockages?

   ……

   ……

   ……

5. Is there any relationship between population and the sewer system?

   Yes ☐ No ☐

6. If yes what type of relationship ……

   ……

   ……

7. What are the sources of these obstacles? ……

8. Other than obstacles what else do you think is responsible for sewer bursts?
   ……
   ……
   ……

To assess residence awareness on the effects of improper sewage management

1. What do you think are the effects of improper sweage management?
   ……
   ……
   ……
2. Are you taught on sewage management?

   Yes ☐ No ☐

3. If yes list the organizations which provides the education?
   ……
   ……
   ……
   …
4. How often is the training done?
   ……
   ……
5. Is it necessary to be educated on sewage management?
   Yes ☐ No ☐

6. Explain your response
   ……
   ……
   ……

To analyse general challenges faced in sewage management

1. What are the challenges faced in sewage management
   a) At individual household?.....

      ……

      ……

      ……

   b) By the local authority?

      .....

      .....

      .....

2. What do you think has to be done to mitigate challenges faced in sewage management?
   a) At individual households

      ……

      ……..

   b) By the local authority

      ……

      ……

      ……

Appendices 3.2 Interview guide for the councillors

Dear Respondent

My name is **Kwakukai Kelvin,** a final year **B.Sc. Honors Geography and Environmental studies** student at Midlands State University. This questionnaire is part of the research that assesses "The challenges associated with sewage management in urban areas of Zimbabwe with special attention given to Gweru urban". Your response to this study will be kept confidential and your contribution will be used for academic purposes only. No name or any form of identification is required on this form.

Section A

How long had you been staying within the community?

For how many terms had you been a councillor?

Section B

To identify nature of wastes or obstacles found in sewer systems

1. Had you at any point attended to sewer burst pipe?
2. What was actually identified as the major cause of blockage?

To assess residence awareness on the effects of improper sewage management

1. Are awareness campaigns done in your area or do you conduct awareness campaigns in your area?
2. How often are they done?
3. Do the residence or locals attend meetings on sewage managemet?

To analyse the general challenges faced in sewage management

1. What are the challenges faced by individual households and local authorities in sewage management?

Appendices 3.3 Interview guide for Gweru City Engineer

Dear Respondent

My name is **Kwakukai Kelvin,** a final year **B.Sc. Honors Geography and Environmental studies** student at Midlands State University. This questionnaire is part of the research that assesses "The challenges associated with sewage management in urban areas of Zimbabwe with special attention given to Gweru urban". Your response to this study will be kept confidential and your contribution will be used for academic purposes only. No name or any form of identification is required on this form.

Section A

For how many terms or years had u been in this office?

Section B

To identify nature of wastes or obstacles found in sewer systems

1. What are the prominent sewer line blockers?
2. Are the nature of obstacle found blocking the same in high density and low density?

To assess residence awareness on the effects of improper sewage management

1. Does your schedule accommodate awareness campaigns on sewage management?
2. If no why
3. If yes how often are they conducted?

To analyse the general challenges faced in sewage management

1. As a department, do you face any challenges in sewage management?
2. Are they internal or external problems?

Appendices 3.4 Interview guide for the Civil Engineer of the municipality of Gweru

Dear Respondent

My name is **Kwakukai Kelvin,** a final year **B.Sc. Honors Geography and Environmental studies** student at Midlands State University. This questionnaire is part of the research that assesses "The challenges associated with sewage management in urban areas of Zimbabwe with special attention given to Gweru urban". Your response to this study will be kept confidential and your contribution will be used for academic purposes only. No name or any form of identification is required on this form.

Section A

For how long had you been working in sewage department of the municipality of Gweru?

Section B

To identify nature of wastes or obstacles found in sewer systems

1. What type of waste are normally found when a blockage is reported?
2. Are types of wastes found blocking the sewer lines the same amoungst high density, medium and low density residential suburbs?

To assess residence awareness on the effects of improper sewage management

1. Do you conduct awareness campaigns on sewage management?
2. How often do campaigns held and what the rate of people' participation?

To analyse the general challenges faced in sewage management

1. As a department what are the major challenges you face in sewage management?