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Evaluation of water and sanitation challenges in informal settlements: A case study of Duncan Village, East London, South Africa

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Together in Excellence

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DECLARATION

I, Khodani Keith Munyai, declare that the work contained in this dissertation is my own original work and has not previously been submitted at any university for the master's or other degree purpose. I also declare that all the sources that I used or quoted have been indicated and duly acknowledged by means of complete references.

Signature



Date: 15 March 2023

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DEDICATIONS

This is dedicated to all those who have supported me throughout my academic years, special dedications to GOD for being there when I needed him the most, my late supportive grandfather Fhedzisani Rueben Munyai, my late aunt Avhurengwi Kate Munyai, my late uncle Shumani Waltor Munyai, my grandmother Tendani Ethel Munyai, my wife Mulamuleli Tshanduko Munyai, my daughter Tshedza Arenalufuno Munyai and my dearest mother Shonisani Irene Munyai for giving me invaluable support.



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I would be failing if I were to forget the Buffalo City Metro Municipality officials for assisting with inputs and Duncan Village informal settlements ward-based maps, the ward councillors and the residents of Duncan Village for giving inputs on the questionnaire and for their time, patience and cooperation during data collection.

ABSTRACT

Water and sanitation are basic human needs. It is also a constitutional right for all citizens in South Africa to have access to both water and sanitation. Supply of water and sanitation services in South Africa is characterised by both achievements and challenges. As informed by literature, in South Africa it is evident that water and sanitation still hold many challenges in poor communities, particularly in informal settlements. This study was conducted with the purpose of evaluating water and sanitation challenges in the informal settlements of Duncan Village and make recommendations, where applicable, to the local municipality for possible remedies. Despite the provision of water and sanitation by the Buffalo City Metro Municipality, the study reveals that there are serious water and sanitation challenges in Duncan Village. High water losses, illegal water connections, illegal sanitation connections causing sewer spillages, vandalism of both water and sanitation service infrastructure, and lack of operations and maintenance are identified as the key water and sanitation challenges. According to the findings, the causes of these challenges include the municipality's lack of proper planning for informal settlements; lack of visibility of municipal water and sanitation officials in informal settlements; lack of awareness; lack of public participation; overpopulation; lack of monitoring; and lack of operations and maintenance budget to help keep the provided facilities intact and usable. The study's key recommendations include intense involvement of the municipality and the ward councillors, ownership by the residents, monitoring of water and sanitation facilities, operations and maintenance, and formalising Duncan Village informal settlements. This was accomplished using questionnaires to gather, analyse, and interpret the collected data. The study targeted residents, ward councillors, and a municipal officer from the municipality's Water and Sanitation section as respondents.

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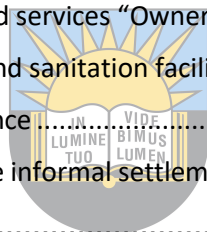
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Chapter 1: Introduction and background of the study

1.1. Introduction

Water and sanitation are basic human needs, and it is a constitutional right for all citizens in South Africa to have access to both (SAHRC, 2018). According to Acharya (2017), access to safe drinking water and improved sanitation service delivery are vital for family well-being and play an important role in maintaining health and sustaining life. In 2001, a national census report indicated that 5 million (11%) people in South Africa had no access to safe water supply and 18.1 million (41%) did not have adequate sanitation services (DWAf, 2003). With all the constructive efforts and policies implemented by the South African government to address these problems (such as the *White Paper on Water Supply and Sanitation Policy* of 1994, *White paper on National Water Policy* of 1997, *National Water Act* of 1998, *White Paper on Basic Household Sanitation* of 2001, and *National Sanitation Policy* of 2016 amongst others), challenges on water and sanitation persists (DGCIS, 2021).

While water and sanitation challenges are a huge problem in South Africa and in other countries around the world, Angoua et al. (2018) point out that it is the people who live in extreme poverty such as informal settlements who are commonly most acutely affected by lack of proper access to municipal services (see also Duff & Fryer, 2004; Muzondi, 2014; DWS, 2016). Usually, these are people from rural areas who often move to cities in search of better lives, which lead increasingly to the creation of unplanned and informal settlements where water and sanitation challenges remain (DWS, 2016). The complex nature of planning and societal issues in the informal

settlements around the world makes the provision of improved sanitation facilities more difficult than providing water services (Daudey, 2018).

1.2. Research background

Supply of water and sanitation services in South Africa is characterised by both achievements and challenges (Muzondi, 2014). After the apartheid era (since 1994), South Africa as a liberated country implemented the 1996 Constitution and other policies in an effort to tackle service delivery backlogs, including water and sanitation (Muzondi, 2014). Section 27 (1) (b) of the Constitution of the Republic of South Africa directs that all people have the right to have access to sufficient water (RSA, 1996). Under Section 27 (2) it further orders that “The state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of each of these rights” (RSA, 1996: 11). Section 152 (1) (b) extends this by stating that it is the mandate of the local authority to ensure that the provision of services to communities is done in a sustainable manner (RSA, 1996). The purpose of this obligation is to guarantee effective management with regard to the provision of basic services such as basic water supply and basic sanitation services, particularly in poor communities.

As directed by the constitution, the South African government must ensure that people have access to water and sanitation. Section 10 of Act No. 108 of 1996, which is the Constitution of the Republic of South Africa, states that every person has an inherent dignity and the right to have their dignity respected and protected. Section 24(a) also provides the right for everyone to an environment that is not harmful to their health

and well-being (RSA, 1996). Furthermore, the Water Services Act 108 of 1997 indicates that everyone has a right of access to basic water supply and sanitation and that every water service authority must in its Water Services Development Plan (WSDP) provide measures to realise these rights (RSA, 1997).

In ensuring that poor communities are not ignored due to the inability to pay for services, the South African government adopted a policy for free basic services in 2001 (DWAF, 2008). The right to access to a basic level of water and sanitation services is enriched in the Constitution of the Republic of South Africa Act 108 of 1996, and municipalities have an obligation to ensure that poor households are not denied access to basic services due to their inability to pay (RSA, 1996; DWAF, 2008).



South Africa with all its past managed to deal with services backlog more than most developing countries (DWAF, 2003). At the dawn of democracy (in 1994) there were an estimated 12 million people without adequate water supply services and nearly 21 million people without adequate sanitation services. Nonetheless, nine years later South Africa managed to deal with the inequality challenges and services backlog where it was estimated that more than nine million people had been provided with basic water supplies by 2003 (DWAF, 2003). More recently, a General Household Survey showed that 89% of households in South Africa had access to a municipal water pipe and 83% had access to improved sanitation (StatsSA, 2019). South Africa has thus made significant progress in realising the universal right to access a basic water supply facility, as defined in the Strategic Framework for Water Services (2003). However, great challenges remain. To date, inequality in access to basic services is

still a stark reality and progress with proper provision of water and sanitation has been much slower, especially in poor communities (Maeko, 2020; Charles, 2021).

Although government initiatives to implement policies and strategies around the provision of water and sanitation are in place, municipalities still do not have capacity to ensure smooth operations and effective maintenance to improve service delivery in informal settlements. A large number of people continue to use communal standpipes and it is also clear that by now the use of natural water sources for accessing water and the bucket system for sanitation should have been completely eliminated (SAHRC, 2018). A National Water Policy Review (NWPR) report indicated that “providing free basic water service to all South Africa places a burden on the state and on the WSA’s, especially where individuals can afford these services” (DWS, undated: 20). According to Hutchings et al. (2018) informal settlements are often not recognized by the policies or municipal authorities because of the land tenure issue and the dwelling arrangements. UN-Habitat (2015) gave emphasis to this by indicating that many governments refuse to acknowledge the existence of informal settlements.

Water and sanitation challenges are a general issue in townships and in informal settlements as has been indicated by WHO and UNICEF reports and other sources (Mwanza, 2001; Bartlett, 2003; Lagardien and Cousins, 2004; Dagdeviren and Robertson, 2009; Mnisi, 2011; Tsinda et al., 2013; Shamsu-Deen, 2013; Muzondi, 2014; Makaudze and Gelles, 2015; Obeta and Nwankwo, 2015; World Bank, 2015; Angoua et al., 2018; Acey et al., 2019; Weststratea et al., 2019; Winter et al., 2019; Lebek and Kruger, 2021; Seethal et al., 2021). The study area, Duncan Village is not an exception to these challenges. Although it was established as a formal township,

currently it has no clear divisions between the formal and informal parts since most informal households are planted on the open spaces within formal houses. For that reason, it has proven to be problematic for the local authority Buffalo City Metro Municipality to provide and maintain water and sanitation services delivery in the informal settlements of Duncan Village (Isaac, 2021).

1.3. Statement of the problem

It is evident as informed by literature that in South Africa water and sanitation still holds many challenges in poor communities. Similar studies have been carried out on this subject locally and internationally (Mwanza, 2001; Bartlett, 2003; Lagardien and Cousins, 2004; Dagdeviren and Robertson, 2009; Mnisi, 2011; Tsinda et al., 2013; Shamsu-Deen, 2013; Muzondi, 2014; Makaudze and Gelles, 2015; Obeta and Nwankwo, 2015; Angoua et al., 2018; Acey et al., 2019; UN, 2019; Weststratea et al., 2019; Winter et al., 2019; Lebek and Kruger, 2021; Seethal et al., 2021). However, in most of the studies, focus was on the lack of provision of water and sanitation. In this study the researcher seeks to investigate the overall challenges associated with water and sanitation in informal settlements, identify the causes, discuss the causes and consequences of water and sanitation challenges in Duncan Village, and recommend the best possible solutions to the local authority.

Duncan Village is serviced by the Buffalo City Metro Municipality (BCMM) and as directed by the constitution of the Republic of South Africa Act 108 of 1996 and the Water Service Act 108 of 1997, BCMM is mandated to ensure that everyone in Duncan village has access to portable water supply and sanitation services. Presently, BCMM

is committed to providing services to Duncan Village and its informal settlements including portable water and sanitation. Informal settlements are provided with water and sanitation through standpipes and communal ablution facilities to ensure equitable access to portable water and sanitation services. Nonetheless, due to the day-to-day influx of people in the area, the municipality has proven to be struggling to cope with the overpopulation as well as maintaining the standard of the service. As a result, portable water and sanitation services continue to be inadequate (Mbi, 2015; Isaac, 2021). WHO (2022a) defines inadequate portable water and sanitation services as services that lacks improved facilities. According to WHO (2022b), improved portable water facilities are defined as facilities that are protected from outside contamination, not shared, and not more than 30 minutes from the collection point. Improved sanitation facilities on the other hand are defined as facilities that hygienically separate human waste from human contact, not shared, and not more than 30 minutes for a round trip (WHO, 2022b). Mbi (2015) reported that the population of Duncan Village informal settlements is large, and residents have to share taps and toilets erected in different areas that are difficult to access. Isaac (2021) stated that the BCMM spokesperson said the main problem was high population density and congestion which put pressure on the provided infrastructure.

Due to inadequacy of water and sanitation facilities, other residents find themselves being physically far from the provided services. As a result, residents resort to illegal connections from municipal water pipelines to their households, while on the sanitation side others resorting to using a bucket system. Other residents resort to collecting water from the nearby streams or rivers, while on the sanitation side others resorting to practicing open defaecation at nearby bushes or veld (Mbi, 2015).

Apart from the issues mentioned above, Duncan Village informal settlements also experience water and sanitation challenges such as vandalism, theft, lack of awareness which leads to unhygienic practices and sewage blockages, and other social ills which makes the effort of service delivery by the local authority even more difficult. The researcher is therefore motivated by the fact that there is a need to address these concerns in the Duncan Village informal settlements by evaluating the challenges associated with water and sanitation.

1.4. Aim of the study

The aim of this study is to evaluate water and sanitation challenges and recommend possible solutions in the Duncan Village informal settlements, East London, Eastern Cape, South Africa.



1.5. The objectives of the study

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The specific objectives of this study are to:

- i. Identify water and sanitation challenges in the Duncan Village informal settlements through quantitative and qualitative data collection on water and sanitation provision.
- ii. Discuss the causes and consequences of water and sanitation challenges in the Duncan Village informal settlements.
- iii. Recommend the best possible solutions to the local municipality to minimise water and sanitation challenges in the Duncan Village informal settlements.

1.6. Research questions

For the purposes of carrying out this study, the following research questions need to be asked:

- i. What are the actual water and sanitation challenges in the Duncan Village informal settlements?
- ii. What are the exact causes of water and sanitation challenges in the Duncan Village informal settlements?
- iii. Is the municipality doing enough to minimise water and sanitation challenges in the Duncan Village informal settlements and if not, what can be done to solve the situation in the Duncan village informal settlements?



1.7. Significance of the study

The challenges associated with poor water and sanitation service supply in informal settlements and other low-income settlements legitimise the need to research further on whether alternative approaches or mechanisms can result in the accomplishment of better levels of service provision. Makaudze and Gelles (2015) pointed out that conducting research is one of the ways of collecting reliable information about the practicality of situations by providing evidence.

Chapter 2: Literature Review

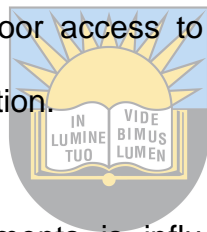
2.1. Introduction

Access to water supply and sanitation services is a basic human right and an essential need. According to WHO (2022b), access to water supply and sanitation services is vital for the health and dignity of all people. DWAF (2018) remarks that lack of access to water supply and sanitation services limits people's ability to overcome poverty and exacerbates the problems of disadvantaged communities, particularly those who are ill with diseases such as HIV/Aids. An estimated 1.1 billion people across the world did not have access to proper water provision, while on the other hand 2.4 billion people lacked improved sanitation services (Shamsu, 2013). These are usually poor people who reside in informal settlements and rural areas. Mwanza (2001) points out that, most governments' opposition to the development of infrastructure and services in informal settlements has had a significant impact on the lack of proper provision of basic portable water and sanitation services for the poor.

Mwanza (2001) further indicates that utilities and municipal governments are discouraged or restricted by policies and regulations in many countries from providing services in informal settlements. Subsequently, where policies are not a constraining issue, utility and local authority activity is hampered by challenging terrain, poor operations and maintenance, lack of ownership by the beneficiaries, and inadequate cost recovery (Mwanza, 2001).

2.2. Informal settlements

World Bank (2015: 1) defines informal settlements as “unplanned areas that have developed outside of the formal urban planning rules of the city, often in physically marginal or peri-urban areas characterised by uncertain or illegal land tenure; minimal or no services such as water supply, sanitation, electricity, and roads; informal employment and low incomes; and lack of recognition by formal governments”. Winter et al. (2019) emphasises this by indicating that poor housing, overpopulation, insecurity of tenure and inadequate basic services such as water and sanitation have become part of defining informal settlements. Furthermore, Simiyu et al. (2019) highlights that the characteristics of informal settlements are often defined by poverty and lack of infrastructure, with poor access to improved basic services such as sanitation, water, and waste collection.



The formation of informal settlements is influenced by poverty and slow rural development leading to urbanisation which puts greater demands on basic services (Hutchings et al., 2018). Hutchings et al. (2018) also indicates that rapid urbanisation amongst other challenges has been described as the main cause of poor water and sanitation provision in informal settlements. Angoua et al. (2018) indicates that failure of governments to adapt to the needs of urban population that is expanding, as well as poor institutional frameworks, attributes to poor planning approaches. This, according to Angoua et al. (2018) results in residents in informal settlements getting exposed to unhealthy and dangerous conditions that negatively impact their social lives, their health, the local economy, and the environment.

2.3. South African water law and policy

South Africa is notable for formally recognising the right to water at the constitutional level, where it underpins the entire legal and policy water framework (Gowlland-Gualtieri, 2007). The constitution, which was adopted on May 8, 1996, was the cornerstone of the extensive water policy reform that was undertaken in the transition period following the end of the apartheid regime (Gowlland-Gualtieri, 2007). It upholds human rights principles and includes a comprehensive bill of rights that includes the right to water as part of a long list of social and economic rights (Gowlland-Gualtieri, 2007). The 1996 Constitution obligates all three spheres of government to realize the right to water. Individuals do not have a right to water under the Constitution, but the government is required to take reasonable steps to give effect to the general rights of the population. While the national government is responsible for establishing a framework to ensure the realisation of this right, local governments are responsible for ensuring water and sanitation delivery to their communities (Gowlland-Gualtieri, 2007).



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In 1997, a White Paper for a National Water Policy was published, followed by the promulgation of the National Water Act (NWA) (Act No. 36 of 1998) (Pegram and Mazibuko, 2003). The NWA was purposefully drafted as a framework Act in order to reduce the complexity of technical details and save drafting time and effort. The institutional arrangements for water resource management adopted in the new Policy and Act are one of the most significant changes from South Africa's previous water law (Pegram and Mazibuko, 2003). This is based on the delegation of many water resource management functions to institutions within a water management area (WMA), specifically catchment management agencies (CMAs) and water user

associations (WUAs), with the goal of involving local communities in decision-making (Pegram and Mazibuko, 2003).

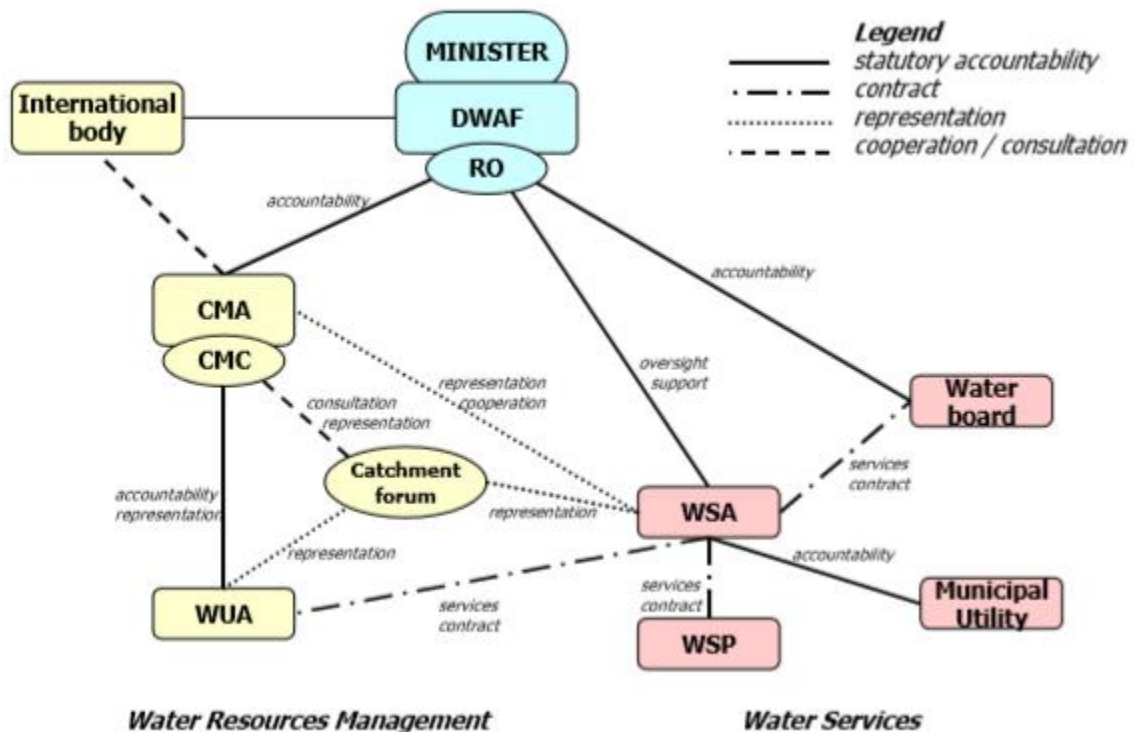


Figure 1: Showing relationships between various water sector institutions.

Source: (Pegram and Mazibuko, 2003)

2.4. The role of national and provincial government on water and sanitation

2.4.1. The role of the national government

The Strategic Framework for Water Services developed by DWAF (2003) specifies that the national government is responsible for providing local government with support, enhancing its capacity to accomplish its duties, and enforcing local government regulations to ensure efficient discharge of its obligations. In addition, it is the national government who must develop legislation governing the provision of water and sanitation services to the communities. Correspondingly, it is subject to national

and provincial legislation for a municipality to govern the local government affairs of its community, as highlighted in the Constitution. In cases where water services authorities fail ensure efficient, effective, and sustainable provision of basic services to the communities, the national government together with provincial government have the right to intervene. The provincial government is required to implement national legislation in the functional areas outlined in Schedule 4 of the Constitution and to step in when a municipality is having trouble carrying out its legislative executive duties (DWAF, 2003).

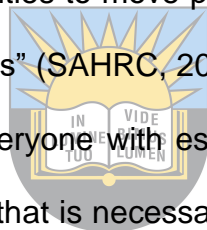
SAHRC (2018) factors out that Section 27(1) (b) of the Constitution ensures anyone access to enough water and calls for the national government take affordable and different measures to make sure the evolutionary realisation of the proper provision is met. The Constitution also implicitly recognises the proper to sanitation through related rights furnished by the Bill of Rights such as the rights to a healthy environment, health, and dignity. Section three of the Water Services Act, 108 of 1997 translates segment 27 of the Constitution through stipulating that everybody has the right to water and basic sanitation services, relevant authorities ought to take affordable measures to realize those rights and that relevant authorities ought to offer measures to realise those rights (SAHRC, 2018).

2.4.2. The role of the provincial government

The Strategic Framework for Water Services developed by DWAF (2003) stipulates that to ensure effective performance in local government, the provincial government, together and jointly with national government, has the constitutional responsibility to support and strengthen its capacity in the fulfilment of its functions, and to regulate it.

In addition, on behalf of other departments in the province, provincial public works departments may carry out (or supervise) the building of water and sewage infrastructure. Setting design guidelines for safe water and sanitation facilities in educational institutions, medical facilities, and clinics is part of this. However, client departments are still ultimately in charge of providing water and sanitation services inside of their own buildings, including paying for any necessary bulk water and sanitation infrastructure (DWAF, 2003).

The Local Government Municipal Systems Act, 32 of 2000 (Local Government Act) was promulgated to “provide for the core principles, mechanisms and processes that are necessary to enable municipalities to move progressively towards the social and economic upliftment of communities” (SAHRC, 2018: 10). The Local Government Act makes it mandatory to provide everyone with essential services. A basic service is described as "a municipal service that is necessary to ensure an acceptable and fair quality of life" and that, if absent, would pose a risk to the general public's health and safety or have an adverse effect on the environment. Access to water and sanitation would be considered a fundamental service (SAHRC, 2018: 10).



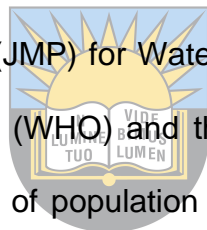
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2.5. Overview of water supply and sanitation in informal settlements

2.5.1. International Overview

Sanitation is essential to health and productive urban life and the provision of sanitation services for rapidly expanding urban populations is one of the most important global concerns (Andersson et al., 2016). Water supply just as sanitation is crucial for public health, regardless of whether it is used for drinking, domestic use,

food production, or recreational activities, just like sanitation (WHO, 2022a). More than 700 million residents living urban areas lack improved sanitation access worldwide, with 80 million practicing open defecation (Andersson et al., 2016). Over 2 billion people according to WHO (2022a) live in water-stressed countries, which is expected to be exacerbated in some regions as result of climate change and population growth. Andersson et al. (2016) highlights that sanitation deficits are especially crucial in quickly developing informal settlements, increasing inequities and unsustainable growth processes. Informal settlements, according to Brown et al. (2018), exacerbate the intrinsically interrelated concerns of water and sanitation provision, environmental degradation, and public health.



The Joint Monitoring Programme (JMP) for Water Supply and Sanitation conducted by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) reported that the share of population using improved sanitation facilities around the world has increased from 54% in 1990 to 68% in 2015 which is a net increase of 2.1 billion people. The Millennium Development Goal (MDG) 2015 targeted 77% of world population using improved sanitation facilities, which in this case could not be met. As a result, almost 2.4 billion people globally still lack access to improved sanitation (WHO and UNICEF, 2000; Shamsu-Deen, 2013; Daudey, 2018).

The United Nations General Assembly adopted the 2030 Agenda for Sustainable Development which covers 17 Sustainable Development Goals (SDGs) (WHO, 2019). The SDG framework included a dedicated goal (SDG 6) for water and sanitation to “ensure availability and sustainable management of water and sanitation for all” (UN, 2019:12). The SDG framework also included a target “By 2030, (to) achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying

special attention to the needs of women and girls and those in vulnerable situations” (UN, 2019: 12). Daudey (2018) highlighted that Despite the Millennium Development Goals (MDGs) being implemented and providing access to water and sanitation for billions of people, UNICEF and WHO continue to highlight discrepancies between regions, rural and urban areas, and marginalised communities.

Furthermore, the latest data from the WHO/ UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) according to UN (2019), show that in the pan-European region, 31 million people still do not have access to basic sanitation services and 314,000 people still practise open defecation, the majority of whom according to UN (2019) live in small rural settings. Basic sanitation services are defined as use of improved sanitation facilities that are not shared with other households (WHO, 2022b). It is further stressed that, despite significant progress in the provision of basic drinking water services between the year 2000 and 2017 globally, over 16 million people have yet to enjoy such access and over 44 million people do not have municipal piped water at home (UN, 2019). According to the WHO/UNICEF joint monitoring programme, basic drinking-water services are defined as drinking water from an improved source, provided that collection time is not more than 30 minutes for a roundtrip, including queuing (WHO, 2022b).

2.5.2. Africa Overview

Mwanza (2001) indicates that of all the continents in the world Africa has the least developed sanitation and water infrastructure. According to DWAF (2003), in Africa, more than 38% of the population lacks access to a reliable water supply and 40% lacks access to improved sanitation facilities. Mwanza (2001) further stressed that in

Africa, more than 1 in 3 people lack access to improved water supplies and sanitation infrastructure. The coverage rates for sanitation (60%) and water supply (62%) in 2000 were roughly the same, with the bulk of these residents residing in rural villages, peri-urban areas, and informal settlements (Mwanza, 2001).

Africa is the continent with the fastest rate of urbanisation (Mwanza, 2001). It has been indicated that between year 1990 and 2025, the total urban population is expected to grow from 150 million to 700 million showing an increase from 30% to 52% of total population (Mwanza, 2001). Furthermore, Mwanza, (2001) and World Bank (2015) emphasise that providing services to urban centres is difficult as a result of the rising urbanisation.



Gold and Namupolo (2013) declared that it is commonly acknowledged that ensuring access to appropriate and sustainable sanitation for many people living in the cities and towns of the Global South is crucial. For Namibia, Gold and Namupolo (2013) indicates that this need was underlined by Namibia's Millennium Development Goals, which aimed to reach half of those without access to improved sanitation by 2015. Namibia also developed a National Sanitation Strategy (2009) with the mission “to provide, with minimal impact on the environment, acceptable affordable and sustainable sanitation services for Namibian households” (Gold and Namupolo, 2013: 5). The vision statement is “a healthy environment and improved quality of life by providing sanitation services for urban and rural households” (Gold and Namupolo, 2013: 5). Despite receiving a portion of the government budget, this sub-sector was still insufficient to meet people's needs. Most sanitation facilities built up to this point

were the result of housing programs or sanitation-specific projects funded by the government with limited donor support (Gold and Namupolo, 2013)

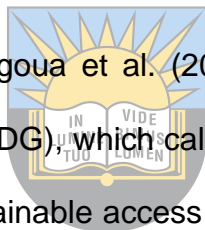
On-site sanitation is defined by Westrate et al. (2019), as decentralised sanitation facilities disconnected from the sewage system. Acey et al. (2019) reported that according to the WHO-UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP), in 2015 31% of Kenya's urban population had access to better on-site sanitation, a small increase from 27% in 1990. Acey et al. (2019) show that the provision of water and sanitation in Kenya's largest cities follows a pattern seen in urban areas throughout the developing world, where wealthy households in the city centre have in-home water and sewerage connections, while those who live in poorer communities and are less affluent rely on alternative water and sanitation services, such as on-site sanitation (pit latrine and bucket system), which necessitates routine emptying and disposal of the faecal sludge (Acey et al., 2019).



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Sub-Saharan Africa and other low-income nations in Asia, South and Middle America, as well as most urban residents there, according to Westrate et al. (2019), use on-site sanitation. These are people who commonly reside in informal settlements. According to Westrate et al. (2019), in sub-Saharan Africa, pit latrines and septic tanks are often utilised as onsite sanitation systems. According to studies undertaken by the research network Afrobarometer in 2014 and 2015, roughly 30% of houses in urban Africa were connected to a sewerage network (Westrate et al., 2019). In addition, the survey reveals that coverage is significantly lower in a number of sub-Saharan African nations, including 9% in Tanzania, 7% in Niger, 11% in Guinea, 18% in Mozambique, and 16% in Kenya.

With regards to Ghana, Osumanu et al. (2010) reported that at least 50% of the population lives in urban areas, where only 18% have access to better sanitation facilities and 90% have access to better drinking water sources. Despite the fact that the accessibility to improved drinking water sources is on the rise, Osumanu et al. (2010) highlight that only 30 % have access to municipal piped water. In addition, Osumanu et al. (2010) reveal that the remaining 60% rely on newer sources such standpipes, safe dug wells, safe springs, and rainfall collecting. There are a number of factors that contribute to Ghana's low access to better water and sanitation services, including ineffective sector policies, a lack of political will, ineffective local government capability, and insufficient funding (Osumanu et al., 2010).



In the West African countries, Angoua et al. (2018) reported that target 7c of the Millennium Development Goals (MDG), which called for reducing by half by 2015 the proportion of persons without sustainable access to clean water and basic sanitation services, was not met. Angoua et al. (2018) stressed that in 2015, 32% of people in sub-Saharan Africa still relied on unimproved drinking water sources such as streams and dams, and around 70% of the population still used unimproved sanitation. Unimproved sanitation provision is defined by WHO (2022b) as a provision of sanitation system that is shared with other households. According to WHO (2022b), flush or pour-flush to elsewhere, pit latrines without slabs or open pits, bucket latrines, hanging latrines or open defecation are considered as unimproved sanitation. Angoua et al. (2018) states that in Côte d'Ivoire it was estimated that only 31.7% of the urban population had access to better sanitation facilities, whereas 91.5% had improved drinking water services. However, the country's socio-political turmoil from 2002 to 2011 and the rising urbanisation rate of the population in the economic centre of

Abidjan, according to Angoua et al. (2018), led to the creation of more informal settlements. Like any informal settlements around the world, these settlements are frequently denied access to basic urban amenities such as sanitation, water, and rubbish collection (Angoua et al., 2018).

2.5.3. South Africa – Duncan Village Overview

South Africa is regarded as the world's most unequal country according to SAHRC (2018), and it has been reported that significant developmental challenges, such as unequal access to essential utilities like water and sanitation, have exacerbated the degree of economic inequality. For those responsible for providing services to urban centres in developing countries, rapid urbanisation has been identified as a critical challenge, wherein many urban centres are seeing a significant increase in the number of people living below the poverty line in informal settlements, many of whom are illegal (Duff and Fryer, 2004). The majority of these informal settlements according to Duffy and Fryer (2004) lack access to appropriate and affordable basic services including clean water and adequate sanitation services.

Despite South Africa's enabling national regulations, institutional efforts to create delivery frameworks for basic sanitation have been noted to move slowly due to a lack of agreement among local authorities' Water Services and related departments on how to proceed (Duff and Fryer, 2004; Muzondi, 2014; DWS 2016; SAHRC, 2018). In an effort to address the service delivery backlogs, numerous other instruments were also put into place, including the 1996 Constitution, the National Water Act 108 of 1997, and the White Paper on Water Supply and Sanitation Policy, among others. However, providing water and sanitation services is still a problem (Muzondi, 2014). According

to SAHRC (2018), by 2030 South Africa through the NDP wants to address these issues by reducing the percentage of the population that lives in poverty, the income gap, and hunger brought on by poverty.

SAHRC (2018) highlighted that the South African government has come a long way in ensuring that everyone has access to clean water and sanitary facilities. However, it has been noted that not everyone in society and in all parts of the country is equally benefiting from the development that has been done. In 2016, it has been indicated that the average access to piped water in South Africa was 88.8%, while in the Eastern Cape the average proportion was 75.7%. SAHRC (2018) demonstrates that the disparity was initially brought about by the inequitable distribution of services amongst the provinces under apartheid spatial planning. Since 1994, according to DWAF (2003), an estimated 12 million people or more did not have adequate water supply services in South Africa and nearly 21 million people did not have adequate sanitation services. Muzondi (2014) 20 years later reported that about 2700 informal settlements with 1.2 million households in South Africa did not have sufficient access to basic services such as water and sanitation.

Statistics South Africa (Stats SA) in 2016 revealed that only 44.4% of people had access to water inside their households, while 30% of households had water taps within their households, and the remaining 70% made use of shared standpipes, rivers and dams (SAHRC, 2018). The same study found that 60.6% of South Africans have access to waterborne toilets connected to the municipal sewerage system while 2.2% of other South Africans are still making use of a bucket system. These figures demonstrate that despite the passage of time since South Africa's democratic elections, a large number of people continue to use communal standpipes. It is also

clear that by now the use of natural water sources for accessing water and the bucket system for sanitation should have been completely eliminated (SAHRC, 2018).

In the Buffalo City Metropolitan Municipality, which is the study area, the municipality reported on their latest IDP (2022) that in terms of access to water between 2010 and 2020 a total number of 120 000 (48.42%) households had piped water inside the dwelling, 52 000 (20.94%) households had piped water inside the yard and 5 850 (2.36%) households had no formal piped water. In terms of access to sanitation, between 2010 and 2020, a total number of 171 000 (69.06%) households had flushing toilets, 53 600 (21.59%) had Ventilation Improved Pit (VIP) toilets and 15 100 (6.08%) households had pit toilets. According to the report (IDP, 2022), this is an improvement from the 55 600 households that had no access to sanitation at all in 2010, to 2020 where 23 200 households that had no access to sanitation.



The National Framework for Basic Services Provision, according to Lagardien and Cousins (2004), shows that South Africa's political will and policy framework are in place to deal with the issue of supplying the poor with basic services such as water and sanitation. They emphasise that attempts to link action at the municipal, local, and policy levels should be based on achieving agreement among the various stakeholders on the best course of action. It is also noted that in order to ensure that households receive sanitation services in an efficient manner, sanitation planning, implementation, and monitoring must be coordinated on the national, provincial, and local levels through specific co-ordination forums and all sorts of practical capabilities like efficient procurement. Furthermore, that governments (both national and local), in collaboration with other actors, should review policy frameworks and regulations (such

as those governing housing, land, local government water, and public health) and develop alternative plans of action and models to guarantee the urban poor's access to services (Lagardien and Cousins, 2004). It has been emphasised that all of these call for a thorough evaluation of current arrangements as well as the testing of ideas that make it easier to improve environmental sanitation by more intentionally tying water and sanitation together. In accordance with the following guideline: "Targeting Poor Households in the Provision of Basic Municipal Services: A Guideline for Municipalities, Department of Constitutional Development, 1999", basic municipal services, characteristically include among others:

- Access to a minimum safe water supply;
 - According to the World Health Organization (WHO), minimum safe water supply is water between 50 and 100 litres per person per day (Ki-moon and UN, 2010).
- Adequate sanitation; and
 - According to WHO (2022b), adequate sanitation entails providing acceptable and accessible basic sanitation services. Basic sanitation services are defined by WHO (2022b) as use of improved sanitation facilities that are not shared with other households.
- Solid waste removal (e.g., Household waste) (Lagardien and Cousins, 2004: 22).



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2.6. Access to water and sanitation services

In 2001, the White Paper on Basic Household Sanitation was established, and identified gaps on water and sanitation (DWAF, 2008). According to estimates, 18 million South Africans lack access to basic sanitary facilities and understanding about health and hygiene. In 2003, the cabinet of South Africa approved the Strategic Framework for Water Services, which was developed by DWAF in consultation with the Water Sector (DWAF, 2008). The vision for water services therefore identified that:

- All people living in South Africa have access to adequate, safe, appropriate, and affordable water and sanitation services use water wisely and practice safe sanitation.
- Water supply and sanitation services are sustainable and are provided by effective and efficient institutions that are accountable and responsive to those whom they serve.
- Water is used effectively, efficiently, and sustainably in order to reduce poverty, improve human health and promote economic development. Water and wastewater are managed in an environmentally responsible and sustainable manner (DWAF, 2008: 1).



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Winter et al. (2019) stressed that, globally, people living in informal settlements are affected by lack of access to improved sanitation services. Most of these are people from rural areas who move to urban areas for a better livelihood because of the extreme poverty, which leads increasingly to the formation of informal settlements (Winter et al., 2019) that characterise the South African urban landscapes.

According to WHO (2019), provision of safe drinking water and improved sanitation services for all is a legal obligation. DWAF (2008) indicate that the specific policy provisions from the Strategic Framework for Water Services, which was approved by the Cabinet of South Africa, makes a specific provision for free basic sanitation for the poor. This is to assist in promoting affordable access by poor households to at least a basic level of sanitation services (DWAF, 2008). Apart from the free basic sanitation policy, free basic water policy was also established to assist in promoting sustainable access to a basic water supply by subsidising the ongoing operating and maintenance costs of a basic water supply service (DWAF, 2003).

Provision of free basic services comes with its own challenges. The challenges identified (DWAF, 2003) on the free basic sanitation policy are:



- The provision of the infrastructure (facilities) necessary to provide access to water to all households.
- The development of subsidy mechanisms which benefit those who most need it.
- The equitable treatment of large households and multiple households sharing one connection.
- Collecting revenue for services rendered over and above an allocated free basic amount (DWAF, 2003: 29-30).

The challenges of providing free basic sanitation are therefore identified as:

- The provision of the sanitation facility itself to poor households (together with the necessary supporting infrastructure).

- Health and hygiene promotion provision and its funding.
- Subsidising the operating and maintenance costs (DWAf, 2003: 30).

2.7. Barriers to progress water and sanitation provision in informal settlements

A 2010 report by the DWA shows that security of tenure is arguably the greatest challenge facing the water and sanitation sector in South Africa. According to DWS (2016), in South Africa between one and two million households reside in informal settlements, making it challenging for local governments to provide basic services due to the insecurity of their land tenure, which is a prerequisite for the provision of ongoing basic services. Informal settlements are often not recognised by the policies or municipal authorities because of the land tenure issue and the dwelling arrangements which makes it difficult for the municipalities to provide adequate and improved water and sanitation services (Hutchings et al., 2018).

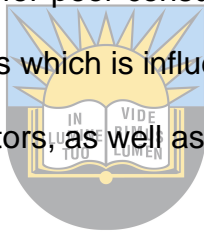


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Dagdeviren and Robertson (2009) stressed that the legal status of the land is the main barrier to the provision of basic services, which includes water and sanitation. Lack of tenure also has consequences, first in terms of the obligation of network utilities to provide services, and second in terms of the lack of sufficient information on the settlements. Over and above that, Dagdeviren and Robertson (2009) add that homeowners' secure tenure of their property, as defined by either legislation for public utilities or contracts for private utilities, is a prerequisite for network utilities' obligation to the community to supply water services. The condition of the structures themselves, which are mostly in informal settlements and are crowded and challenging to access, comes second to the question of land tenure. Dagdeviren and Robertson (2009)

stressed that the standard of buildings and house arrangements depending on local regulations often has an impact on service provision.

Mwanza (2001) emphasised that some of the issues affecting service delivery such as water and sanitation in informal settlements has to do with the difficulty of physical access, lack of proper physical planning, inappropriate technology that does not suit the area, inadequate consultation, limited community participation, socio-economic constraints, and poor information, education, and communication. Mwanza (2001) also states that certain problems are influenced by the utility itself and that good management which includes efficient and effective service delivery plays a key role in improving access and affordability for poor consumers. These according to Mwanza (2001) include poor payment of bills which is influenced by late or irregular billing and unreliable service among other factors, as well as unreliable consumer data.



Muzondi (2014) reported that even though there are clear plans of improving informal settlements worldwide, barriers such as insecurity of land tenure hold back the improvements. An estimated four million South Africans reside on land which they do not own (DWS, 2016). In addition, Muzondi (2014) emphasised that although it was anticipated that improvements in the delivery of water and sanitation services in informal settlements in South Africa would be made by the year 2015, an estimated 884 million people in developing countries continue to have either little or no access to these services.

Service delivery to poor areas such as the informal settlements apart from everything else, is slowed by macro conditions such as corruption and slow economic growth

(SAHRC, 2018). Furthermore, SAHRC (2018) emphasised that access to reliable and safe water supplies and adequate sanitation services is least likely to be available to the poor, and that they are also less likely to be able to obtain the proper recourse when these fundamental rights are violated. This inability to uphold fundamental rights in these communities contributes to the country's ongoing and entrenched cycles of poverty and inequality (SAHRC, 2018).

2.8. Impact of poor water and sanitation in informal settlements

2.8.1. Impact on health

A lack of sufficient water provision and decent sanitation facilities impact human health negatively (WHO, 2022). Globally, investments in the provision of sanitation facilities and safe water supply for all are being made. However, the health benefit of this investment is limited, where inadequate attention is paid to end-user education and health and hygiene awareness. Global experience suggests that once basic needs are met, especially clean water provision and sanitation, together with health and hygiene promotion, this results in the most significant impact on their health (DWAF, 2001).

The lack of adequate water and sanitation services, causes negative public health outcomes (World Bank, 2015). However, for the water and sanitation services to be effective and sustainable, it is dependent on the effectiveness of health and hygiene education which is co-ordinated with the construction and delivery of water and sanitation infrastructure and related service (DWAF, 2003). The Department of Health is mandated to ensure that the health policies are in place and health practices are followed. Together with the provincial departments, the Department of Health is also

responsible to ensure there is sufficient provision of water and sanitation facilities in all hospitals and clinics and that these facilities are operated sustainably and are adequately maintained (DWAF, 2003).

Services such as water and sanitation are often shared in informal settlements (WHO and UNICEF, 2000). Shared water and sanitation facilities has been mostly linked to undesirable health outcomes when compared to individual household services. WHO and UNICEF (2000) reported that approximately four billion cases of diarrhoea each year are responsible for 2.2 million deaths, mostly among children under the age of five. These deaths represent approximately 15% of all child deaths under the age of five in developing countries. Water and sanitation provision, together with hygiene interventions reduce diarrhoeal disease on average by between one-quarter and one-third (WHO and UNICEF, 2000).



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Latest data from WHO (2022a) show that poor sanitation and water contamination are linked to transmission of diseases such as cholera, diarrhoea, dysentery, hepatitis A, typhoid and polio. Furthermore, absent, inadequate, or inappropriately managed water and sanitation services expose people to preventable health risks. According to WHO (2022a), diarrhoea is largely preventable, and the deaths of 297 000 children aged under five years could be avoided each year if proper management of water and sanitation is addressed.

In poor urban communities around the world, thousands of children die every day from preventable diseases related to the inadequate provision and poor management of water and sanitation (Bartlett, 2003). To date, WHO (2022a) show that 829 000 people

are estimated to die each year from diarrhoea because of unsafe drinking-water, lack of sanitation provision and poor hand hygiene. Where there is no sufficient provision of water, people do not prioritise washing hands, as a result it adds to the likelihood of diarrhoea and other diseases (WHO, 2022a). Inadequate water and sanitation provision have been associated with other adverse outcomes including helminth infections, child under-nutrition, and impaired cognitive development (Sinharoy et al., 2019).

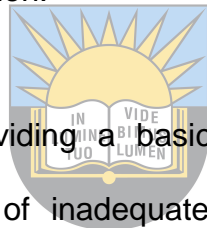
2.8.2. Impact on the economy

Informal settlements are often associated with poor infrastructure management, water and sanitation infrastructure are not an exception. According to Acey et al. (2019), poor sanitation infrastructure compromises economic development, particularly among poor households. Moreover, it has been stressed that 61% of the global population lacks safely managed sanitation services, commonly relying on on-site sanitation facilities with inadequate emptying and treatment of waste, or simply practicing open defecation which degrades the environment (Acey et al., 2019).

Improved water supply and sanitation in communities and better management of water resources, according to WHO (2022a), can boost countries' economic growth and can contribute greatly to reduction of poverty. WHO (2022a) stress that improved water and sanitation services could mean that people would spend less time and effort collecting water and walking to sanitation facilities installed far from their households. This according to WHO (2022a) could afford people more time to be productive in other ways and affords children better school attendance which could help combat poverty. Furthermore, better water and sanitation facilities also means less

expenditure on health because people are less likely to get ill and incur medical costs (WHO, 2022a).

Judging by the cases reported on diarrhoea especially on children under the age of five as well as other diseases that are caused by lack of proper water and sanitation, there could be an economic benefit through the provision of adequate services because the government will not have to spend more on ensuring that people are not ill (DWAF, 2001). World Bank (2015) stressed that, apart from health expenditures, overpopulation, insecurities of land tenure, and frequent natural disasters directly affect informal settlements, and these increases the expense of delivering basic services such as water and sanitation.



Whilst the financial cost of providing a basic standard of sanitation is easily quantifiable, the economic cost of inadequate sanitation on the health of the community and on the environment, according to DWAF (2001), is not easily quantified. DWAF (2001) declared that the United Nations Children Fund (UNICEF) and World Health Organisation have linked investing in sanitation to:

- Reduced morbidity and mortality and increased life expectancy;
- Savings in health care costs;
- Reduced time caring and sick leave (back to work);
- Higher worker productivity;
- Better learning capacities of school children;
- Increased school attendance, especially by girls;
- Strengthened tourism and national pride;

- Direct economic value of high-quality water such as irrigation water for crops; and
- Reduced water treatment costs (DWAF, 2001: 9).

2.8.3. Impact on the environment

Informal settlements are settlements that are often not planned and have little or no infrastructure (SERI, 2018). They are also often associated with pollution and uncollected waste. Informal settlements are often serviced with unpaved roads which makes them vulnerable to natural disasters (SERI, 2018). There is hardly planning of building structures and house arrangements in informal settlements including drainage or sewage systems, which exposes residents to flooding and diseases from contaminated water and uncollected waste. All these factors combined, including lack of access to proper water and sanitation services, poverty, lack of access to emergency services and overpopulation, make households in informal settlements vulnerable to ill-health and other significances (SERI, 2018).

According to Sinharoy et al. (2019), residents in informal settlements commonly rely on pit latrines as a form of sanitation facility, but due to lack of space among other factors, there is a barrier to latrine eradication as well as to safe and hygienic pit-emptying. Residents in informal settlements usually do not empty their pit toilets, causing the toilets to overflow to bare ground surface (World Bank, 2015). Where undertaken, the act of pit emptying may in many ways pollute the environment, spread contamination to households and communities even far beyond the source (Sinharoy, et al., 2019).

Most human activities have a negative impact on the environment (DWAF, 2001). Sanitation also involves the collection and disposal and treatment of waste. Lack of adequate sanitation or inadequately maintained, or inappropriately designed systems can therefore constitute a range of pollution risks to the environment, especially the contamination of surface and ground water resources (DWAF, 2001). DWAF (2001) note that even though water systems can tolerate a certain degree of pollution there is a limit to the amount that can be assimilated without causing the water quality to deteriorate to such an extent that the water cannot be used for human consumption.

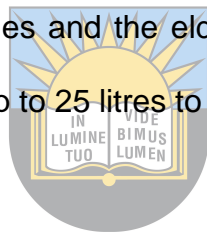
Improved water supply and sanitation as well as drainage and garbage removal improve the health of the residents, particularly poor residents residing in informal settlements (WHO 2022a). However, planning, and operations and maintenance of the infrastructure in developing and undeveloped urban areas have been hampered by political, economic, ecological, and social instabilities. This, according to Tsinda et al. (2013), results in poor environmental performances and continual breakdowns, as a result to lack of proper maintenance or timely investments. Lifewater (2014) indicates that approximately 90% of sewage and wastewater in developing countries is dumped into nearby streams, lakes, and rivers, contaminating some of the same resources that people use for drinking water. Untreated sewage discharge not only contaminates drinking water sources but also harms aquatic and plant life (Lifewater, 2014). According to research studies by the United Nations Environment Programme, untreated sewage discharge into coastal waters due to polluted watersheds, making some of the water completely unusable, is the main threat to coastal habitats, fisheries, marine wildlife, and people nearby several large coastal areas (Lifewater, 2014).



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2.9. Social impact of poor water and sanitation in informal settlements

In its 2014 Report on water and sanitation (SAHRC, 2018), the Commission recommended to the Department of Basic Education that it work with the Department of Human Settlements and the former Department of Water Affairs (now Department of Water and Sanitation) to ensure that service delivery projects address the special needs of women and girls in particular. In South Africa, Municipalities supply water and sanitation in a form communal standpipes and communal toilets that are usually placed along road servitudes and often at inconvenient locations on the perimeters of informal settlements (SERI, 2018). The effect of this is that retrieving water from communal standpipes and using the communal toilets creates a barrier to access, especially for people with disabilities and the elderly who may not be able to carry heavy water containers, typically up to 25 litres to their homes or to walk a distance to the toilets.



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Globally, most residents in informal settlements rely on shared infrastructure in a form of communal toilets (Sinharoy et al., 2019). A shared sanitation facility is a facility that is shared by more than one household. Shared sanitation facilities are likely to pose security risks and cause stress and anxiety among women and girls, especially when shared in an overpopulated settlement. As a result, women and girls may be reluctant to use shared toilets due to security reasons, cleanliness, and privacy (Sinharoy et al., 2019).

Surveys conducted from 45 developing countries revealed that women and girls in low-income countries are responsible for collecting water for the household (SERI, 2018). As a result, the South African Human Rights Commission (SAHRC) has

referred to women and girls as the “bearers of water”. Relying on communal standpipes similar to communal toilets is a difficult task for women and girls in informal settlements according to SERI (2018) because they bear the burden of fetching water while being at an increased risk of violence or sexually assault.

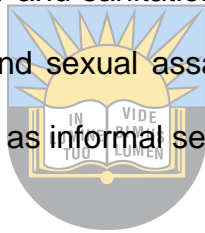
Winter et al. (2019) emphasized that women are mainly burdened by the lack of improved sanitation. Avis (2016) also highlighted that it has been proven that women in informal settlements spend more time and energy accessing basic services such as water and sanitation than other urban counterparts. For that reason, poor water and sanitation management does not only limit women from their daily chores but also exposes women to pathogen-related health issues and risks of being exposed to vaginal infections, violence and indignity (Winter et al., 2019).



Position 17 of the National Sanitation policy according to SAHRC (2018), makes provision for gender, youth, and disabled persons in sanitation services, and states “Global research indicates that sanitation interventions that are designed and managed with the full participation of women are more likely to be sustainable and effective” (SAHRC, 2018: 21). This position encourages women to participate at all levels in consultation, planning, decision making and in the management of water services to address issues that concerns women and girls. Provision of sanitation services is necessary to consider the safety and the dignity of women and girls at all levels (SAHRC, 2018).

The SAHRC (2018) further highlight that, “The UN Water policy brief on Gender, Water and Sanitation, conveys the link between access to safe drinking water and basic

sanitation to gender equality and the empowerment of women, by demonstrating how access to a domestic water supply and sanitation reduces the time, health, and caregiving burden of women” (SAHRC, 2018: 22). It has been emphasised that women bear the burden of collecting water from standpipes and natural water sources such as dams and rivers in settlements without access to running water on behalf of their family (SAHRC, 2018). Proper provision of water and sanitation facilities in communities reduces the risk of sexual violence and assault against women and girls and increases privacy. South Africa, according to SAHRC (2018), has a high number of cases of women and girls who get assaulted and raped while in a process of collecting water or using sanitation facilities that are located far from their households. Adequate and well managed water and sanitation services would make women and girls less vulnerable to violence and sexual assault in South Africa’s communities, particularly poor communities such as informal settlements (SAHRC, 2018).



2.10. Conclusion

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Data from WHO and UNICEF (2021) show that 2 billion people still lacked safely managed water services around the world, with 282 million with limited services, 367 million using unimproved sources, and 122 million drinking surface water from dams and rivers. With regard to sanitation, WHO and UNICEF (2021) reported that 3.6 billion people lacked safely managed sanitation services, 580 million with limited services, 616 million using unimproved sanitation facilities, and 494 million practising open defecation.

South Africa with its own inequalities has managed to deal with the services backlog than most developing countries. According to the General Household Survey of 2018,

89% of households in South Africa have access to drinking water, and 83% have access to improved sanitation services (StatsSA, 2019). Nevertheless, inequality in access to basic services is still a stark reality and progress with improved sanitation provision has been much slower especially in informal settlements. This raises a pressing need to evaluate, identify, and understand the nature and magnitude of the issues causing water and sanitation challenges, especially in poor communities, informal settlements to be precise, to find more cost-efficient and sustainable alternatives to address them.



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Chapter 3: Study Area and Research Methodology

3.1. Study area

To conduct a study, one must first establish the research area, including its history, demography, social conditions, and environmental conditions. Duncan Village is the subject area in this study, which is located within the jurisdiction of the Buffalo City Metropolitan Municipality (BCMM) in South Africa's Eastern Cape Province.

3.1.1. Study area location

Duncan Village (Figure 2) is located between 3 and 5 kilometres west of the East London central business district. East London is a regional node that serves both urban and rural inhabitants from the former Ciskei and Transkei homelands (Hutu, 2018). The city boasts a minor industrial area and harbour at the Buffalo River mouth, as well as a railway connection connecting to Johannesburg via Qonce (formerly known as King William's Town) and Bloemfontein. Hutu (2018) points out that the city's development was influenced by both the industrial harbour area and the railway route. East London's economic development is dependent on industry, with small trade and tourism contributing less.

Duncan Village's current proximity to the East London CBD is the result of people of this township successfully rejecting forcible evacuation in 1955 to Mdantsane, a large township formerly created specifically for black residents around 25 kilometres north direction from the East London CBD (Hutu, 2018). Since apartheid was abolished, a massive inflow of people from rural regions resulted in overpopulation of Duncan

Village and the emergence of other squatter camps throughout the city (Orbeg and Berg, 2005). Duncan Village's overcrowding and continuous influx of people has proven to be a major difficulty for the local government, notably in terms of ensuring that everyone has access to water and sanitation, as well as assuring long-term management.

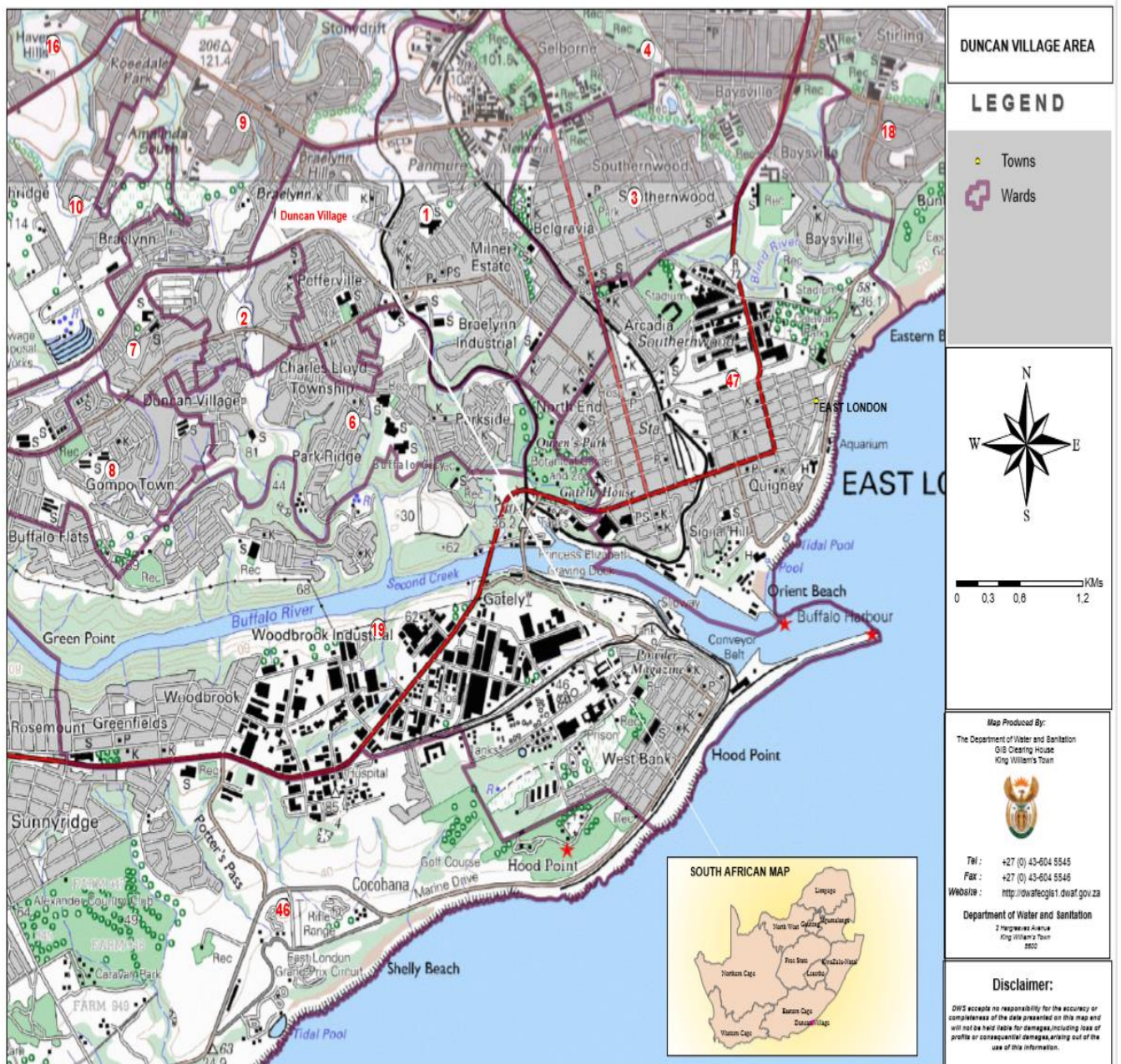


Figure 2: The location of Duncan Village in East London, South Africa. Source (DWS, 2022)

3.2. Duncan Village's history

The history of Duncan Village can be summarized as a series of failed attempts at urban redevelopment, beginning with the construction of several hundred municipally administered rental dwellings in the early 1940s (Kienast, 2020). Duncan Village was founded in 1941 and was named after Patrick Duncan, the then-Governor of East London, who is believed to have managed the opening of a "leasehold tenure area" on the East Bank and had the area named after him (Jansson and Ndhlovu, 2015). The first black people began to move to the now "Duncan Village" in 1871 (this was before the Township layout) (Jansson, 2004). The first Township layout was completed in 1923, with residents erecting the first wood and iron dwellings the same year (Jansson, 2004). Duncan Village was known as the East Bank Location at the time (Jansson, 2004). Kienast (2020) shows that Duncan Village was impacted by the new apartheid legislation "the Group Areas Act," which was a relocation scheme targeting non-white people, implemented by the Nationalist Party in the 1950s. Kienast (2020) underlines the fact that for decades, the East London council attempted to restructure the area in line with the Group Areas Act of 1950.

Jansson (2004) points out that thousands of people were forcibly evacuated and transported to settlement camps 25 km away from East London city, which later became townships, when a decision to disestablish Duncan Village was taken by the government in 1955. Political activists and persons without permission to live in the city, according to Kienast (2020), were deported, residents were segregated into black and coloured groups, and the original location was demolished. According to Kienast (2020), Duncan Village was planned to be a settlement of conventional cottage houses where only married males with stable occupations were allowed to stay. The apartheid

regime established Mdantsane, a vast dormitory town 25 km west of East London, in the 1960s and 1970s which Jansson (2004) refers to as settlement camps that later became townships. Kienast (2020) indicates that the government intended to relocate people from East London's urban areas in order to reduce future rural-to-urban migration.

African residents were relocated to Mdantsane in 1955, which is currently South Africa's seventeenth largest township and second largest in the Eastern Cape Province after Ibhayi in Gqeberha (Port Elizabeth) (Writer, 2016). Some of the residents resisted the removal and remained in Duncan village (Jansson, 2004). According to Hutu (2018), between the 1960s and 1970s, the government's attempt to move residents to Mdantsane was hampered by forceful deportation of African residents. Because of the piecemeal nature of the removals in Duncan Village and the vehement opposition to them, Hutu (2018) shows that some parts of the East Bank location (Duncan Village) were removed and transformed to other racially segregated areas, while several areas remained mostly unaffected by Apartheid removals. As a result, African residents living around the Duncan Village post office and Bantu Public Square were successfully relocated, and the area was converted into an Indian residential neighbourhood known as Braelyn (Hutu, 2018).

The apartheid administration was unable to completely remove African residents from the Duncan Village areas in 1955 due to a lack of accommodation in Mdantsane and opposition to forcible removals (Hutu, 2018). Apartheid reforms in East London then resulted in the establishment of the Gompo Community Council (GCC) in Duncan Village in the early 1980s. The council is thought to have been founded to sway the

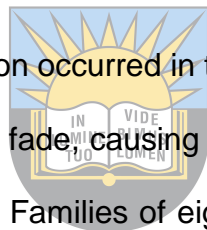
government's efforts to build an African town council that would restore local government to Duncan Village residents (Hutu, 2018).

Many Africans saw the GCC council as a puppet of the apartheid government, and they opposed its authority because the removals were still affecting the area (Hutu, 2018). As a result, even though the GCC was regarded as the body that represented African interests municipally, rental rates in the 1980s continued to rise to unaffordable levels (Hutu, 2018). This revealed that the administration continued to raise rents while refusing to address the state of municipal housing. The government utilized a variety of methods to try to evict Africans from East London, including raising rental costs. Hutu (2018) points out that the government understood Africans would default on their rent payments and be evicted from their homes.



Resistance to apartheid laws grew stronger during the 1980s (Oberg and Berg, 2005). Hutu (2018) indicates that local resistance leaders and residents created the Duncan Village Residential Association (DVRA) in opposition to the GCC's puppet authority. The DVRA asked community people to boycott the government-imposed huge rental prices to challenge the leadership of the GCC. That was viewed as the best approach to bankrupt the GCC while also opposing the apartheid government's authority. Oberg and Berg (2005) report that the Duncan Village Residents Association (DVRA) took control over the township and transformed the systematic and strict layout of houses that had been applied. The DVRA permitted shacks to be built in backyards and in open spaces, resulting to the formation of informal settlements (Kienast, 2018).

Because of its proximity to the city, Duncan Village saw a rebirth of interest in the 1980s (Makhanya, 2011). Hutu (2018) points out that, the densification of Duncan Village in the late 1980s obliterated all appearance of planning, designing, and orderliness. Shacks were erected in public areas, playgrounds, and the rear yards of municipal buildings. Hutu (2018) goes on to say that the line between public and private space, as well as urban and rural space, was blurred as single household sites were converted into multiple household sites and public utilities such as public spaces, toilets, water, and roads were put to enormous strain. From the late 1980s onwards, the population then grew rapidly due to the fast densification of the area encouraged by the DVRA policy of open squatting.



Another phase of shack densification occurred in the early 1990s, when the apartheid government's regulations began to fade, causing the informal settlements to become even more densified (Hutu, 2018). Families of eight to ten people living in municipal houses began to migrate out of their homes and into backyard and freestanding shacks around this period (Hutu, 2018). As a result, formal housing in Duncan Village, according to Hutu (2018), de-densified during that time, but shack density in Duncan Village skyrocketed as people who had previously lived in official housing moved into informal housing.

In the 1980s and 1990s, the fast growth of shack settlements in Duncan Village prompted white East London residents to demand that the city authorities cease the inappropriate, indiscriminate shack and hovel installations that threatened their families and the city (Minkley, 2004). As a result of these accusations, authorities from the Gompo Community Council (GCC) devised plans for the renovation and

resettlement of the region in an attempt to maintain control over Duncan Village. The GCC ordered at least 5,000 squatters to vacate the area so that reconstruction plans could be carried out (Hutu, 2018).

Residents of Duncan Village ignored these demands and in one of the most violent occurrences in East London history, 12 000 residents marched on downtown East London in January 1990 in protest of the Gompo Community Council's (GCC) redevelopment plans (Hutu, 2018). The protests concluded in violent battles with police, resulting in 28 deaths, and served as a definitive declaration that Duncan Village inhabitants would no longer allow an apartheid government or its puppet GCC to intervene in their daily lives. Any attempts to rehabilitate Duncan Village were abandoned following this violent conflict (Hutu, 2018).



Following the initial planning and development in the early 1940s, Duncan Village remained undeveloped throughout apartheid (Ndhlovu, 2015). Duncan Village's municipal council announced a new master plan for urban regeneration and growth in 2003. While the concept aroused aspirations and dreams about achieving the envisaged better living characterized by housing development, Ndhlovu (2015) indicates that it was necessary to relocate individuals to other regions in order to clear some of the shacks for the project's implementation. Illegal occupation of properties intended for resettlement of Duncan Village residents in new development areas such as Reeston was among the issues. Residents of Duncan Village who had been scheduled for resettlement, according to Ndhlovu (2015), were left homeless as their homes were illegally occupied and their shacks dismantled as part of a municipal procedure for resettling shack dwellers.

3.2.1. Residential structure

Duncan Village is a densely populated low-income area with both formal and informal settlements (Kienast, 2020). It is bounded on the west by the Buffalo River Valley, on the east by Second Creek tributary valley and on the North-west bordered by the predominantly coloured residential neighbourhoods of Braelynn, Pfefferville, and Buffalo Flats (Oberg and Berg, 2005). Housing has taken up most of the land, leaving no room for parks or public places (Jansson, 2004). It is further indicated that due to a scarcity of suitable land and a rise in population, even backyards and slopes down to flood lines are occupied by shacks.

Duncan Village is one of South Africa's townships that played a vital role in the anti-apartheid campaign (Ndhlovu, 2015). It was recognized as one of the six townships in the Reconstruction and Development Programme (RDP) policy document for development objectives as one of the Presidential Projects under Urban Renewal Projects and received enormous financing for development in 1996. Nonetheless, since the township circumstances continue to deteriorate twenty years after democracy, this past may appear to have been erased (Ndhlovu, 2015).

In late 2003, the municipal planning department began drafting a local spatial development framework (LSDF) to improve living conditions and reduce vulnerability in the area (Kienast, 2020). The Duncan Village Redevelopment Initiative (DVRI) was a holistic renewal plan that included the construction of state-subsidized homes to eventually replace the area's shacks. The traditional typology of free-standing, minimum-standard dwellings could only accommodate a small portion of the local population due to the high density of the housing stock. As a result, the building of

terraced row and semi-detached houses was agreed upon by local urban planners, consultants, and councillors (e.g. Figure 3).



Figure 3: Showing an attached row housing in Ward 2, Duncan Village. Source: Author (October, 2021)

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According to the LSDF stated in Kienast (2020: 228), at least 20,000 new dwellings were to be built over a twelve-year period (years not mentioned). Only one-tenth of the new dwellings are planned to be erected in Duncan Village. The municipal engineering department stipulated that new building in Duncan Village and surrounding neighbourhoods could not be approved until a regional sewage treatment plant was operational and sewage was diverted to this plant. Up to 300 housing units were scheduled to be erected under these restrictions. The only region where large development and resettlement could begin quickly according to Kienast (2020) was Reeston, the historic buffer zone between East London and Mdantsane.

Duncan Village is made up of three types of residential structures: formal residences, informal backyards dwellings and shacks (Hutu, 2018). Unlike other townships where formal houses and informal communities are separated there is no clear separation between formal houses and informal houses in Duncan Village (Ndhlovu, 2015). Ndhlovu (2015) further notes that on the formal areas of the township, formal houses are made of bricks, the majority of which were built by the apartheid regime, while informal houses are made of zinc, cardboard, plastic, corrugated metals, and wooden shacks. Most formal dwelling units in Duncan Village are either created by local residents or secured through the Reconstruction and Development Program (RDP), which was established by former President Nelson Mandela (Hutu, 2018), (Figure 4).



Figure 4: Showing a formal Reconstruction Development Programme (RDP) house in Ward 8, Duncan Village. Source: Author (October, 2021)

Duncan Village is known for its backyard shacks (Figure 5a). Backyard shack dwellings, according to Ndhlovu (2015), have persisted in South Africa for more than a century and aided the apartheid state's project to demolish informal constructions at the height of the apartheid struggle. The formal house owners in Duncan Village operate as landlords, collecting rent from the residents of the backyard shacks (Hutu, 2018). Hutu (2018) further notes that shack constructions occupy most of the public property designated for public space development. The bulk of these shacks are placed on very steep slopes or along riverbanks, making them dangerous to live in (Figure 5b). Floods and other natural calamities are common in Duncan Village (Hutu, 2018) and the informal housing structures are also a fire threat due to their density.



Figure 5a & b: Formal RDP house with a backyard dweller in Ward 6 and shacks close to Amalinda river in Ward 7, Duncan Village. Source: Author (October, 2021)

Despite the history, there appears to be a light at the end of the tunnel for Duncan Village's reconstruction. Ngcukana (2020) wrote in City Press on February 12, 2020, that President Cyril Ramaphosa appeared set to fulfil one of his electoral pledges in

the Eastern Cape with the commencement of the massive project to rehabilitate Duncan Village. It was stated that during the construction of Duncan Village, around 20 000 families in this informal settlement will be transferred to temporary homes. Pam Tshwete, the then-Deputy Minister of Human Settlements, Water and Sanitation, Nonkqubela Pieters, the MEC for Human Settlements, and Buffalo City Metro Municipality executive mayor Xola Pakati signed a memorandum of understanding, paving the way for the rehabilitation of Duncan Village to begin. It was also reported that Tshwete said after the signing ceremony: *“The Housing Development Agency (HDA) has identified land parcels for housing development in and around the city and the three spheres of government have agreed on the funding arrangements. This means all parties concerned will prioritise Duncan Village and surrounding areas when it comes to the R1.8 billion Human Settlements Development Grant in the 2020/21 financial year and the R761 million Urban Settlements Development Grant in the 2020/21 financial year. This intervention is in line with the district development model as launched by the president last year,”* said Tshwete. According to the article, the HDA, an organization of the national department of human settlements, would oversee the project, which would include the construction of 5 500 houses in the first phase (date not mentioned) at a cost of R220 million (Ngcukana, 2020).



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The researcher visited the Duncan Village redevelopment project on October 22nd 2021, and discovered that the project is underway. The project managers on site remarked that the municipality has identified three sites where temporary dwellings will be built. One of the managers also stated that residents will be relocated from their informal homes to these sites in phases while the construction company constructs new formal homes at evacuation areas, and then relocated back when their houses

are completed. He further indicated that, this practice will be continued until all informal sites in Duncan Village are fully formalized with completed houses equipped with water and sanitation. The temporary housing sites are in an area known as Braelyn (7de Laan) along the Ziphunzana bypass, and across from Heaven Hills Cemetery (Figure 6a & b).



Figure 6a & b: Showing temporary homes sites for Duncan Village informal homeowners in Braelyn. Source: Author (October, 2021)

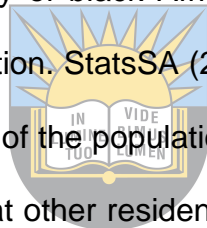
3.2.2. Demographics

The StatsSA (2011) data showed that Duncan Village had 33 964 households and a population of 105 391 people (Hutu, 2018). When compared to the Breaking New Grounds Sustainable Human Settlement report of 2005 (BNG, 2005), which recorded a population of over 80,000 people and around 21,000 households, this shows an increase in population and households in Duncan Village, and as the population and families grow, so does the demand for water and sanitation. Jansson (2004), on the other hand, claims that the total population decreased by 30% between 1996 and

2001. The government subsidies offered to those living in shacks were cited by Jansson (2004) as one cause for the population decline at that time.

In terms of population distribution by age, Jansson (2004) indicates that the area then was dominated by people aged 30-49, followed by people aged 5-19, who account for almost 55% of the population, and people aged 20-29 who account for 26%. Duncan Village has slightly more females than males in terms of gender distribution; females, who are generally the primary collectors of water (SERI, 2018), make up 52% of the population (Hutu, 2018)

Duncan Village features a majority of black Africans and a minority of mixed-race residents in terms of racial distribution. StatsSA (2011) indicates that, black people in Duncan Village account for 97.6% of the population, followed by coloured and indian people. Jansson (2004), states that other residents in Duncan Village are temporary residents who work in East London and live in shacks during the week.



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3.2.3. Social conditions

Duncan Village, like most informal settlements, is characterized by poverty, unemployment, and low-wage workers. StatsSA (2011) data show that 43% of the Duncan Village population lived in poverty, with no reliable monthly income (Hutu, 2018). As of 2011, only 4% of the economically engaged population earned more than R3200 per month, while 45 percent made less than R1600 per month (Hutu, 2018).

The difficult circumstances, combined with low earnings, a high unemployment rate, and poverty, contribute to criminality and violence. People who live in informal settlements are more likely to be victims of violent crime than people who reside in other areas, particularly children and women, with theft property and violent crime being the most common types of crime (Jansson, 2004). Because most informal settlements rely on shared facilities such as toilets, women and children are at risk of being victims. According to Sinharoy et al. (2019) shared sanitation, defined as any sanitation facility shared by more than one household, can pose security issues and induce tension and anxiety in women and girls, especially when shared among many people.

3.2.4. Environmental conditions



Duncan Village has experienced population growth, particularly since early 2000 due to migration from other parts of the Eastern Cape Province to East London, which has resulted in urban sprawl in the city of East London and a rise in population density, which has had a negative impact on the environmental quality of Duncan Village Township (Hutu, 2018). Duncan Village is plagued by a wide range of pollution, from sewer spills caused by blocked drainage system to land pollution caused by illegal dumping (Figure 7a & b).



Figure 7a & b: Showing examples of sewer spillages in Ward 2 and solid waste pollution in Ward 7, Duncan Village. Source: (Author, October, 2021)



The deplorable state of the environment, according to Seethal et al. (2021), adds to unhealthy living conditions, health risks, and environmental injustice, particularly for children. Seethal et al. (2021) remarked that there have been numerous attempts to better the environmental conditions in Duncan Village, one of which was the 2007 Duncan Village Dense Settlement Project which provided salaried employment for 167 people on a quarterly rotational basis. Nonetheless, waste continued to be dumped illegally on pathways, riversides, and road reserves in Duncan Village on a regular basis.

Furthermore, several proposals to address solid waste management problems are said to have been initiated in Duncan Village by the municipality, including waste reduction educational campaigns, the provision of handcarts and tricycles to allow workers to navigate between houses, and the decentralization of management functions via the establishment of a committee of seventeen people drawn from each

section with the municipal co-ordinator. Despite these attempts, addressing environmental and waste management problems in Duncan Village proved to be hard (Seethal et al., 2021).

3.2.5. Water and Sanitation services in Duncan Village

Siyongwana and Chanza (2019) show that the state of poor water and sanitation in Duncan Village was influenced by its history of forced relocations and resistance by some residents, as well as conflicts, which resulted in the apartheid government withdrawing its support services, making Duncan Village less appealing than Mdantsane. This comes after the apartheid administration requested in 1957, in response to the Duncan Village uprisings, that Amalinda, a white suburb near Mdantsane, be classified as a black settlement. The white residents of Amalinda, on the other hand, were adamant that the area be kept as a white zone. As a result, a different arrangement was developed to accommodate the black people, leading to the suggestion for the establishment of an urban settlement in Mdantsane, which would be fully serviced (Siyongwana and Chanza, 2019).

Duncan Village is serviced by the Buffalo City Metro Municipality. The municipality was founded in the year 2000 by the merging of East London, King William's Town, Bhisho (the previous capital of the homeland Ciskei), various black townships, and their rural hinterlands (Kienast, 2020). Buffalo City was then raised to the status of metropolitan municipality in 2011. As a secondary city surrounded by former homeland lands, it is regarded as one of the most densely populated areas in South Africa (Kienast, 2020). The municipal official claims that the first piloting for the installation of the communal ablution facilities in Duncan Village took place in Ward 7 in 2008 and provision has

continued ever since. In addition, he mentioned that water standpipes “have been around for a while”, albeit he did not provide the exact year. He stated that the provision was made based on the demand in the same manner as it is now.

3.2.5.1. Water services

Buffalo City Metropolitan Municipality (BCMM) according to the Buffalo City Draft Annual Report 2009/2010 (BCMM, 2010) is both the Water Service Authority (WSA) and the Water Services Provider (WSP) for its entire jurisdiction including Duncan Village Township. The Amatola Water Board is an external WSP contracted to the provision on bulk portable water to BCMM to augment the demand by consumers. BCMM being a Water Service Authority (WSA) decides whether to act as Water Service Provider (WSP) itself or whether to outsource this role to another agent (Clifford-Holmes et al., 2016). Aside from providing water and sanitation, BCMM is also responsible for keeping the environment within its authority clean and well-kept by collecting trash and maintaining the sewage system (BCMM, 2010).

Duncan Village's water supply is connected to the municipal water system (Jansson, 2004). The water network in the area is reported more recently by the municipality to be in bad condition, with old infrastructure and water supplies that are insufficient in some areas (BCMM, 2019). Nonetheless, the BCMM annual report for 2018/2019 financial year (BCMM, 2019), indicates that 98% of BCMM population including the study area Duncan Village has access to minimum basic water services and approximately 75 868 indigent consumers receive free basic water (6kl per month).

The report also states that BCMM is generally a water stressed region which is due largely to the lack of additional capacity at water treatment plants, insufficient budget allocations and water losses owing to vandalism, theft, aging and poor maintained infrastructure. The water department, according to the BCMM Integrated Development Plan (IDP) 2020/2021 financial year (BCMM, 2020:96), “has managed to reduce water losses by a massive saving of 6 079 637 kilolitres in 2017, 2018, and 2019”.

3.2.5.2. Sanitation services

In Duncan Village, the sanitation system is primarily connected to the formal houses and the provided shared toilets. In the informal areas, pit latrines or public sanitation facilities are utilized, whereas formal residences have their own flush toilets (Jansson, 2004). Living conditions in Duncan Village's informal settlements remained appalling even after the Duncan Village Redevelopment Initiative was established (Kienast, 2020). It is indicated that during the apartheid era, many people living in shacks relied on public toilets and the so-called bucket system.

According to research conducted by the Eastern Cape NGO Coalition in May 2009, 333 shack inhabitants had to use one public toilet on average, as reported in the Daily Dispatch on 19 and 27 May 2009 (Kienast, 2020). The research shows that angry community rallies about a lack of service delivery were reported in the Daily Dispatch on July 28, 2009, and March 18, 2011, indicating that fifteen years after the first democratic elections, shack dwellers had lost patience waiting for fully serviced homes. According to Kienast (2020), Buffalo City provided 26 "movable ablution blocks" throughout the next three preceding financial years (2011, 2012, and 2013) in

response to that. However, given the continued lack of maintenance and security, it is no surprise that service delivery protests continued to occur (Kienast, 2020).

Duncan Village residents utilize the municipality's shared stand-alone toilets and standpipes, which are mostly positioned at the edge of each informal settlement (Ndhlovu, 2015) (Figure 8a & b). Depending on the size of the area, these communal toilets are used by at least a hundred to three hundred people. In the more informal portions of Duncan Village, the bucket system is heavily used for daily tasks. Residents prefer to use the bucket system, according to Ndhlovu (2015), because toilets are often located far from residents' shacks and are dangerous to use, particularly at night and particularly for women.



Figure 8a and b: Showing examples of communal ablution block in Ward 7 and Ward 8 respectively in Duncan Village. Source: (Author, October 2021)

3.3. Overview of Duncan Village informal settlements wards

The study's objectives require the researcher to collect data in Duncan Village informal settlements wards. As part of the data collection, the researcher using a systematic sampling method selected 50 households in five wards (see section 3.4) in order to determine the water and sanitation challenges that the areas face, as well as the causes of those challenges. Ward councillors were also interviewed to find out more about how the municipality manages water and sanitation in their wards.

Buffalo city metro municipality consists of 50 wards, with five wards (Figure 9) representing the study area Duncan Village namely: Ward 1, 2, 6, 7, and 8 (BCMM, online). A description of these wards follows.

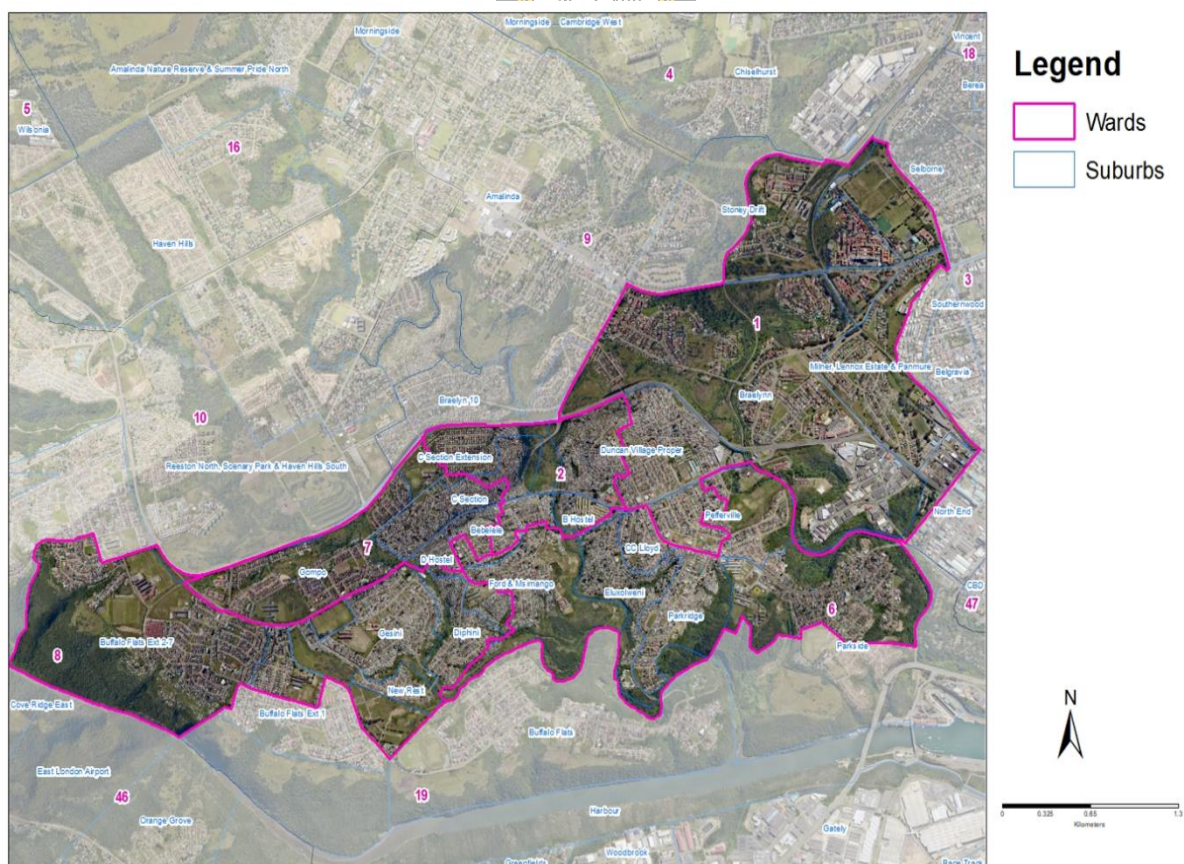


Figure 9: The location of Duncan Village five wards. Source (BCMM, 2022)

3.3.1. Ward 1 Duncan Village informal settlements

Ward 1, as seen in (Figure 10), is characterised by a higher proportion of formal houses and fewer informal settlements (bordered in red colour) than the other Duncan Village wards. According to the municipal records, there are 100 communal ablution facilities in Ward 1, and street-standpipes or water basins with water taps. Parks, marshes, steep slopes, and floodplains make up the majority of the open spaces visible on the map, which are mostly on the formal side of Ward 1.

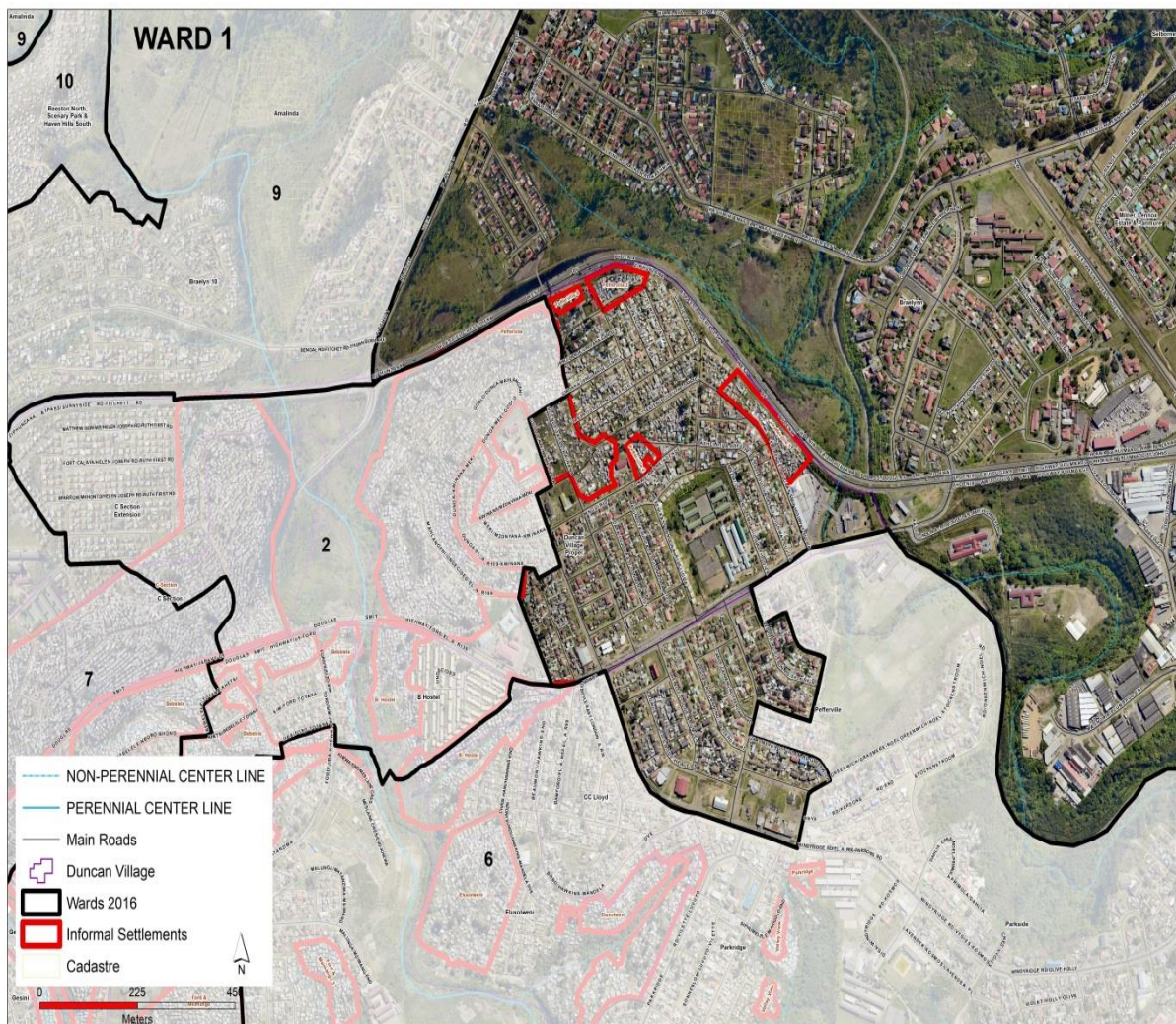


Figure 10: Duncan Village informal settlements under Ward 1. Source: (BCMM GIS, 2021)

3.3.2. Ward 2 Duncan Village informal settlements

Unlike Ward 1, Ward 2 contains a large number of informal settlements in between and on the edges of formal houses. Residents occupy a large portion of Ward 2. More informal communities (bordered in red) are found on steep slopes reaching towards flood plains, as seen in (Figure 11). There are 260 communal ablution facilities in Ward 2, with either street-standpipes or water basins with water taps. A wetland makes up the open space visible on the centre point of the map.

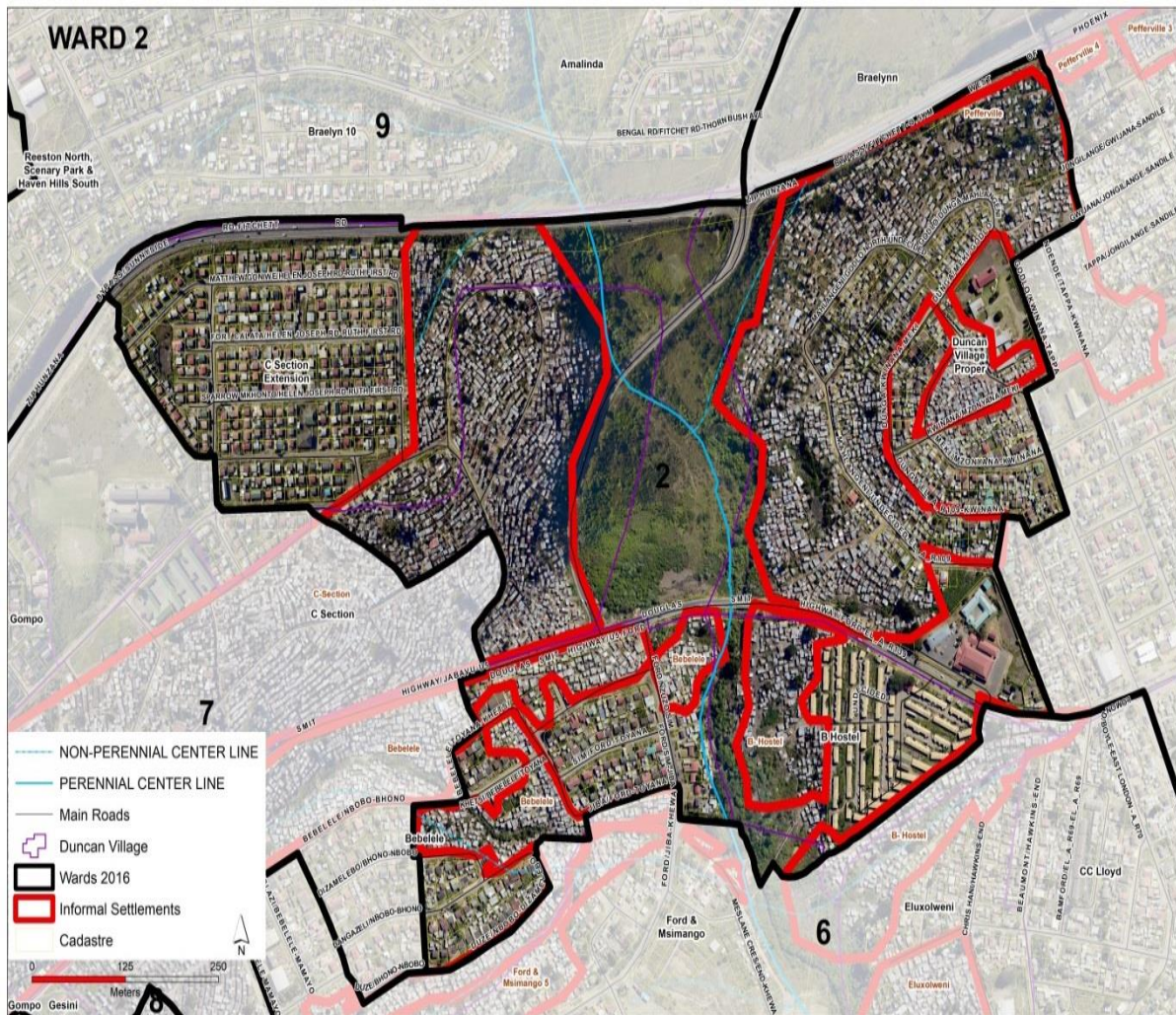


Figure 11: Duncan Village informal settlements under Ward 2. Source: (BCMM GIS, 2021)

3.3.3. Ward 6 Duncan Village informal settlements

Ward 6 has a considerable number of informal settlements in between formal houses, as found in Ward 2. Most informal settlements (bordered in red) are located on steep slopes and are primarily erected around rivers and marshes, as seen in the other Wards (Figure 12). There are 180 communal ablution facilities in Ward 6, with either street-standpipes or water basins with water taps. The majority of visible open spaces on the map are steeper hills and marshes.

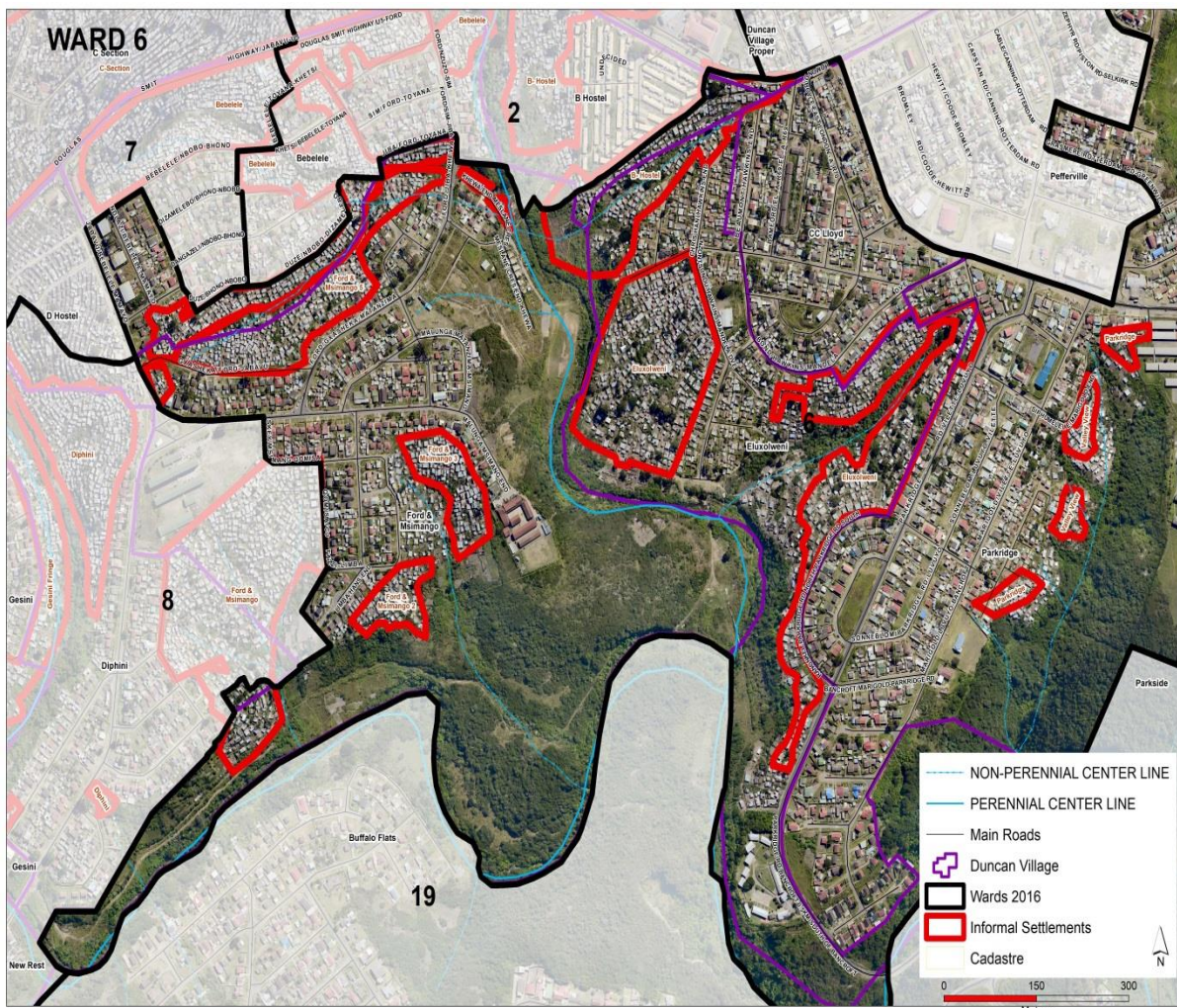


Figure 12: Duncan village informal settlements under Ward 6. Source: (BCMM GIS, 2021)

3.3.4. Ward 7 Duncan Village informal settlements

Ward 7 has the highest density of informal settlements compared to the other wards (Figure 13). In contrast to other wards, the formal and informal sections are clearly separated (bordered in red colour). The formal side has open places such as sports fields and planned developments, but the informal side is completely dominated by informal houses. There are 270 communal ablution facilities in Ward 7, with either street-standpipes or water basins with water taps.

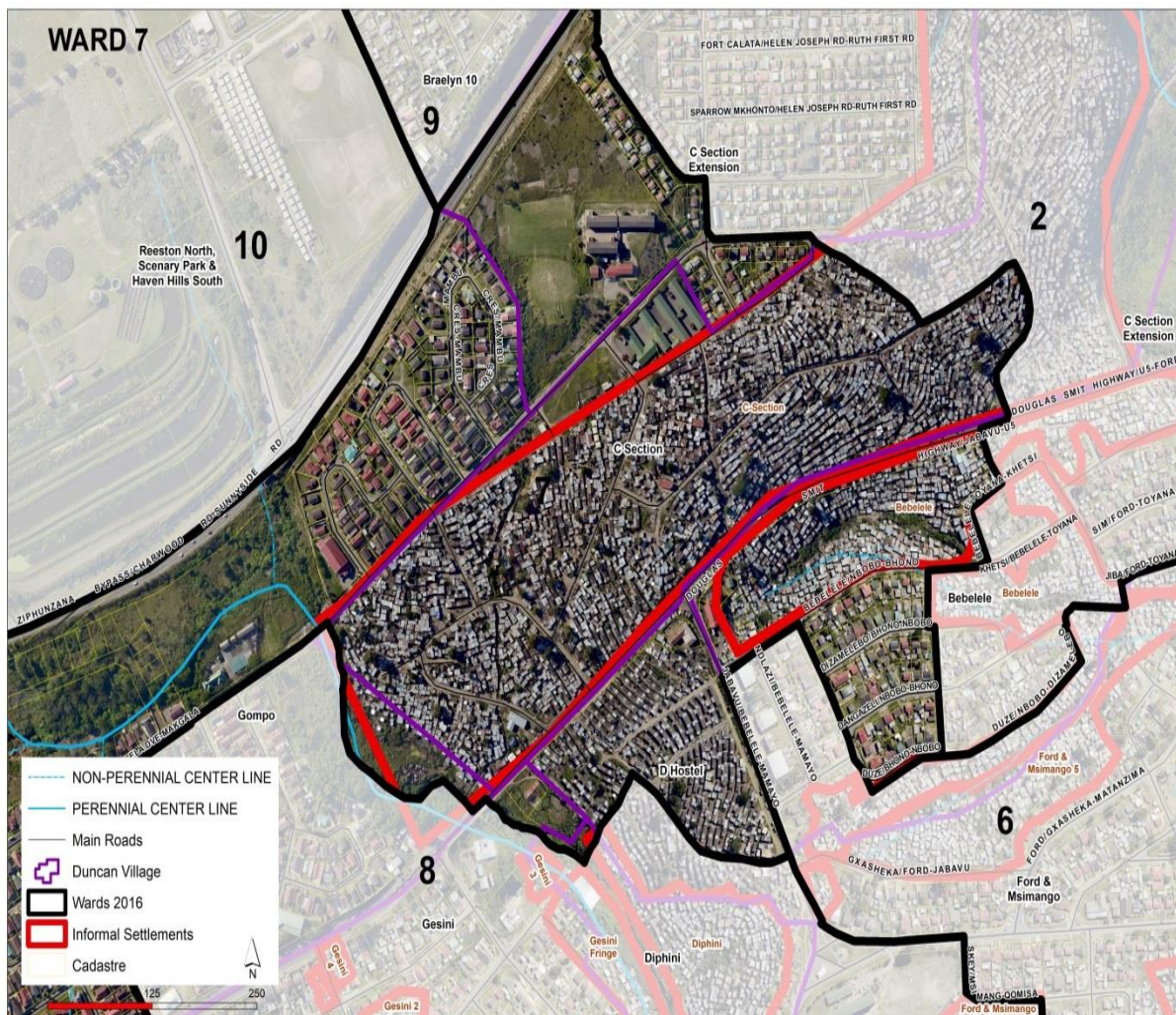


Figure 13: Duncan Village informal settlements under Ward 7. Source: (BCMM GIS, 2021)

3.3.5. Ward 8 Duncan Village informal settlements

Ward 8 is generally characterized by formal houses. Informal communities (bordered in red) are typically found on floodplains on the outskirts of established residential houses (Figure 14). There are 220 communal ablution facilities in Ward 8, with either street-standpipes or water basins with water taps. The open spaces depicted on the map are mostly formal development sites and sports fields, which are mostly found on formal sections.

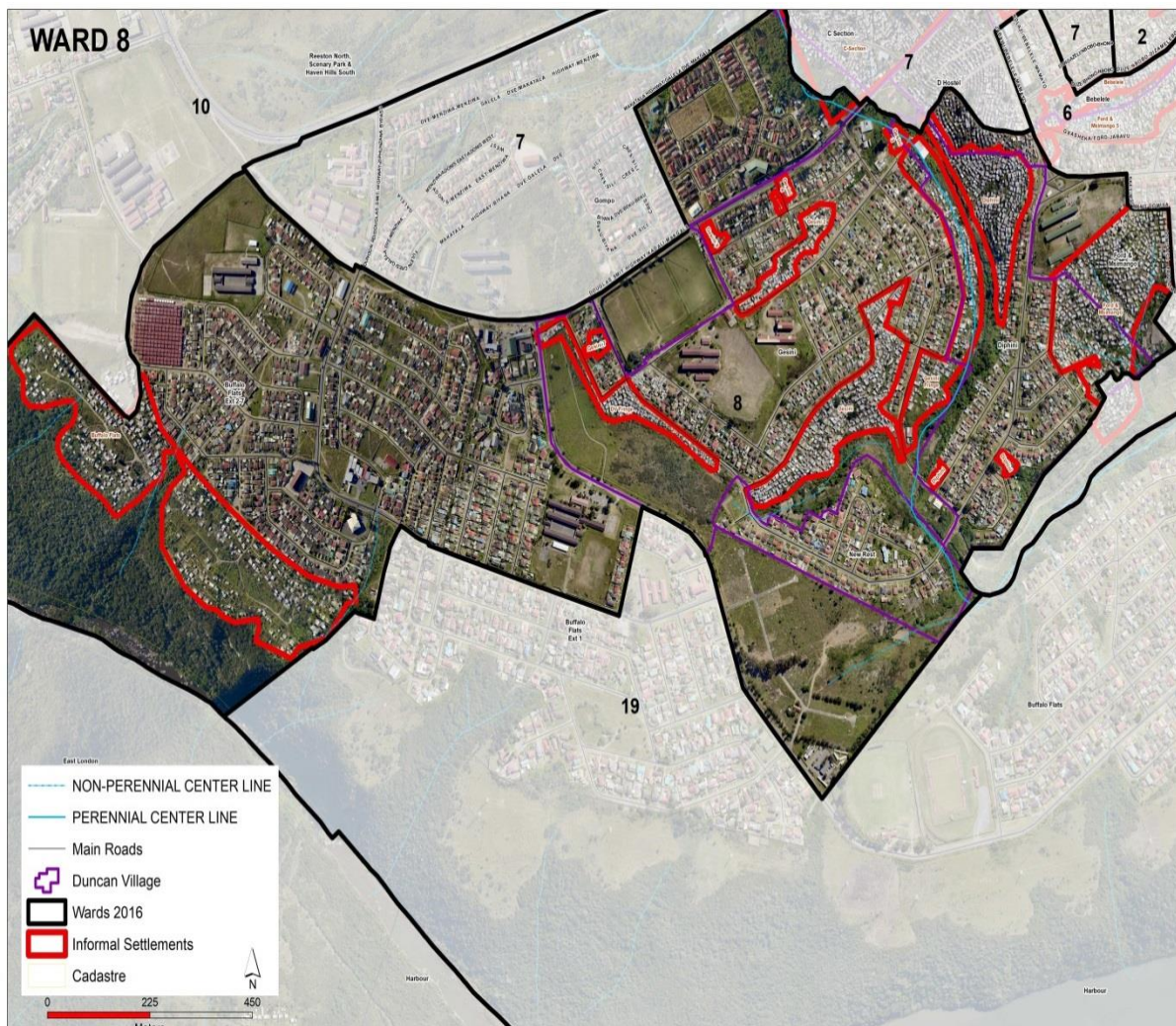


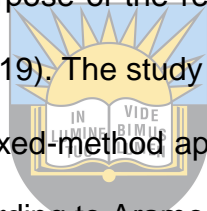
Figure 14: Duncan Village informal settlements under Ward 8. Source: (BCMM GIS, 2021)

3.4. Research Methodology

A research methodology is defined by Ade Bilau et al. (2018) as the theory and analysis of conducting research. It justifies the methodological framework used in generating research data and conducting analysis in order to create knowledge.

3.4.1. Research design

The term "research design" refers to the decisions made regarding how the study is conceptualised, how a specific research project is carried out, and what kind of contribution the research is meant to make to the advancement of knowledge in a given field (Cheek, 2008). The purpose of the research design is to offer a suitable framework for a study (Sileyew, 2019). The study employed a mixed-method strategy to meet the study objectives. A mixed-method approach considers both qualitative and quantitative approaches, according to Aramo-Immonen (2013).



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A qualitative approach allows the researcher to have a greater understanding of participants' experiences (Barret and Twycross, 2018). The goal of this study was to assess the water and sanitation challenges in the Duncan Village informal settlements and make recommendations for possible remedies. This was accomplished by employing questionnaires to gather data, analysing the collected data, and interpreting the collected data.

A quantitative approach gathers numerical data that must be analysed in order to make conclusions from the investigation (Albers, 2017). This was done by employing questionnaires to present obtained data during the investigation from the Duncan

Village informal settlements. The form of questions in this study was adopted from the study conducted by Timba (2005). Bar graphs, pie charts and tables were used to present collected data.

The age of respondents began from 16 years old upwards as per the research design. Any person from the age of 16 found at the sampled households during data collection, whether renting as a backyard dweller or a permanent member of the household qualified to complete the questionnaire. All targeted households during data collection had respondents. Only one person in the household responded. Other prospective respondents in sampled households were either in high school, tertiary institutions, or at work during data collection, which influenced the study findings. The findings solely represented the perspectives of the present respondents per household and could have been different. COVID-19 also had a significant influence on study findings particularly on the employment outcome which could have been different under normal circumstances.



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3.4.2. Research population

The research population is described as a group of people who share common features and are of interest to the researcher (Sileyew, 2019). This study targeted the householders, ward councillors, and a municipal officer from the Buffalo City Metro Municipality's Water and Sanitation section representing the Duncan Village informal settlements. The Citizens Handbook (undated) indicates that there are approximately 14, 000 informal dwellings in the research study area, located within the divided five wards of Duncan Village (Ndhlovu, 2015; Hutu, 2018).

3.4.3. Sampling methods

Sampling is the process of selecting actual data sources from a broader pool of options (Given, 2008). Because of the vastness and congestion of the study area, the researcher used a systematic sampling method to select the households. Mostafa and Ahmad (2017) define systematic sampling as a sampling design wherein only the first unit is randomly selected, and the rest is automatically selected according to a set pattern. To achieve this, the following was done:

In each of the five wards of Duncan Village, targeting the informal settlements, the researcher started sampling the first informal household closest to the main road as household number 1, then moved into the centre of the informal households in a linear pattern selecting every fourth informal household until 50 households were sampled. Informal households on the outskirts were not sampled due to the distance from the main road.



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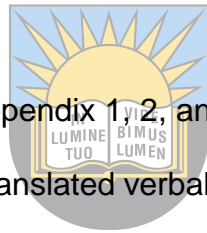
3.4.4. Sampling size

A sample size refers to the number of data sources chosen from the entire population (Given, 2008). The Citizens Handbook (accessed online) states that, there are 3,500 formal dwellings and 14,000 shacks in Duncan Village. A sample size for this study therefore came out from the estimated 14,000 informal households. To obtain a manageable sample of respondents from this large number of households across the five wards of Duncan Village, the researcher used a systematic sampling method as clarified under 3.4.3. to sample 50 households in each of the five wards. Similar sampling technique was used by Timba (2005) wherein fifty households were sampled

from two hundred households in Mthuzuni settlement in the Bushbuckridge Local Municipality.

3.4.5. Data collection

The term “data”, as stated by Given (2008), refers to a collection of information. A more extensive description comprises sorts of data, such as numbers, text, photos, video, audio, and concepts, that combine to generate the collected information. The data for this study was collected through a field study that included prepared questionnaires for the householders (Appendix 1), ward councillors (Appendix 2), and a municipal official (Appendix 3), as well as participant observation. Ethical clearance was observed as per (Appendix 4).



With regards to questionnaires (Appendix 1, 2, and 3), the questions were composed in the English language and then translated verbally into isiXhosa language in-person, only on request in instances where respondents did not understand the question in English. None of the householders did not speak English at all. Although not specifically noted, it is estimated that less than one in ten householders in each of the five wards needed clarification in isiXhosa, and this was done only in parts, and not in all questions. Some respondents were hesitant to participate in the study with the fear of being exposed, however, none of them refused to take part. Leading nature of the first three questions under section D and first question under section E of the questionnaires was acknowledged as they may have influenced the outcome of the responses because the respondents may have been ashamed to reveal their poor hygiene practices. Boynton and Greenhalg (2004) indicate that questionnaires provide an objective method of gathering data about people's knowledge, beliefs, attitudes, and behaviour.

Research objectives	Research questions	Analysis and data presentation
i. Identify water and sanitation challenges in the Duncan Village informal settlements through quantitative and qualitative data collection on water and sanitation provision.	i. What are the actual water and sanitation challenges in the Duncan Village informal settlements?	Data was collected using questionnaires. Responses were analysed and discussed under Chapter 4 of the study. Analysed data was presented in a form of graphs, pie charts, and tables.
ii. Discuss the causes and consequences of water and sanitation challenges in the Duncan Village informal settlements.	ii. What are the exact causes of water and sanitation challenges in the Duncan Village informal settlements?	Discussion came from a total 250 householders' responses together with the responses from the 5 ward councillors and a response from a municipal officer. This was done under Chapter 4 of the study and was presented in a form of graphs, pie charts, and tables.
iii. Recommend better ways to the local municipality to minimise water and sanitation challenges in the Duncan Village informal settlements.	iii. Is the municipality doing enough to minimise water and sanitation challenges in the Duncan Village informal settlements and if not, what can be done to solve the situation in the Duncan village informal settlements?	Key recommendations were sated under Chapter 6 of the study.

Table 1: Showing how the researcher collected data for each study objective.

With regards to participant observation, the researcher went to site to observe the water and sanitation situation and the surrounding study area in general as well as the residents' behaviour towards the provided water and sanitation facilities. Barret and Twycross (2018) state that participant observation is an excellent strategy for gathering qualitative data because it allows researchers to acquire a wide range of

information. A camera was used to take pictures of the existing state of water and sanitation facilities. No image of a person was captured at site. The researcher also took detailed notes whilst at site in order to avoid forgetting critical details during data analysis. The table (Table 3.4.5) below shows how the researcher collected data for each of the research objectives.

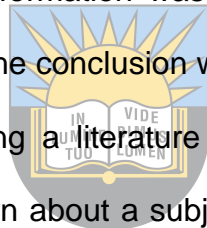
3.4.6. Data analysis

According to Kelley et al. (2003), the objective of data analysis is to synthesize data such that it is easily understood and to also provide answers to the research questions. To analyse the collected data, all 250 respondents' responses were divided into groups according to each question per ward. Similar answers that might not have been exact answers were grouped into one and analysed as same answers. The data were grouped for the purpose of identifying differences among them and calculating the proportion of respondents for each question. When analysing the questionnaires, the researcher made sure that the information was consistent with the study's aim and objectives. The data was displayed in the form of bar graphs, pie charts and tables, which included statistical data. Graphs and charts according to Haughton and Stevens (2010), are an excellent means of presenting information and calling attention to particular elements that may be less obvious in a table format.

With regards to participant observation analysis, the researcher in this study employed photographs and field notes. The images were captured during participant observation. This included images of the surrounding environment, as well as water and sanitation facilities currently in use by the community. No images of people were taken during participant observation. During the site visits, the researcher took

numerous notes from year 2019 to 2021 that described the surrounding region, existing water sources, and sanitation facilities in use. The notes were summarised and linked to the images. The observed obstacles and the reported practical status quo of the surrounding area led to a conclusion. Field notes can take several forms (Barret and Twycross, 2018), including a chronological log of what is happening in the environment, a description of what has been observed, a record of talks with participants, or an expanded account of impressions from the fieldwork.

The researcher also analysed the literature by examining existing research on water and sanitation challenges in informal settlements that had been undertaken both internationally and locally. The information was sorted and summarised from the previously prepared documents. The conclusion was reached based on the facts that had been summarised. Conducting a literature review analysis is critical since it consolidates what is already known about a subject (Winchester and Salji, 2016). It also allows you to discover any knowledge gaps and how your research could help fill those gaps.



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4. Chapter 4: Findings

4.1. Introduction

This chapter presents the research findings. The findings were analysed from the questionnaires (Appendix 1, 2, and 3) and explained with the help bar charts and tables. This chapter is developed and organised in a way that is consistent with the study's aims and objectives. The study revealed that there are water and sanitation challenges in the Duncan Village informal settlements. The findings were gathered from Duncan Village's five wards, with a focus on informal settlements. This chapter also played a significant role in identifying potential solutions to the water and sanitation challenges in Duncan Village informal settlements that could help the municipality as discussed in Chapter 5.



4.2. Householders' response

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Fifty households from each of the selected Duncan Village's five wards, targeting informal settlements, formed part of the respondents by the use of questionnaires. The study was able to draw a total sample of 250 respondents with the support of the ward councillors in order assist in identifying the actual water and sanitation challenges in the Duncan Village informal settlements and to determine the causes of such challenges.

4.2.1. Biographical profile of the respondents

4.2.1.1. Age composition of the respondents

Ward 1 households (n = 50, for each ward) were dominated by respondents between the ages of 45 and above with 15 respondents. Followed by respondents between the ages of 35 and 44 with 11 respondents. Then 12 respondents between the ages of 16 and 24 as well as those between the ages of 25 and 34.

In Ward 2, respondents between the ages of 25 and 34 was made up of 17 respondents. Followed by 16 respondents between the ages of 45 and above. Then 10 respondents between the ages of 16 and 24, and 7 respondents between the ages of 35 and 44.



In Ward 6, respondents between the ages of 25 and 34 were 14. Respondents between the ages of 16 and 24 as well as those between the ages of 45 and above were made up of 13 respondents, followed by the respondents between the ages of 35 and 44 with 10 respondents.

Ward 7 householders were dominated by respondents between the ages of 25 and 34 with 18 respondents, followed by respondents between the ages of 45 and above with 13 respondents. Respondents between the ages of 35 and 44 were made up of 11 respondents, followed by 8 respondents between the ages of 16 and 24.

In Ward 8, respondents between the ages of 45 and above formed were 18, followed by respondents between the ages of 25 and 34 with 16 respondents. Respondents

between the ages of 16 and 24 were made up of 12 respondents, followed by the respondents between the ages of 35 and 44 with 4 respondents.

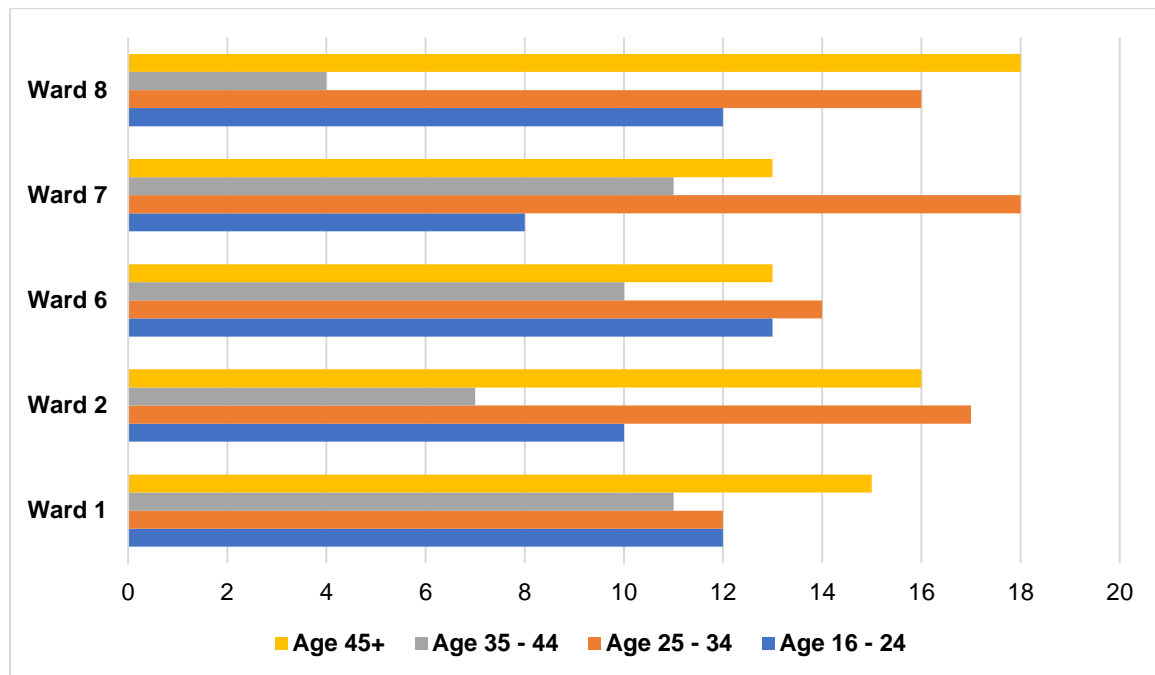
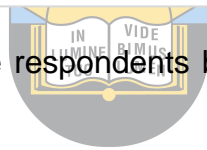


Figure 15: Age composition of the respondents by ward in Duncan Village informal settlements (n = 50, per ward).



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4.2.1.2. Overall age composition of the respondents

An overall average percentage of respondents (n = 250) in all five wards of Duncan Village was made up of respondents between the ages of 25 and 43 with 30,8%. This is due to unemployment because data collection happened during working hours. It is also linked to a lack of education, resulting in residents being unemployed and staying at home. Taylor (2017) indicates that people in poor communities are less likely to complete school. Respondents between the ages of 45 and above followed with 30.0%. Then 22.0% of respondents between the ages of 16 and 24, and 17,2% of those between the ages of 35 and 44.

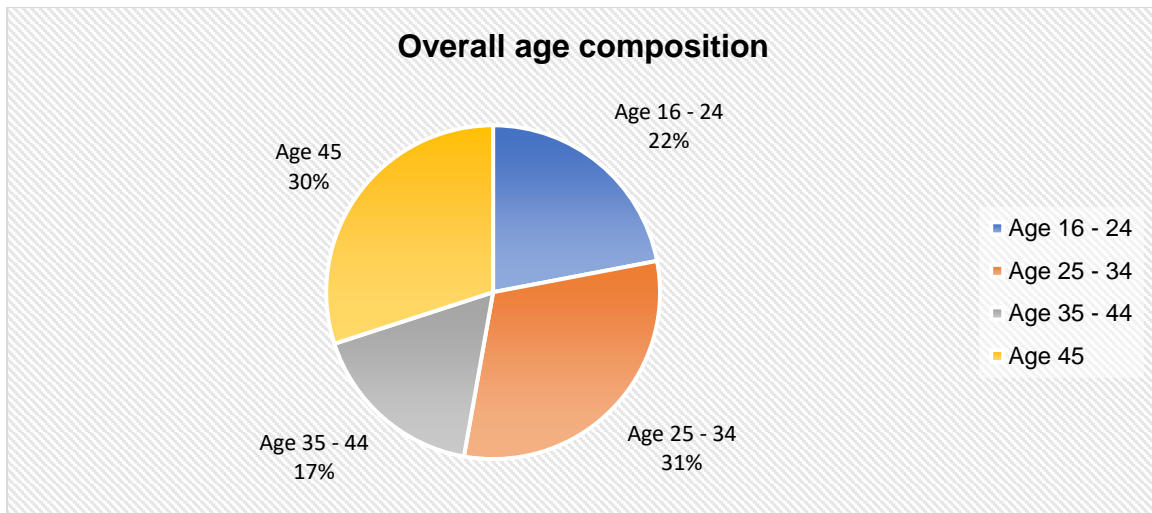


Figure 16: Overall age composition of the respondents in all wards of Duncan Village informal settlements (n = 250, from all five surveyed wards).

4.2.1.3. Gender composition of the respondents

Ward 1 had 20 female respondents (n = 50, for each ward) and 30 males. Ward 2 had 25 female respondents and 25 males. Ward 6 had 20 female respondents and 30 males. Ward 7 had 16 female respondents and 34 males. Ward 8 had 19 female respondents and 31 males.

Ward (s)	Females	Males	Total (250)
Ward 1	20	30	50
Ward 2	25	25	50
Ward 6	20	30	50
Ward 7	16	34	50
Ward 8	19	31	50
Average (%)	40.0	60.0	100%

Table 2: Gender composition of the respondents by wards (n = 50, per ward) and total for respondents combined for Duncan Village informal settlements.

4.2.1.4. Overall gender composition of the respondents

Across all 5 wards (n = 250) of Duncan Village, female respondents were made up of 40%, and 60% were male respondents.

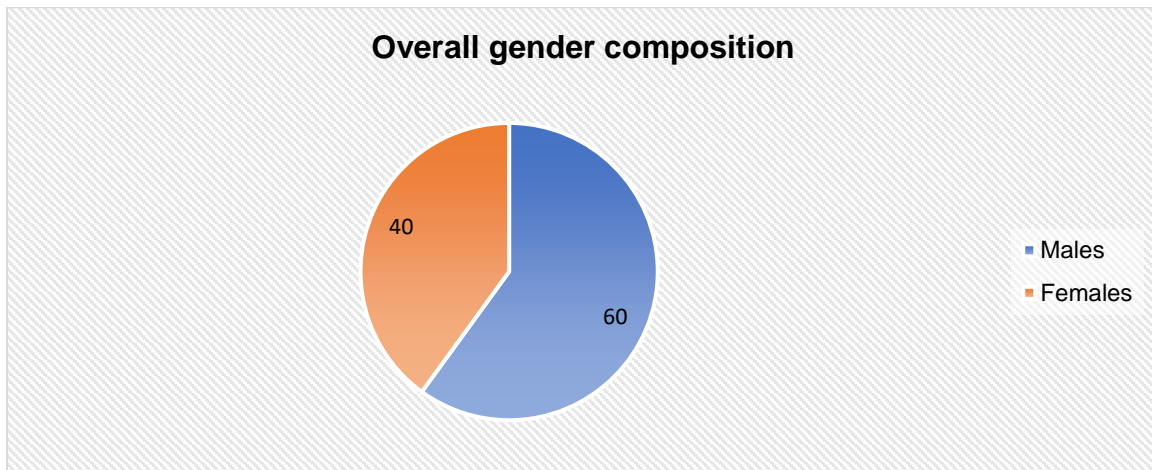


Figure 17: Overall gender composition of the respondents in all wards of Duncan Village informal settlements (n = 250, from all five surveyed wards).

4.2.1.5. Composition of educational background of the respondents

In Ward 1, 10 respondents (n=50, for each ward) present during data collection had no formal education. Only 3 respondents completed their schooling at the primary level. 22 respondents completed their education at the secondary level, while the remaining 15 respondents completed their education at the tertiary level.

Only 4 respondents who were present during data collection in Ward 2 had no formal education. 12 respondents completed their education at the primary level. 21 respondents completed their education at the secondary level, while the remaining 13 completed their education at the tertiary level.

In Ward 6, 10 respondents present during data collection had no formal education. 2 respondents finished school at primary level. 17 respondents completed their education at the secondary level, while the remaining 21 completed their education at the tertiary level.

In Ward 7, 7 respondents present during data collection did not have any formal education. Only 9 respondents finished schooling at primary level. 24 respondents finished their education at the secondary level, while the remaining 13 finished at the tertiary level.

In Ward 8, 11 respondents present during data collection had no formal education. Only 2 respondents completed their education at primary school. 24 respondents completed their education at the secondary level, while the remaining 13 completed their education at the tertiary level.



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Ward (s)	No formal education	Primary	Secondary	Tertiary	Total (250)
Ward 1	10	3	22	15	50
Ward 2	4	12	21	13	50
Ward 6	10	2	17	21	50
Ward 7	7	9	30	4	50
Ward 8	11	2	24	13	50
Average %)	16.8	11.2	45.6	26.4	100%

Table 3: Composition of educational of the respondents by ward in Duncan Village informal settlements (n = 50, per ward).

4.2.1.6. Overall composition of educational background of the respondents

Across all surveyed five wards (n = 250) of Duncan Village informal settlements, 16.8% of the respondents present during data collection had no formal education. Only 11.2% of the respondents completed their education at primary school. 45.6% of the respondents completed their education at the secondary level, while the remaining 26.4% completed their education at the tertiary level.

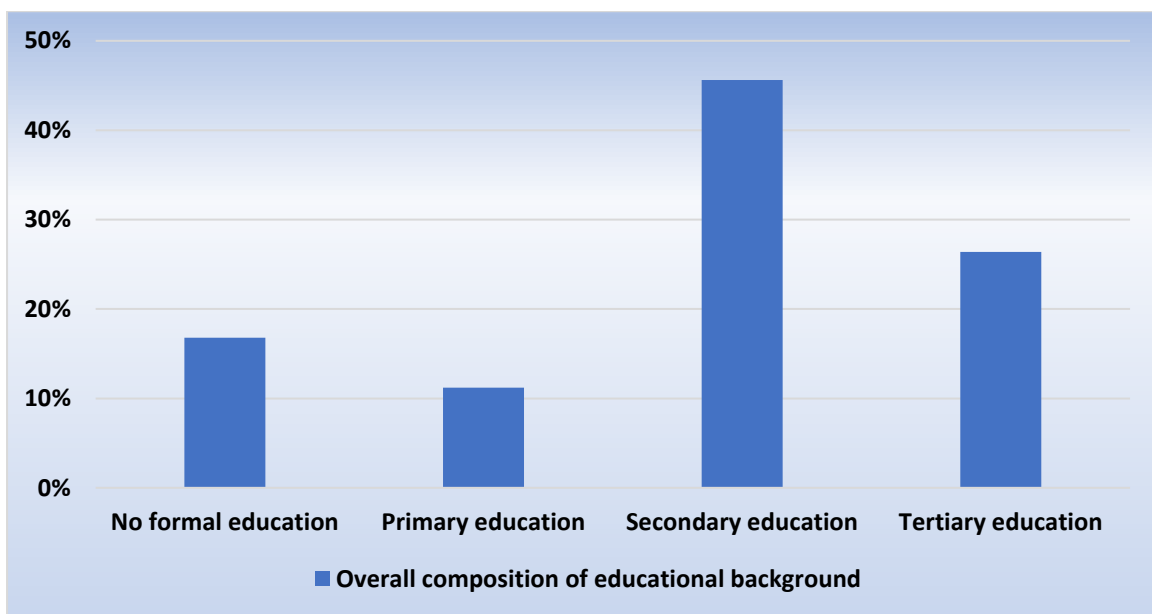


Figure 18: Overall composition of educational of the respondents in all wards of Duncan Village informal settlements (n = 250, from all five surveyed wards).

4.2.1.7. Composition of source of income of the respondents

Findings in Ward 1 showed 24 unemployed respondents (n = 50, for each ward) present during data collection, with 11 reliant on social grants. 5 represented pensioners, while the other 4 represented self-employed respondents. The remaining 6 was made up of employed respondents.

According to Ward 2 findings, 15 was made up of unemployed respondents present during data collection, with 17 of the respondents relying on government assistance. 3 represented retired respondents, with 8 self-employed, and 7 working respondents.

Ward 6 findings revealed 18 unemployed respondents present during data collection, with 16 relying on social grants. 3 of the respondents represented pensioners, with 3 being self-employed, and the remaining 10 employed.

Ward 7 findings indicated 20 unemployed respondents present during data collection, with 8 relying on government assistance. Pensioners were made up of 9 respondents, with self-employed made up of 7 respondents and employed made up of the remaining 6 respondents.



According to Ward 8 findings, 22 represented unemployed respondents present during data collection, with 9 relying on social grants. 3 on the other hand represented pensioners, while 4 was made up of self-employed respondents, and the remaining 12 representing employed respondents.

Ward (s)	Unemployed	Social grant	Pensioner	Self-employed	Employed	Total (250)
Ward 1	24	11	5	4	6	50
Ward 2	15	17	3	8	7	50
Ward 6	18	16	3	3	10	50
Ward 7	20	8	9	7	6	50
Ward 8	22	9	3	4	12	50
Average (%)	39.6	24.4	9.2	10.4	16.4	100%

Table 4: Composition of social income of the respondents by ward in Duncan Village informal settlements (n = 50, per ward).

4.2.1.8. Overall composition of source of income of the respondents

Across all surveyed five wards (n = 250) of Duncan Village informal settlements, 39.6% was made up of unemployed respondents present during data collection, with 24.4% of the respondents relying on social grant. 9.2% represented pensioners, with 10.4% self-employed, and 16.4% employed respondents.

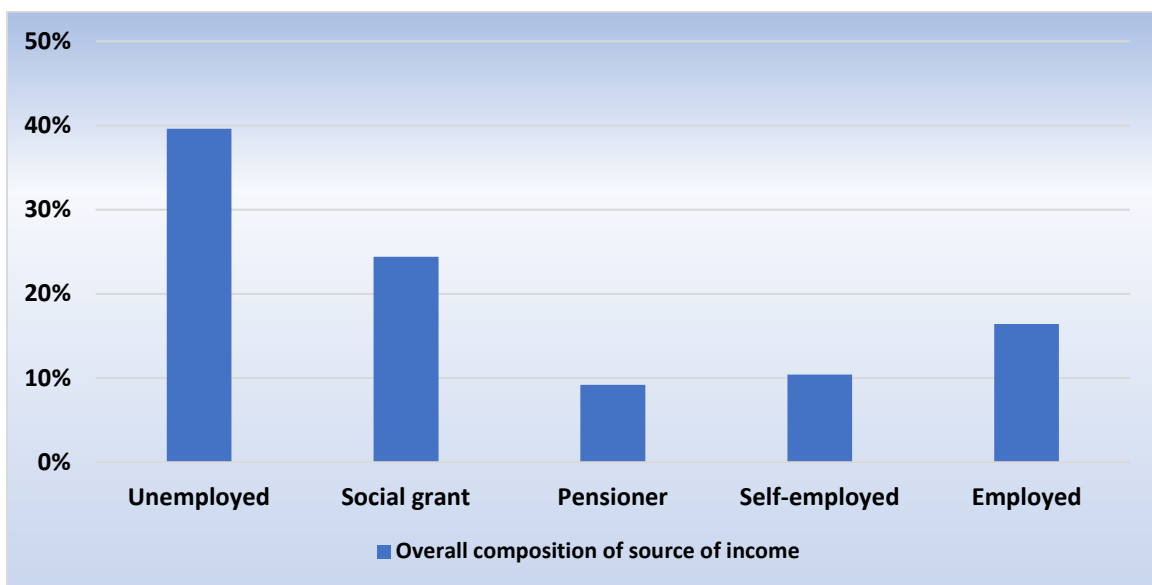


Figure 19: Overall composition of social income of the respondents in all wards of Duncan Village informal settlements (n = 250, from all five surveyed wards).

4.2.2. Household information

4.2.2.1. Duration of stay of respondents in Duncan Village informal settlements

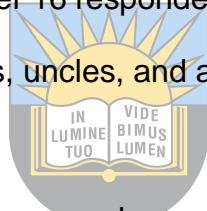
Across all surveyed five wards of Duncan Village informal settlements, 68% of the respondents who were present during data collection indicated that they were born in Duncan Village, while the remaining 32% was made up of respondents who came to Duncan Village from 3 years back and above, mostly for job hunting and school.

4.2.2.2. Total number of respondents' family members

In all five surveyed wards of Duncan Village informal settlements, respondent's households were made up of adult family members ranging from one to three, and children ranging from two to six family members.

4.2.2.3. Composition of respondents' breadwinners

In Ward 1, breadwinners who are mothers were made up of 12 respondents (n = 50, for each ward), while breadwinners who are fathers were made up of 18 respondents. Grandfathers were made up of 2 respondents, while grandmothers were made up of 2 respondents as well, with the other 16 respondents represented the others category which consisted of brothers, sisters, uncles, and aunts.



Breadwinners who are mothers were made up of 9 respondents in Ward 2, while breadwinners who are fathers were made up of 28 respondents. Grandfathers accounted for 2 respondents, while grandmothers were represented by 1 respondent, with the remaining 9 falling into the category of others.

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Breadwinners who are mothers were represented by 10 respondents in Ward 6, while breadwinners who are fathers were represented by 16 respondents. Grandfathers were represented by 3 respondents, while grandmothers were represented by 1 respondent, with the remaining 20 falling into the "others" category.

Mothers were made up of 16 respondents in Ward 7, while fathers were made up of 18. Grandfathers were made up of 1 respondent, while grandmothers were represented by 2 respondents, and the remaining 13 were classified as "others."

Breadwinners who are mothers were made up 7 respondents in Ward 8, while breadwinners who are fathers were made up of 7 respondents as well. Grandfathers did not have any representative as a respondent, while grandmothers had 1 respondent, with the remaining 35 falling into the "others" group.

Ward (s)	Mothers	Fathers	Grandmothers	Grandfathers	Others	Total
Ward 1	12	18	2	2	16	50
Ward 2	9	29	2	1	9	50
Ward 6	10	16	3	1	20	50
Ward 7	16	18	2	1	13	50
Ward 8	7	7	1	0	35	50
Average (%)	21.6	35.2	4.0	2.0	37.2	100%

Table 5: Composition of respondents' breadwinners of the respondents by ward in Duncan Village informal settlements (n = 50, per ward).

4.2.2.4. Overall composition of respondents' breadwinners

Across all surveyed five wards (n = 250) of Duncan Village informal settlements, breadwinners who are mothers were made up of 21.6% of respondents, while breadwinners who are fathers were made up of 35.2% respondents. Grandfathers were made up of 2.0% of respondents, while grandmothers were made up of 4.0% of respondents, with the other 37.2% of respondents represented the others category which consisted of brothers, sisters, uncles, and aunts.

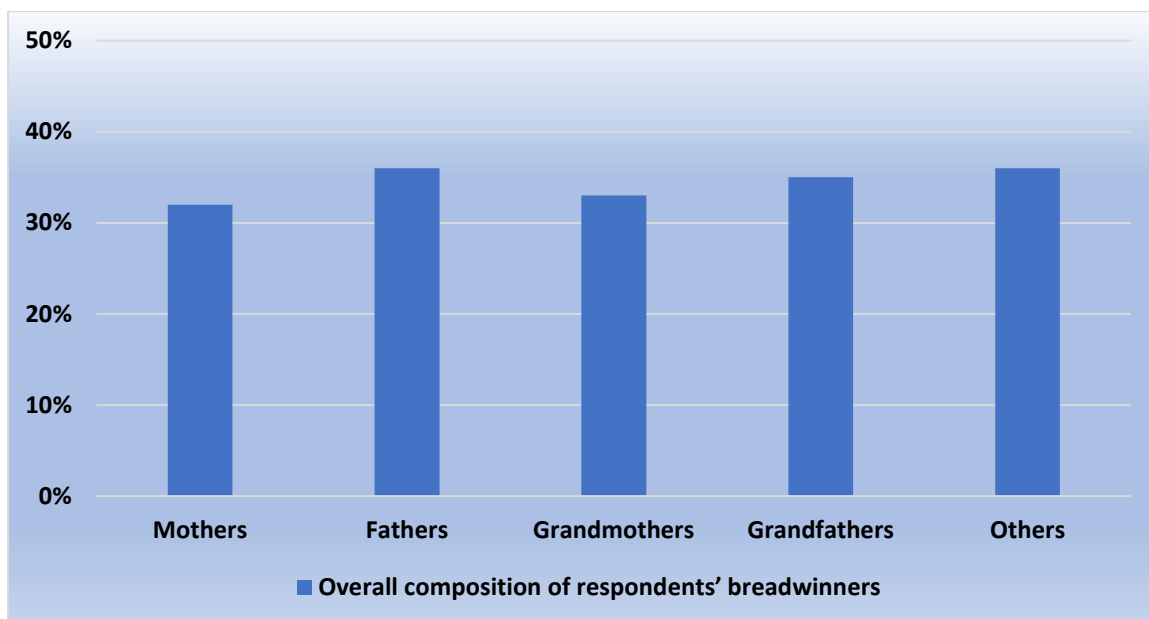


Figure 20: Overall composition of respondents' breadwinners of the respondents in all wards of Duncan Village informal settlements (n = 250, from all five surveyed wards).



4.2.2.5. Composition of breadwinner's occupation

Breadwinner's occupations across all five surveyed wards of Duncan Village informal settlements ranged from self-employed respondents to social grants recipients, cashiers, petrol attendants, those in contracts, security guards and pensioners.

4.2.2.6. Composition of respondents' breadwinners' monthly income

In Ward 1, 4 respondents (n = 50, for each ward) present during data collection were earning less than R1000 per month, with 20 earning between R1000 and R2500. Respondents earning between R2501 and R4000 made up 9 respondents, while respondents earning between R4001 and R5000 made up 3, and respondents earning more than R5501 made up the remaining 14.

In Ward 2, respondents present during data collection earning less than R1000 per month were represented by 18 respondents, with 23 earning between R1000 and R2500. respondents earning between R2501 and R4000 were represented by 5 respondents, while those earning between R4001 and R5000 were made up of 2 respondents, and those earning more than R5501 were represented by the remaining 2.

In Ward 6, of the 50 respondents present during data collection, no one represented those earning a monthly income of less than R1000. 16 respondents had a monthly income of between R1000 and R2500. Those earning between R2501 and R4000 were represented by 18 respondents, while those earning between R4001 and R5000 were made up of 5 respondents. Those earning more than R5501 were made up of 11 respondents.



In Ward 7, 9 respondents present during data collection earned less than R1000 per month, while 29 earned between R1000 and R2500. Respondents earning between R2501 and R4000 were made up of 6 respondents, while those earning between R4001 and R5000 were made up of 3 respondents. Respondents earning more than R5501 were represented by 3 respondents as well.

Of all respondents present during data collection, those earning less than R1000 per month were represented by 1 respondent in Ward 8, with 17 earning between R1000 and R2500. Respondents earning between R2501 and R4000 were also made up of 17 respondents, while those earning between R4001 and R5000 we represented by

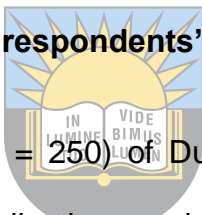
accounted 8 respondents. Those earning more than R5501 were made up of 7 respondents.

Ward (s)	<R1000	R1000 – R2500	R2501 – R4000	R4001 – R5500	R5501	Total
Ward 1	4	20	9	3	14	50
Ward 2	18	23	5	2	2	50
Ward 6	0	16	18	5	11	50
Ward 7	9	29	6	3	3	50
Ward 8	1	17	17	8	7	50
Average (%)	12.8	42.0	22.0	8.4	14.8	100%

Table 6: Breadwinner’s monthly income composition of the respondents by ward in Duncan Village informal settlements (n = 50, per ward).

4.2.2.7. Overall composition of respondents’ breadwinners’ monthly income

Across all surveyed five wards (n = 250) of Duncan Village informal settlements, respondents present during data collection earning less than R1000 per month were represented by 12.8% of respondents, with 42% earning between R1000 and R2500. respondents earning between R2501 and R4000 were represented by 22% of respondents, while those earning between R4001 and R5000 were made up of 8.4% of respondents, and those earning more than R5501 were represented by the remaining 14.8%.



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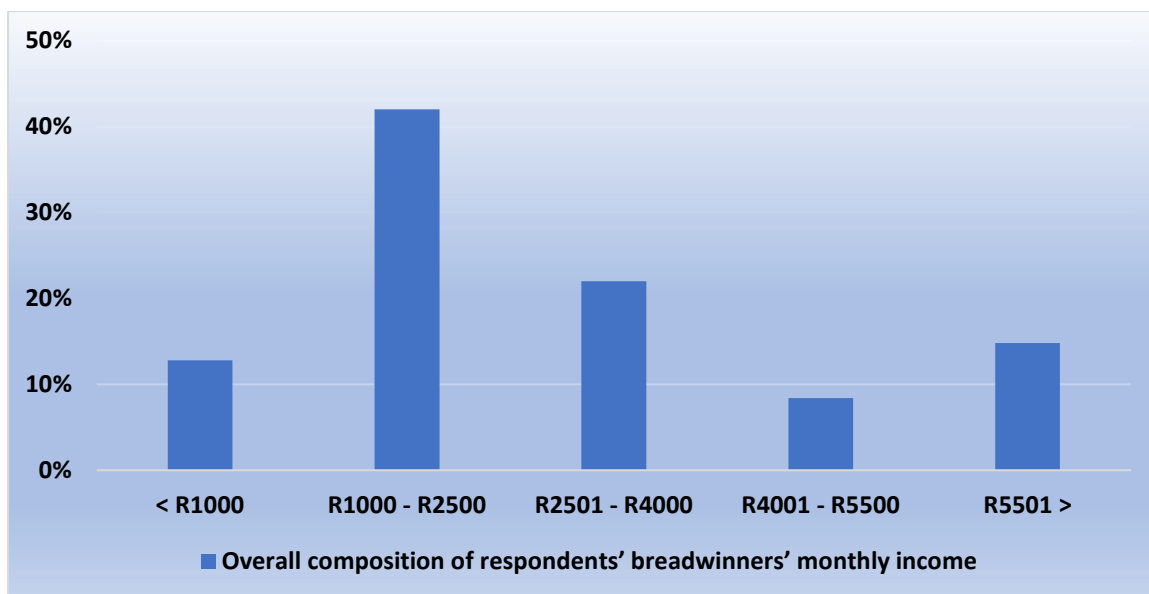


Figure 21: Breadwinner’s monthly income composition of the respondents in all wards of Duncan Village informal settlements (n = 250, from all five surveyed wards).



4.2.3. Access to water and sanitation in Duncan Village informal settlements

The access to water and sanitation in Duncan Village informal settlements per ward is presented in this section.

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4.2.3.1. Access to water and sanitation in Ward 1

Ward 1 is dominated more by formal than informal settlements. This alone gives the informal settlements in this ward an edge in terms of water supply. In this ward 48 respondents (n = 50, for each ward) said they had access to water (Figure 22a), with the remaining 2 respondents indicating that the provided standpipes are too far away from households, and some don't work due to theft and damage of water pipes. In terms of sanitation, Ward 1 benefits from the dominance of formalised settlements nearby, which simplifies the reticulation of sewer lines to informal areas. 43 respondents in this ward therefore reported having access to sanitation in the form of

communal ablution facilities provided by the municipality (Figure 22b). The remaining 7 stated that communal ablution facilities provided are located far from their homes, and they are difficult to access, especially at night. Respondents indicated that they normally collect water twice a day, in the morning and towards night, and visit toilet facilities once a day in the morning.



Figure 22a & b: Showing examples of standpipes and communal ablution facilities in ward 1, Duncan Village. Source: (Author, November 2021)

4.2.3.2. Access to water and sanitation in Ward 2

Ward 2 is more dominated by informal settlements than formal settlements, making water and sanitation a little harder to reach across informal areas as opposed to Ward 1. This is due to the fact that most informal settlements in this ward are situated on steep hillsides and near rivers making it difficult for the municipality to reticulate. Furthermore, informal settlements in this ward are significantly denser making it harder for the municipality to service the residents. In relation to access to water, 46

respondents in this ward said they had access to it through communal water taps and standpipes (Figure 23a). The remaining 4 claimed that the provided standpipes are farther away from their shacks to offer adequate service. When it comes to sanitation, 30 respondents said they have access to toilets in the form of communal ablution facilities (Figure 23b). The remaining 20 said that the allocated ablution facilities are too far away from their shacks, thus they have to utilise buckets or open spaces at night. Respondents indicated that they normally collect water twice a day, in the morning and towards night, and visit toilet facilities once a day in the morning.



Figure 23a & b: Showing examples of communal water taps in Ward 2 and communal ablution facilities in Ward 2, Duncan Village. Source: (Author, November 2021)

4.2.3.3. Access to water and sanitation in Ward 6

Ward 6 informal settlements are located on steep hillsides on the outskirts of the formal settlements. As in Ward 1, this simplifies the supply of water and sanitation to adjacent informal settlements by reticulation of water and sewer pipes from nearby formal pipelines. In terms of water supply, 46 respondents in this ward claimed that they had

access to water via standpipes (Figure 24a). The remaining 4 stated that the installed water standpipes are inaccessible owing to distance, hence most people make illegal connections. In terms of sanitation, 40 responded that they had access to sanitation through communal ablution facilities (Figure 24b). The remaining 10 responded that the toilets offered are insufficient for everyone, particularly those living in sloping areas near rivers, a distance less than 10 minutes, but difficult to access, especially at night. Respondents indicated that they normally collect water twice a day, in the morning and towards night, and visit toilet facilities once a day in the morning.



Figure 24a & b: Showing examples of communal standpipes and communal ablution facilities both in Ward 6, Duncan Village. Source: (Author, November 2021)

4.2.3.4. Access to water and sanitation in Ward 7

Ward 7 is characterized by highly inhabited informal settlements known as C-section. In this ward, 46 respondents said they had access to water via standpipes (Figure 25a). The remaining 4 stated that the area is too congested and that the provided standpipes are insufficient. They also stated that the majority of the standpipes are

damaged and takes time to get repaired. In terms of sanitation, 38 respondents said they had access to toilets through supplied ablution facilities (Figure 25b). The remaining 12 stated that the available ablution facilities are placed far away from their shacks, a distance less than 10 minutes, but difficult to access, especially at night. Respondents indicated that they normally collect water twice a day, in the morning and towards night, and visit toilet facilities once a day in the morning.



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Figure 25a & b: Showing examples of communal standpipes and communal ablution facilities in Ward 7, Duncan Village. Source: (Author, November 2021)

4.2.3.5. Access to water and sanitation in Ward 8

Ward 8 is characterised by a combination of formal and informal settlements. Informal settlements as in other wards are found on the outskirts of formal areas, mostly near rivers and steep areas. In terms of water access, 49 respondents in this ward said that they have access to water via standpipes (Figure 26a). The remaining 1 respondent stated that the standpipes provided are insufficient and some are damaged. In terms of sanitation, 40 respondents reported that they have access to sanitation through

supplied ablution facilities (Figure 26b). The remaining 10 stated that the available ablution facilities are insufficient, and are in distance, though it's less than 10 minutes. They remarked that it's difficult to access the facilities at night. Respondents indicated that they normally collect water twice a day, in the morning and towards night, and visit toilet facilities once a day in the morning.



Figure 26a & b: Showing examples of water standpipes and communal ablution facilities in Ward 8, Duncan Village. Source: (Author, November 2021)

4.2.3.6. Overall water and sanitation access

An overall average of 94% of respondents (n = 250) across all surveyed wards of Duncan Village informal settlements indicated that they have access to water, with the remaining 6.0% indicating that the provided water facilities are far from their households, and some are damaged. With regards to sanitation, an overall average of 76.4% of respondents across all surveyed wards of Duncan Village informal settlements indicated that they have access to sanitation, with the remaining 23.6% indicating that the provided sanitation facilities are installed far from their households

and that some are not working due to vandalism and blockages. The distance to the facilities is however less than 10 minutes according to the respondents, but there is difficulty in accessing the facilities especially at night. Respondents across all five surveyed wards of Duncan Village indicated that they normally collect water twice a day, in the morning and towards night, and visit toilet facilities once a day in the morning.

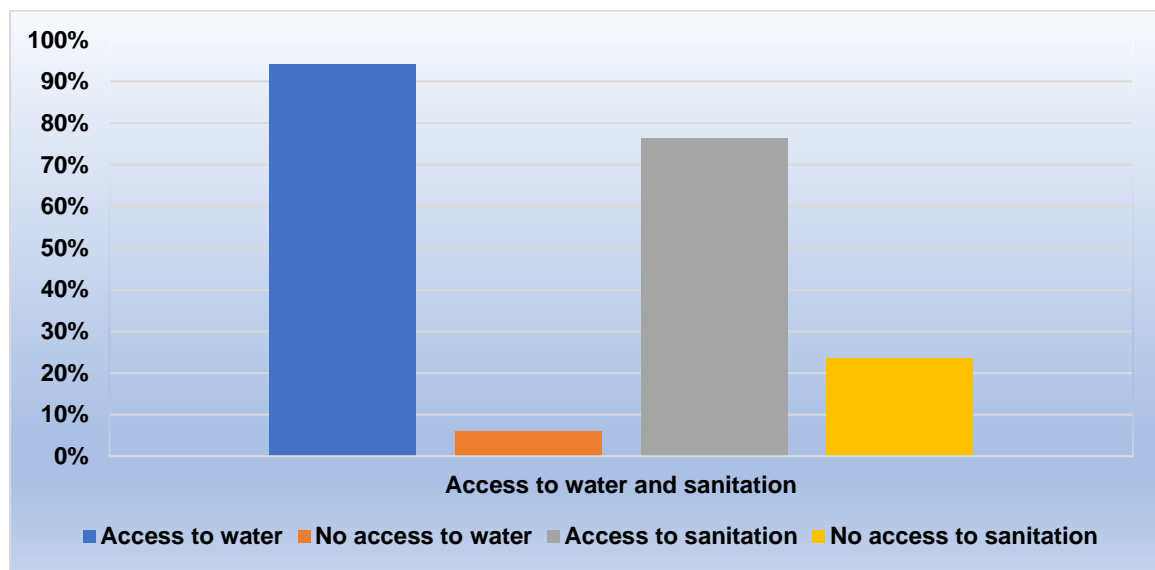


Figure 27: Overall water and sanitation access in Duncan Village informal settlements (n =250, from all five surveyed wards)

4.2.4. Practices of water and sanitation in Duncan Village informal settlements

The practices of water and sanitation in Duncan Village informal settlements per ward are presented in this section.

4.2.4.1. Respondents' practices of water and sanitation by ward

In Ward 1, 48 respondents (n = 50, for each ward) present during data collection remarked that they do close the taps tightly after collecting water, with the remaining 2 indicating that most water taps are vandalised and as a result even if they close them, they still drip. In response to the question on whether they flush the toilets and clean after themselves after using the toilets or not, 49 respondents reported that they do, with the remaining 1 highlighting that some of the toilets are blocked and as a result cannot flush, so people use them as they are in desperation. In response to the question on whether they close their hands after visiting toilets, all 50 respondents present during the data collection indicated that do.



In Ward 2, 46 respondents who were present during data collection highlighted that they do close the taps tightly after collecting water, with the remaining 4 indicating that some standpipes can't completely close due to vandalised. In response to the question on whether they flush the toilets and clean after themselves after using the toilets or not, 49 respondents reported that they do, with the remaining 1 highlighting that some of the toilets are blocked and as a result cannot flush, so they use them as they are in desperation. In response to the question on whether they wash their hands after visiting toilets, all 50 respondents present during the data collection indicated that do.

In Ward 6, 49 respondents who were present during data collection indicated that they do close the taps tightly after collecting water, with the remaining 1 indicating that most water taps are vandalised, and as a result people don't close. In response to the question on whether they flush the toilets and clean after themselves after using the toilets or not, all 50 respondents reported that they do. In response to the question on whether

they close their hands after visiting toilets, all 50 respondents present during the data collection indicated that do.

In Ward 7, 48 respondents who were present during data collection highlighted that they do close standpipes tightly after collecting water, with the remaining 2 reporting that most standpipes are vandalised and as a result they do not close. In response to the question on whether they flush the toilets and clean after themselves after using the toilets or not, 48 respondents reported that they do, with the remaining 2 indicating that most of the toilets are blocked and cannot flush. In response to the question on whether they close their hands after visiting toilets, all 50 respondents present during the data collection indicated that do.



In Ward 8, 46 respondents who were present during data collection highlighted that they do close the taps tightly after collecting water, with the remaining 4 indicating that most water taps are vandalised and cannot close. In response to the question on whether they flush the toilets and clean after themselves after using the toilets or not, 49 respondents reported that they do, with the remaining 1 reported that some of the toilets are blocked and cannot flush. In response to the question on whether they close their hands after visiting toilets, all 50 respondents present during the data collection indicated that do.

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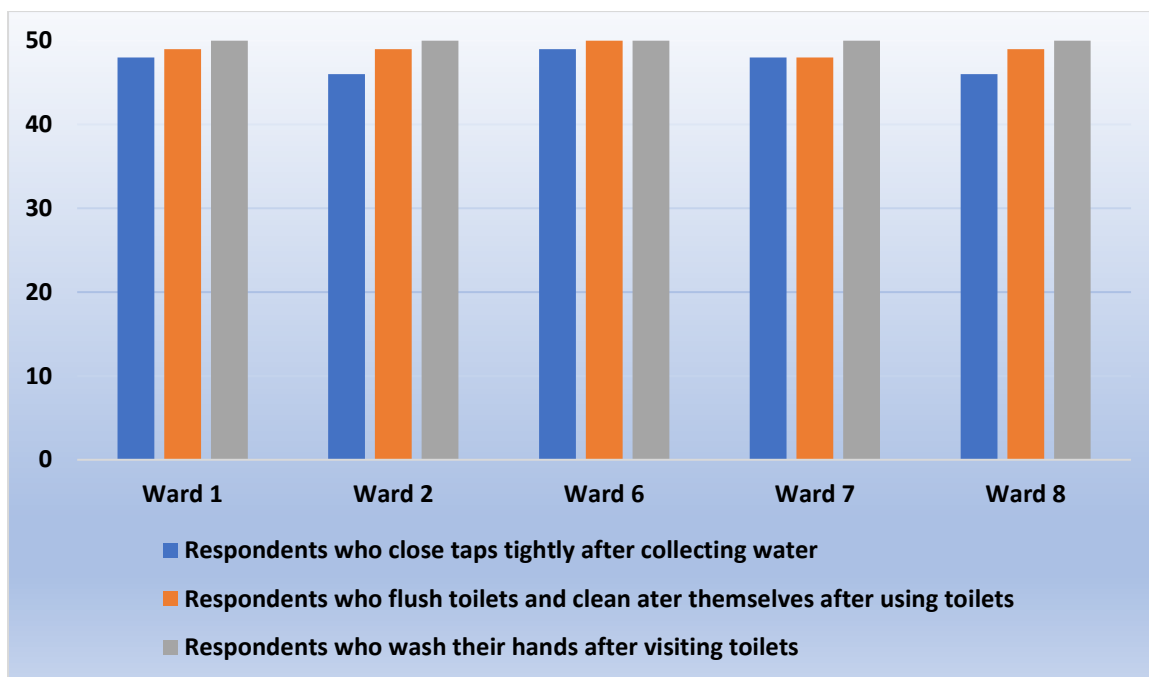
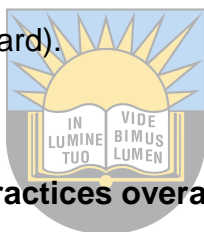


Figure 28: Respondents' practices of water and sanitation by ward in Duncan Village informal settlements (n = 50, per ward).



4.2.4.2. Water and sanitation practices overall statistics

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Overall, 94,8% of the respondents (n = 250) across all five surveyed wards stated that they do close the water taps tightly after collecting water. 98.0% indicated that they flush and clean after themselves after using the toilets. On top of that 100% remarked that they do wash their hands after visiting toilets.

Furthermore, with regards to water and sanitation practices in Duncan Village informal settlements, 100% of respondents present during data collection stated that when they see a tap leaking, they try to stop the leakage and if they cannot, they call the municipality to fix the taps. Moreover, 100% respondents stated that whenever there is raw sewage spilling, they call the municipality officials to come and fix the blockages. In response to the disposal of waste, 96.0% of the respondents indicated that they

dispose in the plastic bags and throw at the municipal bins, with the remaining 4.0% stating that they leave the waste alone.

4.2.5. Knowledge, attitude and experience of water and sanitation in Duncan Village informal settlements

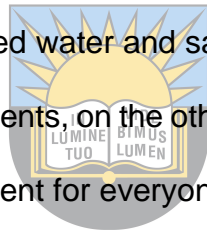
With regards to the knowledge, attitude and experience about water and sanitation in informal settlements, only 96.0% respondents (n =250) across all surveyed wards of Duncan Village informal settlements indicated that they wash hands before handling food, with the remaining 4.0% indicating that the provided water facilities are physically far from their households, and some are damaged due to vandalism and theft which makes it difficult for them to always have water readily available. This supports the findings on water access, which showed that 6.0% of respondents lacked access to water. Across all surveyed wards of Duncan Village informal settlements, every respondent who was present during data collection stated that no one has ever become ill from a waterborne or sanitation disease within their homes. The researcher thinks that this result might have occurred because the respondents knew little to nothing about waterborne or sanitation-related illnesses. When asked what they think should be done to prevent a person from being infected by waterborne or sanitation diseases, respondents suggested that the town run ongoing awareness efforts to educate residents about the value of water and the repercussions of damaging or stealing water and sanitation infrastructure.

4.2.6. Challenges of water and sanitation in Duncan Village informal settlements

The challenges of water and sanitation in Duncan Village informal settlements per ward are presented in this section.

4.2.6.1. Challenges of water and sanitation in Ward 1

In Ward 1, 23 respondents (n = 50, for each ward) reported a challenge of water leaks which they claim is caused mostly by vandalism. 12 respondents reported vandalism and theft of communal ablution doors and water pipes (Figure 29a). There is a problem of sewer spillages caused by blockages, according to 8 respondents. Furthermore, 5 respondents stated that the provided water and sanitation facilities are old and poorly maintained (Figure 29b). 2 respondents, on the other hand, felt that the available water and sanitation facilities are insufficient for everyone.



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Figure 29a & b: Showing examples of vandalism and theft and poorly maintained water and sanitation facilities in Ward 1, Duncan Village. Source: (Author, November 2021)

4.2.6.2. Challenges of water and sanitation in Ward 2

In Ward 2, 21 respondents said there is a challenge of water leaks in their ward that the municipality takes too long to remedy (Figure 30a). In terms of sanitation, 11 respondents said they experience a lot of sewer spills, which are a health hazard to them and their children (Figure 30b). 5 respondents believe that the available facilities are unable to cope owing to overcrowding and inadequacy of facilities. Vandalism, according to 10 respondents, is a major challenge that makes their life difficult since other residents vandalise the provided infrastructure, leaving them with nothing to use. The remaining 3 respondents claimed that there is also an issue with old infrastructure, which causes the offered water and sanitation services to malfunction.



Figure 30a & b: Showing examples of water losses and sewer spillages in Ward 2, Duncan Village. Source: (Author, November 2021)

4.2.6.3. Challenges of water and sanitation in Ward 6

In Ward 6, 19 respondents said they have a problem with water leaks, which they believe are caused by vandalism according to 13 respondents (Figure 31a). In terms of sanitation, 6 respondents said that the allocated toilets are always blocked, resulting in spillages (Figure 31b). 2 respondents said the facilities are insufficient, while 10 respondents believe most of the provided water and sanitation facilities are old.



Figure 31a & b: Showing examples of water losses caused by vandalism and theft, and toilet clogs and sewage spillages in ward 6, Duncan Village. Source: (Author, November 2021)

4.2.6.4. Challenges of water and sanitation in Ward 7

Water leaks and water waste caused by vandalism and theft are a problem in Ward 7, according to 24 respondents (Figure 32a). 14 respondents said that toilet clogs and sewage spillages are also a problem, which some say is caused by flushing foreign objects because not everyone can afford toilet paper (Figure 32b). 3 respondents said

the provided facilities are insufficient, and 6 said vandalism is a major issue. 3 respondents reported that the infrastructure is old and poorly maintained.



Figure 32a & b: Showing examples of water losses caused by vandalism and theft, and toilet clogs and sewage spillages in Ward 7, Duncan Village. Source: (Author, November 2021)

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4.2.6.5. Challenges of water and sanitation in Ward 8

In Ward 8, 20 respondents said there is a problem with water leaks and wasting (Figure 33a). In terms of sanitation, 15 respondents claimed that there is a concern with blockages and spillages. 3 stated that the available water and sanitation facilities are insufficient for everyone. People who vandalise the supplied facilities, according to 8 respondents, pose a significant challenge (Figure 33b). The remaining 4 stated that their infrastructure in their ward is old.



Figure 33a & b: Showing examples of vandalised facilities in ward 8, Duncan Village.

Source: (Author, November 2021)

4.2.6.6. Overall water and sanitation challenges

Across all five wards (n = 250) of Duncan Village informal settlements, an average of 42.8% of respondents indicated that there are water leakages around their areas, which makes it the biggest challenge with regards to water. Blockages and sewer spillages make up the second biggest challenge in Duncan Village informal settlements, reported by an overall average of 21.6% respondents. The third biggest challenge with regards to water and sanitation in Duncan Village informal settlements is vandalism, reported by an overall average of 19.6% respondents. This is followed by the challenge of aging of infrastructure reported by an average of 10.0%. The least of the challenges according to the respondents is the shortage of water and sanitation facilities, reported by an overall average of 6% respondents.

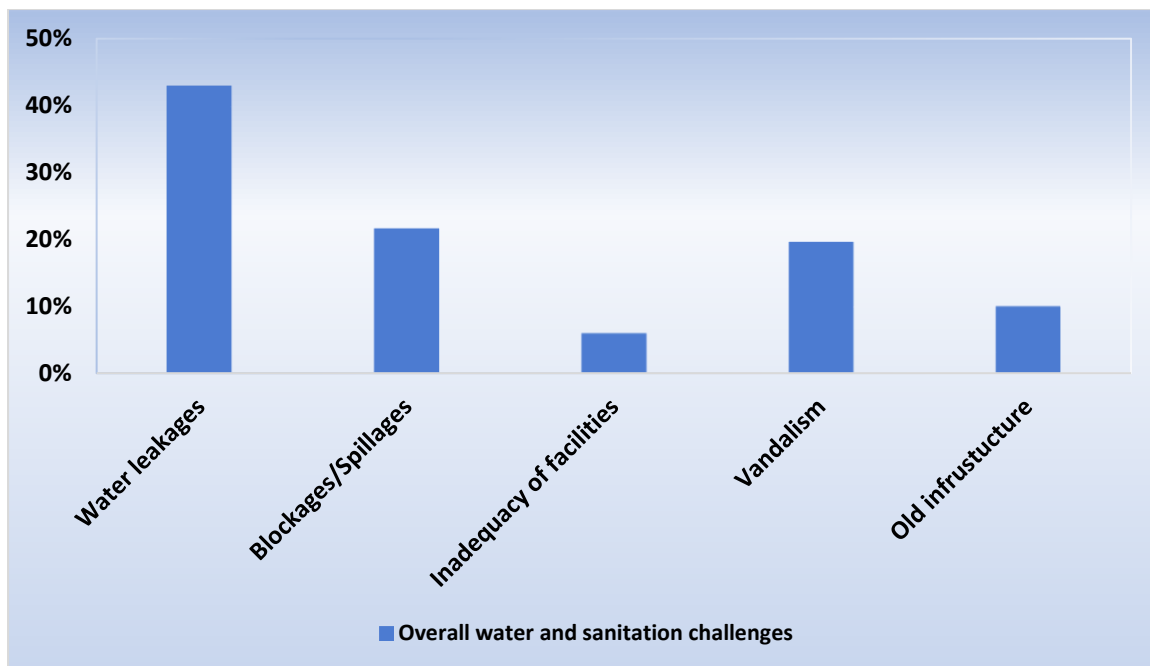


Figure 34: Overall water and sanitation challenges in Duncan village informal settlements (n = 250, in all 5 surveyed wards).



4.2.7. Possible solutions to water and sanitation challenges in Duncan village informal settlements

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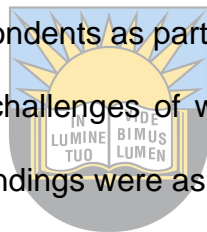
Respondents (n = 250) present during data collection in all five wards of Duncan Village informal settlements were asked what they think should be done to address the identified water and sanitation challenges. An overall of 95.0% of them indicated that the municipality need to boost its presence and establish awareness campaigns in informal communities. Residents especially those who reside in informal settlements are unaware of how the municipality runs and are not familiar with the correct health and hygiene standards, according to the respondents.

Within the above mentioned 95.0% of respondents, 80.0% believe that teaching people of Duncan Village informal settlements about taking care of the provided water and sanitation services is critical. In addition, the respondents suggested that the

municipality should find a means to employ locals especially the youth as ablution facility caretakers and water rangers in order to reduce vandalism and waste of clean potable water. 70.0% respondents concluded by stating that the municipality should make every effort to guarantee that water and sanitation facilities are adequate for all inhabitants and that the facilities have a separate budget for operations and maintenance.

4.3. Response by the ward councillors

Ward councillors in each ward are tasked with ensuring that services are provided in a timely and efficient manner as stipulated by the Buffalo City Metro Municipality. Ward councillors were identified as respondents as part of the research methodology to aid the researcher in examining the challenges of water and sanitation in the Duncan village informal settlements. The findings were as follows:



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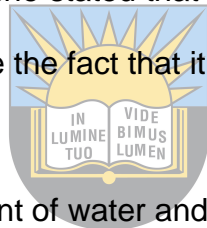
4.3.1. Ward 1 councillor's response

In response to the biographical profile, the ward councillor stated that she was born in Duncan Village and had previously worked for BCMM as an administrator before running for a councillor position in 2016. With regards to the educational background, she indicated that she studied up to tertiary level. When asked what prompted her to run for councillor position, she stated that she was driven by her love for people as well as her want to see her community grow.

When asked about her understanding of service delivery in terms of the function of IDP and the definition of quality service delivery in informal settlements, she stated

that the function of IDP is to facilitate development and make sure that the community voices out its desired and needs. In addition, she defined quality service delivery as the act of delivering adequate services to the people.

Regarding water and sanitation challenges in her ward, she stated that there are challenges. According to the councillor, people erect shacks everywhere, including on top of manholes, making it impossible for the municipality to service the area and access the manholes for maintenance. She stated that urbanisation and poverty are the root causes, and that relocating people is tough for the municipality. When asked if she believes the municipality has the capacity to offer quality water and sanitation services to residents in her ward, she stated that she believes it does because water and sanitation are provided despite the fact that it is insufficient for everyone.



When asked about the management of water and sanitation services in her ward, the councillor stated that the services are not effectively handled. She stated that there are instances where individuals waste water, particularly while washing their clothes and blankets. She went on to clarify that there are situations where people do not flush toilets after using them. According to her, the root of all these issues is residents not being able to take care of the provided water and sanitation services and ignorance, as they are aware that no one will hold them accountable. In closing, the councillor stated that the municipality makes every effort to guarantee that essential services like water and sanitation are available in her ward, but that owing to overcrowding, they become overwhelmed.

4.3.2. Ward 2 councillor's response

The ward councillor stated that she was born in Duncan and had previously worked for BCMM as an administrator also before running for a councillor position in 2016. With regards to the educational background, she indicated that she studied up to tertiary level. When asked what prompted her to run for councillor, she stated that she was driven by her passion for serving people which she was already doing through community structures.

When asked about her understanding of service delivery in terms of the function of IDP and the definition of quality service delivery in informal settlements, she stated that the function of IDP is to look at the community's priorities in order to budget for them. In addition, she defined quality service delivery as service that is on a good standard for the community.



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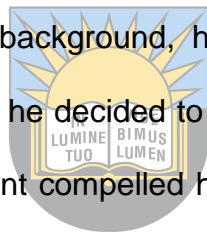
With regard to water and sanitation challenges in her ward, she stated that amongst others, shared communal facilities are a problem because they are difficult to maintain. She added by indicating that the facilities are not enough and one of the causes is because people have built shacks all over leaving no space for installing the facilities. When asked if she believes the municipality has the capacity to offer quality water and sanitation services to residents in her ward, she indicated that she does not think so because there is lack of monitoring and maintenance of the facilities which results to blockages and vandalism.

When asked about the management of water and sanitation services in her ward, she indicated that they are not well managed. She stated illegal connections and lack of

maintenance as the main problems. She went on to say that the municipality should employ more people who will be able to monitor and maintain the facilities all the time. In closing she indicated that there should be more awareness campaigns in informal settlements because most people who reside in informal settlements are from the rural areas and do not have the knowhow of using and taking care of the waterborne facilities.

4.3.3. Ward 6 councillor's response

The ward councillor stated that he has lived in Duncan for the past 24 years, and that prior to running for a councillor position in 2016, he ran his own community businesses. With regards to the educational background, he indicated that he studied up to secondary level. When asked why he decided to run for a councillor job, he said his passion for community development compelled him to do so because he wanted to help his community grow.



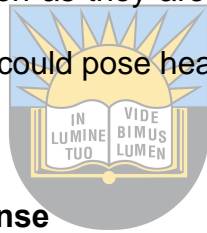
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When asked about his understanding of service delivery in terms of the function of IDP and the definition of quality service delivery in informal settlements, he stated that the function of IDP is to identify the top priorities of the ward. In addition, he defined quality service delivery as service that is in good quality.

Regarding water and sanitation issues in his ward, the councillor acknowledged that they exist. He identified one of the key challenges in his area as old water and sanitation infrastructure, which he alleges leads to sewage blockages and water pipe bursts. He went on to say that theft of water and sanitation infrastructure is also a big concern which he claims is a problem they confront from time to time, particularly when

it comes to removing standpipes. When asked if he believes the municipality has the capacity to provide high-quality water and sanitation services to residents in his ward, he stated that he does because everyone in his ward has access to both despite the identified challenges.

When asked how well his ward's water and sanitation services are managed, he stated that they are not effectively managed. He claimed that there are several leaks from wasting a significant amount of drinking water. He further stated that the toilets are constantly clogged, resulting in sewage spillages on the streets. In conclusion, he stated that in order to resolve this, regular monitoring should be conducted, and facilities should be repaired as soon as they are detected, in order to reduce water waste and pollution, both of which could pose health hazards to inhabitants.



4.3.4. Ward 7 councillor's response

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The ward councillor revealed that she was born and raised in Duncan village and had previously worked as an official for BCMM before running for a councillor position. With regards to the educational background, she indicated that she studied up to tertiary level. When asked what motivated her to run for councillor in 2016, she said it was her passion for service delivery and community development.

When asked about her understanding of service delivery in terms of the function of IDP and the definition of quality service delivery in informal settlements, she stated that the function of IDP is to prioritise community needs so that it can be budgeted for. In addition, she defined quality service delivery as service that is suitable for the community.

Regarding water and sanitation challenges in her ward, she indicated that there are challenges in her ward which are as follows: water leakages, illegal water connections, illegal sewer connections, and vandalism. According to her, the lack of public participation when planning for service provision is the root cause of the mentioned issues. She stated that people should be consulted prior provision and they should be told about the services they are going to receive and how they work. She believes these teach accountability. Furthermore, she believes that there are adequate water and sanitation services for everyone in her ward.

When asked about the management of water and sanitation services in her ward, the councillor indicated that they are not well managed. She claims that there is lack of monitoring and maintenance of the provided facilities and that there are no caretakers to clean and guard the facilities. In closing she indicated that their municipality should make a budget for operations and maintenance of these facilities available and also hire caretakers. Moreover, she believes that there should also be some health and hygiene education to the community to protect them from hazardous infections.

4.3.5. Ward 8 councillor's response

The ward councillor indicated that she was born and raised in Duncan village and previously served for BCMM as a ward councillor in 2011. With regards to the educational background, she indicated that she studied up to tertiary level (qualification was not mentioned). When asked what motivated her to run for councillor, she responded that she enjoys serving her community and being a part of the community development in her area.

When asked about her understanding of service delivery in terms of the function of IDP and the definition of quality service delivery in informal settlements, she stated that the function of IDP is to consolidate community needs on service delivery and prioritise them. In addition, she defined quality service delivery as service that is quality and sustainable.

With regards to water and sanitation challenges in her ward, she indicated that there are challenges. According to her, standpipes and toilets are insufficient in her ward. She claims that the number of shacks is increasing every day, and as a result, they are unable to keep up. Furthermore, she added that the municipality should strengthen the land invasion by-laws to address this issue.



When asked how effectively her ward's water and sanitation are managed, she said they are not well managed. She claims that there is a lack of upkeep and that toilets are always blocked due to the high population density. In closing, she stressed the significance of the municipality initiating user education and communicating with the community about the importance of appropriate hygiene habits. She also stated that in order to avoid most of the identified challenges, the municipality must respond immediately to water and sanitation reports.

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4.3.6. Overall councillors' responses

Water and sanitation challenges have been acknowledged by all five ward councillors in Duncan Village informal settlements. They also acknowledged that the water and sanitation facilities in Duncan Village informal settlements are insufficient for everyone, which they believe is primarily due to overpopulation, which results in people erecting

shacks all over, even in steep areas, leaving no space for the facilities to be installed. During participant observations indeed shacks could be seen erected in steep areas, on top of manholes, and in low-lying areas which are not easily accessible. Aside from the challenge of insufficient facilities, ward councillors identified lack of user education and residents not being able to take care of the provided water and sanitation services as a major concern, claiming that people purposefully vandalise the provided facilities, resulting in severe water wastage and shortage of available usable facilities. The observations of vandalised sanitation facilities and water taps at site supports the councillors' statements (see section 4.2.6). Furthermore, ward councillors stated that because of poverty, people use a variety of materials to assist themselves in the toilets, causing blockages and spillages. This was also observed, and pictures were taken (also see section 4.2.6.). Concerning the municipality's delayed reaction to reported water and sanitation problems, ward councillors stated that the municipality is short of water and sanitation staff, resulting in delays in resolving reported issues. They suggested that the municipality appoint more water and sanitation rangers to monitor the operational state of existing water and sanitation facilities and assess the need for additional facilities. Lastly, ward councillors stated that there is a need for user education and ownership awareness in Duncan Village informal settlements, and they urged municipality officials to be visible at all times in order to increase people's trust in their municipality.

4.4. Response by the municipal officer responsible for water and sanitation in Buffalo City Metro Municipality

As part of the research methodology, a municipal officer from the Buffalo City Metro Municipality's water and sanitation section representing the Duncan Village area was

part of the three target categories for this study's responders. In response to the questions, the following were the findings:

- The municipal officer indicated that he is in the age between 41 and 50. With regards to the educational background, he indicated that he studied up to tertiary level (qualification was not mentioned). In addition, he stated that he has worked for BCMM for the past ten years and that he was initially drawn to the technicality of the water services function, but then he later discovered that his job draws him closer to people.

When asked about his understanding of service delivery in terms of the function of IDP and the definition of quality service delivery in informal settlements, he stated that the function of IDP is to integrate and coordinate municipal programmes as well as projects for both internal and sector departments. In addition, he defined quality service delivery as service that is sustainable.



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In response to the question on the difference in providing water and sanitation in formal areas as opposed to informal areas, he stated that it is very difficult to provide services in informal settlements due to congestion and densification, no available space to spare for water services infrastructure hence the municipality services areas through communal facilities, payment for services is impractical. On the other hand, formal areas are planned, and it is very easy to provide services and these services can be paid for by the consumers.

With regard to water and sanitation challenges services in Duncan Village informal settlements in BCMM, he indicated that there are numerous water and sanitation challenges, including the following:

- Lack of accessibility and space to provide ablution facilities.
- Lack of operations and maintenance of the communal facilities.
- Poor drainage system provided due to lack of individual toilet or water point provision.
- High water losses from vandalises standpipes.
- Illegal water connections (some people connect water to their shacks and this cause leakages as they not done by qualified personnel).
- Illegal connections for sanitation this elevate the number of blockages encountered.
- Vandalism of water services infrastructure.
- Poverty



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The lack of ownership (residents not taking care) of the water and sanitation services infrastructure, according to the municipal officer, is one of the causes of the challenges described above, as residents do not see the need to be accountable because they share the facilities. Furthermore, he stated that unemployment plays a significant role, with residents vandalizing and theft of facilities. Lastly, he stated that densification also makes it difficult for residents to move between shacks with buckets of water while using communal facilities, resulting in illegal connections.

When asked if he believes the municipality is capable of resolving the challenges mentioned, the municipal officer said yes. He stated that they have the necessary

resources. He went on to say that the municipality has begun the process of decreasing densification by relocating some residents to neighbouring newly constructed RDP houses. He went on to say that the municipality is dealing with a lack of adequate administration of the spaces where individuals have been relocated, which he claims is being currently addressed. Moreover, he also stated that a plan is in place to guarantee that the shacks are eradicated and that RDP houses are built as soon as possible. According to him, he feels that this will solve many of the challenges outlined above.

When asked about the adequacy of water and sanitation in Duncan Village informal settlements, the municipal officer stated that the services are insufficient for all residents. He explained that the proliferation of shacks is the root of the problem, making it impossible to provide adequate water and sanitation services. This, he claims, is a moving target that is tough to hit. He went on to say that according to the BCMM standard, one toilet seat in an informal settlement should serve at least ten homes and one water point should serve at least fifty households, but this is not possible owing to density. Furthermore, he stated that in certain cases, individuals construct shacks in areas where there is no water or sanitation infrastructure at all, or in areas below the sewer line, making flush toilets hard to furnish.

When asked what he believes is the reason of the aforementioned difficulties and what he believes should be done to address them, he stated that the causes include urbanisation and a lack of land management by the municipality. He continued, "I believe the only way to overcome this is to control land invasion and provide more RDP houses."

When queried about the management of water and sanitation services in the Duncan village informal settlements, the municipal officer stated that they are not effectively managed. He explained that this is due to a lack of staffing, which makes it impossible to monitor the performance of all facilities due to their dispersed location. He went on to remark that thievery and vandalism occur as a result of the municipal staff's lack of visibility. Furthermore, the municipal officer stated that there is no budget for operations and maintenance, which contributes to the facilities' poor management. He concluded by stating that some of the residents do not have water and toilets due to the terrain, wherein according to him a desired ratio of 1:10 (one facility accessed by ten households) is not achievable.

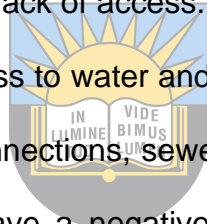


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Chapter 5: Discussion

5.1. Introduction

South Africa's provision of water and sanitation services is distinguished by both successes and challenges (Muzondi, 2014). As Mwanza (2001) points out, water and sanitation challenges are especially visible in disadvantaged areas such as informal settlements, where physical access is difficult, there is a lack of physical design, improper technology, inadequate consultation, limited community engagement, socio-economic constraints, and poor information, education, and communication, which relates to the discussions in this section. Water and sanitation challenges in informal settlements are not limited only to lack of access. Informal settlements such as those in Duncan Village, may have access to water and sanitation, but still face challenges such as water wastage, illegal connections, sewer spillages, vandalism, and theft of provided facilities, all of which have a negative impact on the provision of these essential services.



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In this Chapter, findings are discussed following the study objectives, namely: Identify water and sanitation challenges in the Duncan Village informal settlements through quantitative and qualitative data collection on water and sanitation provision; Discuss the causes and consequences of water and sanitation challenges in the Duncan Village informal settlements; and Recommend the best possible solutions to the local municipality to minimise water and sanitation challenges in the Duncan Village informal settlements.

5.2. Demographics and Education

The age composition of this study as shown under findings in Chapter 4 shows that respondents between the ages of 25 and 34 dominated the survey in all five surveyed wards of Duncan Village informal settlements. The study design qualified any person above the age of 16 found at the household during data collection, whether renting as a backyard dweller or a permanent householder to fill in the questionnaire as indicated under Chapter 3. The dominance of the youth in the survey shows that most of the young people in Duncan Village informal settlements may have not completed school, resulting to unemployment. This is because data collection took place in the afternoons during the week. Taylor (2017) states that poor people in poor communities are less likely to complete school, which is an expected outcome.



In terms of education, findings shows that an overall 45.6% of respondents (n = 250) who were present during data collection across all five wards completed their education at the secondary level. Those with no formal education accounted for 16.8%, and those who completed their schooling at the primary level accounted for 11.2%. Lastly, those who completed their education at the tertiary level accounted for 26.4%. This outcome was anticipated based on site observations, which proved that the majority of residents are impoverished among other variety of reasons, including social ills, and struggle to finance tertiary education. Accordingly, this shows that most residents in Duncan Village informal settlements do not have required education for employment and have the inability to find good-paying jobs, resulting in poverty. Poverty is inextricably linked to education and quality of life, and because of poverty, poor people in poor communities are less likely to complete school (Taylor, 2017). Furthermore, they are also less likely to have the luxury to safe water and adequate

sanitation services provision. This failure to realise such basic rights in such communities serves to perpetuate and entrench cycles of poverty and inequality (SAHRC, 2018). The unemployment outcome is however also influenced by the timing of the interviews which took place during the peak of COVID-19 in 2020 which also had a negative impact on job availability and security.

5.3. Socio-economic status

This section interprets the study findings as well as the causes of water and sanitation challenges in the Duncan Village informal settlements in relation to the socioeconomic position of the respondents. Significant evidence connects socioeconomic status to internalizing and externalizing behaviour challenges (Korous et al., 2018). Internalizing behaviour is defined by DiMaria (2020) as behaviours that is quite and often not visible because they are generally not disruptive, unlike externalizing behaviours. This causes people to feel sad, feel unwanted, and have concentration problems. It results to poor performance at school and affects daily social life negatively, which as per the study findings is the case in Duncan Village informal settlements. Fraser-Thill (2021) defines externalizing behaviours as behaviours which include physical aggression, relational aggression, theft, and vandalism, which is also related to the study's findings.

In terms of employment, Chapter 4 of this study shows that 39.6% of respondents across all five wards of Duncan Village informal settlements who were present during data collection are unemployed, with those receiving social grants accounting for 24.4%, pensioners accounting for 9.2%, self-employed accounting for 10.4%, and those employed accounting for 16.4%. This result was expected based on the findings on educational background, which revealed that the majority of residents don't have

post-secondary education, making it difficult to get well-paid jobs. This emphasises the fact that poverty exists in Duncan Village's informal settlements. This also confirms the concerns raised by the ward councillors that toilets blockages are sometimes caused by residents who flush foreign objects because they cannot afford toilet papers. It also influences vandalism and theft of water and sanitation provided facilities which affects proper access. As noted by Angoua et al. (2018) people who live in extreme poverty are commonly affected by lack of proper access to water and sanitation services, which is the outcome in Duncan Village informal settlements.

The findings also revealed that 42.0% of respondents' breadwinners who were present during data collection across the five wards of Duncan Village informal settlements earn between R1000 and R2500 monthly, with those earning less than R1000 per month accounting for 12.8%, those earning between R2501 and R4000 accounting for 22.0%, those earning between R4001 and R5000 who accounted for 8.4%, and those earning more than R5501 who accounted for 14.8%. This finding relates to the outcome on educational background detailed above. World Bank (2015) also indicated that informal settlements are areas that have informal employment and low incomes.

5.4. Access to water and sanitation in Duncan Village informal settlements

As mentioned in Chapter 1, all South African individuals have a constitutional right to both water and sanitation (SAHRC, 2018). WHO and UNICEF (2000) emphasised this by stating that access to water and sanitation is critical for all people's health and dignity. Winter et al. (2019), as indicated in Chapter 2, state that residents living in informal settlements around the world are disadvantaged by a lack of access to sanitation. In relation to this study, Buffalo City Metro Municipality revealed that 98%

of the areas under their jurisdiction including the study area Duncan Village have access to minimum basic water services, and approximately 75 868 indigent consumers provided free basic water (6kl per month).

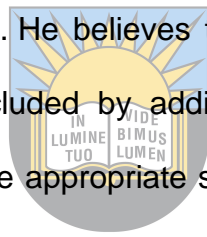
According to Chapter 4 findings, 94.0% of respondents across the five surveyed wards in Duncan Village informal settlements said they have access to water, with the remaining 6.0% saying the provided water facilities are distance from their homes and some are damaged owing to vandalism and theft of water and sanitation infrastructure. In terms of sanitation, 76.4% reported having access to sanitation, with the remaining 23.6% reporting that the offered sanitation facilities are located distance from their homes and that some are not operational owing to vandalism and blockages. This demonstrates that despite all identified challenges, the majority of Duncan Village informal settlements residents have access to water and sanitation.



5.5. Challenges of water and sanitation in Duncan Village informal settlements

One of the objectives of the research is to identify the actual water and sanitation challenges in Duncan Village informal settlements, as mentioned in Chapter 1. According to Chapter 4 findings, access to water and sanitation is not the actual challenge in Duncan Village informal settlements. The following water and sanitation challenges in Duncan Village informal settlements were identified through questionnaires and site observations as presented under Chapter 4:

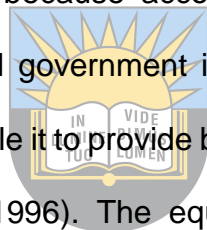
- Lack of accessibility and space to provide ablution facilities
 - The issue of lack of space to provide ablution facilities closer to their households was also raised by 23.6% of respondents, who stated that the facilities supplied are located far from their households. This is due to overcrowding, according to the ward councillors' response, which results in people establishing shacks in open spaces, even in hilly terrain, leaving no space for sufficient utilities to be constructed. A large number of people are moving to urban areas for school and work possibilities, therefore this finding was expected. Furthermore, the municipal officer stated that the problem stems from the growth of shacks, making it impossible to provide adequate basic services. He believes that this is a moving target that is difficult to hit. He concluded by adding that due to the terrain, some communities do not have appropriate services, and that a desired ratio of 1:10 (one facility accessed by ten households) is not attainable, according to him. Mallory et al. (2022) highlights comparable challenges in Kenya, where informal settlements face technical challenges due to dense populations limiting access to sanitation service provision. The Kenyan government uses container-based sanitation (CBS) as part of the solution in their informal settlements (Mallory et al., 2022). The Buffalo City Metropolitan Municipality may add this to the existing communal ablution facilities in informal settlements such as Duncan Village to curb the distance challenge to the provided facilities and open defaecation. CBS is defined by Tilmans et al. (2015) as a sanitation system in which toilets collect human excreta in sealable, removable containers (also known as cartridges) that are transported to treatment facilities. In South Africa, although the City of



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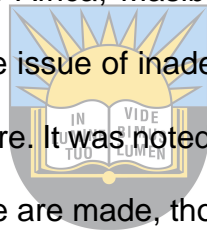
Cape Town Metropolitan Municipality prioritises flush toilets in informal settlements, they are also providing a range of non-sewered sanitation options, including chemical toilets, as well as two CBS options: portable flush toilets (PFTs) and container toilets to solve this challenge (GreenCape, 2022).

- Lack of operations and maintenance of the communal facilities.
 - Lack of operations and maintenance according to the municipal officer is due to no funding for operations and maintenance which contributes to the inadequate management of the water and sanitation infrastructure. This is an unexpected finding, because according to the Constitution of South Africa section 227, local government is entitled to an equitable share of national revenue to enable it to provide basic services (such as water supply and sanitation) (RSA, 1996). The equitable share provides funding for municipalities to deliver free basic services and subsidises the cost of administration and other core services for those municipalities with the least potential to cover these costs from their own revenues. The operations and maintenance of water services infrastructure is the responsibility of the municipalities and should be funded by the equitable share and the revenue that the municipalities can raise (RSA, 1996). Ward councillors on their responses recommended that the municipality should prioritise operations and maintenance budget in order to be able to provide adequate services and maintain them. Operations and maintenance is a challenge in South African government and must be viewed as essential to the long-term viability of systems (Ballard and Iling, 2010). Ballard and Iling (2010) note



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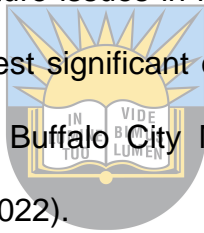
that the DWAF Sustainability Audit from 2005 indicates that calls for proper operations and maintenance have been made in a number of Department of Water Affairs and Forestry (DWAF) reports over the past few years in South Africa. According to the 2005 DWAF Sustainability Audit, inadequate operations and maintenance posed a significant obstacle to the delivery of sustainable sanitation services. It is widely acknowledged, as found in the Duncan Village informal settlements within the Buffalo City Metropolitan Municipality, according to Muanda and Lagardien (Undated), that insufficient Operations and Maintenance (O&M) continues to be a significant and frequent challenge with regard to the sustainability of the provision of basic services. In South Africa, Masibambane II evaluation conducted in 2007 also brought up the issue of inadequate operations and maintenance (O&M) of the infrastructure. It was noted that unless adequate provisions for O&M of the infrastructure are made, those who have been served will soon re-join the backlog queue (Ballard and Iling, 2010).



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- Poor drainage system provided due to lack of individual toilet or water point provision.
 - According to the researcher's observations, the lack of individual toilet or water point provision causes residents to overburden the provided facilities, which are already insufficient due to overpopulation and lack of space to install more toilets. This then overburdens the current drainage systems, resulting in spills and water spilling on roadways. Residents in informal settlements cannot acquire individual toilets and water points until the area is formalised, which was expected due to overpopulation and policies

governing the provision of water and sanitation in informal settlements. As a result of overpopulation and other social issues, overburdening of available services remains inevitable. Human (2021) reported a similar issue in Cape Town, stating that the city's capacity for sanitation and water pollution has been exceeded by the population growth over the past few years. According to Human (2021), the stormwater system in the majority of Cape Town's informal settlements functions as a second sewer system, primarily because residents of these areas lack adequate access to sanitation facilities owing to overpopulation, a problem that is also present in the informal settlements of Duncan Village. In order to address the water and sanitation infrastructure issues in informal settlements, the city stated that they planned to invest significant capital expenditure (Human, 2021), which is also what the Buffalo City Metropolitan Municipality intend to accomplish (Xabanisa, 2022).



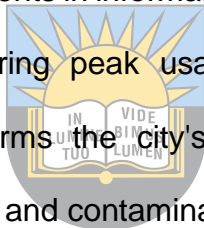
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- High water losses.
 - Water losses in Duncan Village informal settlements are a severe concern, according to the study findings in Chapter 4. On the survey, 42.8% of respondents across 5 wards of Duncan Village informal settlements stressed this. The findings suggest that vandalism, illegal connections, and theft of water pipes are the primary causes of leaks in taps and water meters. According to studies in Kenya, significant levels of water infrastructure vandalism are widespread in underprivileged communities, with vandalism mostly targeting water meters and distribution pipes in peri-urban areas (Tularam and Properjohn, 2011; Kemendi and Tutusaus,

2018). According to study findings, this also occurs in Duncan Village informal settlements, where locals steal and vandalise steel water taps to sell for cash. The same challenge was noted by Zindoga et al. (Undated) in the informal settlements of Cape Town, who claimed that infrastructure theft and vandalism in these areas have significantly contributed to the inadequateness and inefficiency of the water and sanitation facilities provided by local municipalities, which have a limited ability to extend or improve services to informal settlements. Ward councillor's response on the survey indicates that water management in Duncan Village informal settlements is ineffective. They claimed that residents leave significant amount of clean water running while washing at the provided standpipes and ablution facilities which contributes to high water losses. The researcher through observation also discovered that there are many car washes around Duncan Village, where residents are trying to make a living while causing water losses, which is an expected outcome based on the findings that majority of the residents of Duncan Village informal settlements are unemployed. Adequate community participation in water management is one of the solutions suggested by Zindoga et al. (Undated) to solve this problem.

- Illegal water connections
 - Illegal water connections are a result of inadequate provision of standpipes and overpopulation which limit access and space to install water services. Lebek and Krueger (2021) in their KwaZulu-Natal case study remarked that illegal water connections cause water leakage, which can lead to community

water shortages. According to a Buffalo City Metropolitan Municipality officer, some residents in Duncan Village informal settlements illegally connect water to their shacks, which he alleges causes leaks because it is not done by qualified personnel. Findings in this study further demonstrate that these are primarily residents who allege that ablution facilities and standpipes are located distant from their households, which is an expected outcome because residents prefer water services to be closer to their households. Yuku (2022) reported the similar challenge in Cape Town's informal settlements wherein the City of Cape Town Metropolitan Municipality indicated that Illegal connections to the reticulation pipes is a major contributor to residents in informal settlements experiencing low water pressure, especially during peak usage times such as mornings and evenings. This also harms the city's infrastructure and increases the likelihood of water waste and contamination (Yuku, 2022). The municipality has stated that as part of the solution, they are investing in providing new taps and installing drinking water pipes with meters in informal settlements where this is legally and physically possible, according to approved budget plans that also take the national tap-to-household ratio into account (Yuku, 2022).



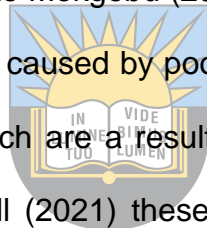
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- Illegal connections for sanitation
 - The illegal connections for sanitation are also a result of insufficiency of sanitation facilities and overcrowding. The arguments on these issues include lack of monitoring by the municipality and lack of by-laws by the

municipality to control illegal connections on sanitation facilities. As a result, residents of Duncan Village informal settlement connect sewer pipelines to their homes in order to reduce the distance between themselves and the offered facilities, as well as for hygiene reasons. Because of the bad hygiene conditions in the majority of the available ablution facilities, this result was expected, and was also reported by an overall 6% of the respondents (n = 250, from all five surveyed wards) who indicated that the facilities are insufficient, resulting in an increase in the frequency of toilet blockages. Subsequently, residents who can afford to extend sewer pipelines to their homes do so in order to minimise sharing and distance, particularly at night. Van Petegem (2018) reported a similar problem in the Gamorrah and Malusi informal settlements in Pretoria west, where it is stated that residents illegally connect stormwater to the wastewater system, which increases the volume delivered for treatment and which overload wastewater treatment plants. Most sewerage systems are simply not designed to collect stormwater, which is especially problematic during heavy rains as it happened in Gamorrah and Malusi informal settlements because it causes blockages and spillages (Van Petegem, 2018). Fining the offender, discouraging illegal connections, and educating members of the community may be solutions to this type of problem (Mokgobu 2017).

- Vandalism of both water and sanitation services infrastructure.
 - Von Heland et al. (2015) and Kemendi and Tutusaus (2018) state that the causes of water infrastructure vandalism are not only a function of the economic strata of communities, but are also subject, particularly in poor

areas, to management systems. Findings in Chapter 4 shows that 19.6% of respondents across all five wards stated that vandalism is a huge problem in the Duncan Village informal settlements. Duncan Village informal settlements are suffering from a lack of caretakers to look after water and sanitation services infrastructure, according to the BCMM municipal officer. The local government has not chosen to put aside funds for such jobs, which will help alleviate unemployment. According to the ward councillors, in Duncan Village informal settlements, lack of ownership and accountability is a major issue. They argue that people intentionally vandalise and destroy water and sanitation facilities in the knowledge that they will not be held accountable. According to Mokgobu (2017), an increase in the vulnerability of water infrastructure is caused by poor policing of vandalism and theft of water infrastructure, which are a result of community behavioural issues. According to Fraser-Thill (2021) these are externalizing behaviours, and they include physical aggression, relational aggression, theft, and vandalism, which is part of the study's findings. Similar challenges were noted by Mokgobu (2017) in Aganang Municipality in Limpopo province, South Africa. Mokgobu (2017) suggests yard connections, reporting theft and vandalism to the police, fining the offender, hiring water inspectors and security guards, discouraging illegal connections, and educating the community members as solutions to this problem.



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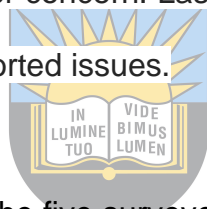
- Poverty.
 - Literature demonstrates that the government frequently overlooks disadvantaged communities, particularly informal settlements (Hutchings et

al., 2018; SAHRC, 2018). The legal status of informal settlements is frequently the principal impediment to the supply of essential services such as water supply and sanitation (Dagdeviren and Robertson, 2009). Apart from that, poverty in the community of Duncan Village informal settlements, as well as other social ills, make it difficult for the government to administer the offered services. This is because there is clear inequality among the community wherein people who cannot afford end up being involved in theft of water and sanitation infrastructure and vandalism. These findings suggest that poverty does exist in Duncan Village's informal settlements, and that it contributes to the existing water and sanitation challenges such as vandalism, illegal connections, and theft (Isaac, 2021). In a study by Obeta and Nwankwo (2015), similar challenge was identified as a factor in vandalism in Nigerian informal settlements, with Nigerian unemployed young people blaming the government for failing to lift them out of poverty. In South Africa, the Buffalo City Metropolitan Municipality stated that one of the solutions is to construct formal houses and apartments for the underprivileged residents of Duncan Village informal settlements in Reeston. They also mentioned that they have been placing some people in temporary houses to solve this problem (Isaac, 2021).

In relation to the study objectives, the first objective intended to Identify the actual water and sanitation challenges in the Duncan Village informal settlements. An average of 42.8% of respondents across all five selected wards of Duncan Village informal settlements indicated that there are water leakages around their areas. Blockages and sewer spillages were reported by an average of 21.6%. Vandalism was

reported as the third water and sanitation challenge by an average of 19.6%, followed by the challenge of shortage of water and sanitation facilities reported by an average of 6.0%. An average of 10.0% respondents reported aging of infrastructure. All of this is connected to one another, resulting in water and sanitation challenges in Duncan Village's informal settlements.

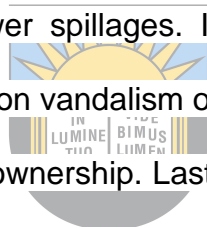
The second objective intended to analyse water and sanitation challenges in the Duncan Village informal settlements. Findings shows that facilities are insufficient for everyone, primarily due to overpopulation. Aside from the challenge of insufficient facilities, there is also a challenge of lack of operations and maintenance. Lack of user education and ownership is a major concern. Lastly, the municipality is understaffed, resulting in delays in resolving reported issues.



When comparing the results from the five surveyed wards of Duncan Village informal settlements, the researcher discovered that the challenges regarding water and sanitation are practically similar. This also verifies the studies done by ongoing WHO and UNICEF reports and other sources (Mwanza, 2001; Bartlett, 2003; Lagardien and Cousins, 2004; Dagdeviren and Robertson, 2009; Mnisi, 2011; Tsinda et al., 2013; Shamsu-Deen, 2013; Muzondi, 2014; Makaudze and Gelles, 2015; Obeta and Nwankwo, 2015; World Bank, 2015) whose study outcomes show that water and sanitation challenges are a general challenge in townships and in informal settlements. The findings also draw similarities from a report by Mbi (2015), who reported about water and sanitation challenges in Khayelitsha informal settlements, in Cape Town, South Africa.

5.6. Conclusion

In conclusion, it is crucial to mention that the municipality has ensured some degree of water supply and sanitation in the Duncan Village informal settlements. Nevertheless, with the constant influx of people moving from rural to urban areas and poverty, it has proven to be difficult for the municipality to keep up with demand, resulting in service insufficiency. As per SAHRC (2018), poverty is connected to quality of life. Quality of life is largely associated with education, which according to the findings is an issue in Duncan Village informal settlements. This has a negative impact on daily lifestyle and social behaviour. All of this adds up to the identified challenges like vandalism and theft of water and sanitation infrastructure, which results to excessive water losses, and sewer spillages. It is critical for the municipality to strengthen awareness campaigns on vandalism of water and sanitation infrastructure and wastage of water to promote ownership. Lastly, the municipality should prioritise hiring locals, particularly the youth, to trade work skills and to encourage young people at large to prioritise education in order to find better work opportunities. If all mentioned could be addressed, water and sanitation challenges in Duncan Village informal settlements could be alleviated.



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Chapter 6: Conclusions and recommendations

6.1. Introduction

This chapter contains the study conclusions and recommendations, which are based on reflections on the study's objectives, research questions, and findings interpretation. The research purpose was to evaluate water and sanitation challenges in Duncan Village's informal settlements. One of the objectives of this research, according to Chapter 1, was to recommend the best possible solutions to the local municipality in order to minimise water and sanitation challenges in the Duncan Village informal settlements. According to Makaudze and Gelles (2015), research is one of the methods for gathering accurate, sound, and reliable information regarding the effectiveness of activities, and so giving evidence of their success. As a result, the researcher gathered all available information on the challenges of water and sanitation, what causes them and potential solutions. The conclusions and recommendations to the municipal authority were also stated.

Even though the informal settlements of Duncan Village receive municipal water and sanitation services, there are noticeable challenges such as water wastage, illegal connections, sewer spillages, vandalism, and theft of provided facilities. The researcher's expectation was to reach out to all sections of each ward in order to provide an equitable representation of the entire ward, which proved to be challenging given to the density and expanse of the informal settlements. This was accomplished by using questionnaires prepared by the researcher in accordance with the study objectives, as well as site observations. As stated in Chapter 3 of this study, Barret

and Twycross (2018) indicates that site observation is a good technique for acquiring qualitative data since it allows researchers to collect a wide range of information.

6.2. Conclusions

The study's objective was to evaluate water and sanitation challenges in Duncan Village's informal settlements. Despite BCMM ensuring some degree of water supply and sanitation, the evaluation reveals that there are serious water and sanitation challenges in Duncan Village informal settlements. As indicated in Chapter 5 of this study, the main findings are as follows: High water losses: an average of 42.8% of respondents across all five selected wards of Duncan Village informal settlements indicated that there are water leakages around their areas mainly caused by illegal connections, theft, and vandalism. Sewer spillages: Blockages and sewer spillages were reported by an average of 21.6% mainly caused by overpopulation and throwing foreign objects in the toilets. Vandalism: Vandalism was reported as the third water and sanitation challenge by an average of 19.6% mainly caused by lack of ownership and poverty. Inadequate facilities: shortage of water and sanitation facilities was reported by an average of 6.0% respondents (n = 250, from all five surveyed wards) mainly caused by urbanisation and poor planning by the authorities. Aging of infrastructure: An average of 10.0% respondents reported aging of infrastructure as one of the water and sanitation challenges in Duncan Village informal settlements, mainly caused by lack of operations and maintenance.

6.3. Recommendations

6.3.1. Intense involvement of the municipality

Findings show that there is a lot of vandalism, theft of water and sanitation infrastructure, making it difficult for the municipality to keep up with the proper water and sanitation supply. These include, among other things, damage of property, stealing of pipelines, fittings, toilet doors, toilet seats, steel taps and manhole covers, and water wastage. As per findings, municipal officials have minimal visibility on the ground, which makes it hard for them to identify and respond to challenges in a timely manner.



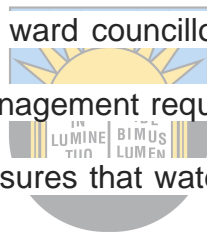
Outsourcing caretakers and water rangers would be an effective antidote to acts of vandalism, theft of water and sanitation infrastructure, illegal connections, and water wastage in Duncan Village informal settlements. Active enforcement of laws, such as by-laws, as well as the enactment of legislation will serve as a deterrent to other culprits who may harbour the thought of committing these unwanted actions.

Improved enforcement of municipal by-laws, as well as a planned and area-specific community awareness campaign and education to the communities, will go a long way to reducing the threat. Community-based awareness programs should be put in place according to Mnisi (2011), to teach individuals how to defend their own facilities. This will need additional public awareness efforts to inform locals about the necessity of taking care of government infrastructure.

6.3.2. Intense involvement of the ward councillors

Residents of Duncan Village informal settlements indicated that the municipality should increase its presence on the ground and establish awareness campaigns aimed at the public and empowering youth and women. Ward councillors should be the municipality's second eye by virtue of their work, gathering all needs and issues and reporting to the municipality for assistance.

Residents are said to be unaware of how the municipality operates, as well as the rights and wrongs that result from them, according to respondents. They further claimed that this contributes to unrests since residents believe that they are being neglected by the municipality and ward councillors. According to Matiwane (2012), improved water and sanitation management requires public participation and strong governance. Good governance ensures that water is effectively managed and fairly distributed, preventing conflicts (Kumar-Jha, 2022).



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6.3.3. Taking care of the provided services “Ownership” by the residents

The Buffalo City Metro Municipality has identified several challenges that need to be addressed, including unemployment and residents not being able to take care of the provided water and sanitation services. Unemployment is a major factor, with residents vandalising facilities in the exchange of money. As a result, it is critical for the municipal officer to encourage infrastructure ownership awareness initiatives.

80.0% of respondents in this study agree that creating awareness about taking care of the provided water and sanitation services Duncan Village informal settlements

residents is vital. In addition, respondents suggested that the municipality should find a way to employ people, particularly youth, as ablution facility caretakers and water rangers. According to Dunker (2017), projects should be demand-driven rather than resource-driven. Problems and needs should be recognised with the full participation of the community in the latter approach, also known as a people-centred approach, wherein community is inspired to participate in all phases of projects, which develops a sense of ownership and responsibility. Even though the residents in this situation share facilities, their participation in all project phases gives them a sense of responsibility and encourages them to take care of the water and sanitation services that are provided.

6.3.4. Monitoring of the water and sanitation facilities



As per findings, there is no effective monitoring of water and sanitation facilities in Duncan Village informal settlements, resulting in vandalism, theft and illegal connections, and water wastage that goes for days without being attended to. There is a lack of staffing according to the municipal official, which makes monitoring the performance on the ground impossible due to their dispersed location. According to Muzondi (2014), the public ownership and public operation could be regarded as the best option, because the public sector usually has the interests of the citizens at heart, and it is customarily mandated by the constitution and law to do so. The municipality should consider employing people who reside in the informal settlements as caretakers to augment the municipal staff. Furthermore, there should be more awareness campaigns in informal settlements because most people who live in informal settlements are from rural areas and lack knowledge of how to use and take care of waterborne facilities.

6.3.5. Operations and Maintenance

The BCMM municipal officer stated that there is fund for operations and maintenance, which adds to aging of infrastructure and the water and sanitation facilities being vandalised and not being maintained. Therefore, it is critical for the municipality to provide funds for operations and maintenance to keep the facilities intact and usable. This is especially crucial for shared infrastructure projects such as toilets and water standpipes.

A sustainable funding approach is crucial since it enhances the efficiency and effectiveness of existing resources (Mnisi, 2011). The municipality should also ensure that there are enough services for everyone in Duncan Village informal settlements despite where they are located.



6.3.6. Formalising Duncan Village informal settlements

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The findings indicate that the proliferation of shacks is at the root of water and sanitation challenges in Duncan Village informal settlements, making it impossible to provide adequate water and sanitation services and successfully monitor them. According to the municipal officer, in some cases, people build shacks in areas with no water or sanitation infrastructure, or in areas below the sewer line, making flush toilets difficult to furnish.

Therefore, it is critical that the municipality consider formalizing all informal sites in Duncan Village and relocating those that cannot be formalized. Fortunately, findings indicate that the municipality has begun the process of reducing densification by

transferring some inhabitants to nearby newly constructed RDP houses and is in the process of formalising Duncan Village informal areas. As a result, the municipality should enact relocating by-laws to prevent people from establishing shacks after they have profited from houses. Because there will be no shared facilities, formalizing and relocating people from informal settlements could solve many of the problems identified. Residents, according to Ojo (2018), require RDP housing to have access to adequate services, which alleviates the identified water and sanitation challenges.

6.4. Conclusion

In conclusion, public participation should be prioritised to address the identified water and sanitation challenges in Duncan Village informal settlements. Residents should be included in all phases of water and sanitation projects in their wards, as well as related programs, and should be given the opportunity to provide comments. Residents should also be able to choose their preferred water and sanitation technology, as well as the location of water sources and ablution facilities. Residents should be given the option to work on income-generating activities such as caretaking and cleaning of toilets. Customers care helpline numbers should be made available to all community members so that ward councillors can be notified of incidences of vandalism, theft, illegal connections, and water waste in time. Ward councillors should be visible not only during election campaigns, to prevent problems before they occur and to identify areas where constituents require support. Lastly, it is acknowledged that some questions, particularly the first three questions under section D (Water and sanitation practices in informal settlement), and the first question under section E (Knowledge, attitudes and experience about water and sanitation in informal settlements) from the householders questionnaires are personal and probably leading,

and may have influenced the outcome of the responses because the respondents may have been ashamed to reveal their poor hygiene practices. However, these personal questions should not have a major impact on the outcome of the study aspects of water and sanitation challenges.

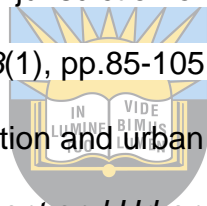


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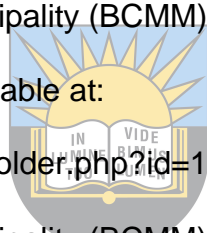
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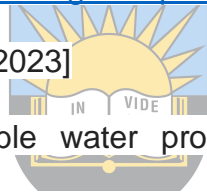
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APPENDIX 1

QUESTIONNAIRE FOR THE HOUSEHOLDERS

Evaluation of Water and Sanitation challenges in informal settlements: A case study of Duncan Village, East London, South Africa

A. BIOGRAPHICAL PROFILE

1. Age

16-24		25-34		35-44		45+	
-------	--	-------	--	-------	--	-----	--

2. Gender

Male	
Female	

3. Educational background

No formal education	
Primary	
Secondary	
Tertiary	



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4. Source of income

Unemployed/no income	
Social grants	
Pensioner	
Self - Employed	
Employed	

B. HOUSEHOLD INFORMATION

1. How long have you been staying in Duncan village?

.....

2. How many are you at your household?

Adults	
Children	

3. How many females live in the house?

.....

4. How many males live in the house?

.....

5. Who is the breadwinner at your household?

Father	
Mother	
Grandfather	
Grandmother	
Other	



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6. If your answer is other, please specify the breadwinner.

.....

7. What is the breadwinner's occupation?

.....

8. How much is the breadwinner's monthly income?

< R 1000	
R 1001 – R 2500	
R 2501 – R 4000	

R 4001 - R 5500	
R 5501 >	

C. ACCESS TO WATER AND SANITATION FACILITIES

1. Do you have access to water and sanitation facilities?

Yes	
No	

2. If your answer is no, how do you access water and sanitation?

.....

.....

.....

3. If your answer is yes, who built the facilities?

Own	
Community	
Government	



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4. Where are the facilities located?

Yard	
House	

5. What type of water facilities is used in your household?

House connection tap	
Yard connection tap	
Communal tap	
River /dam	
Other	

6. If your answer is other, please specify.

.....

7. What type of sanitation facilities is used in your household?

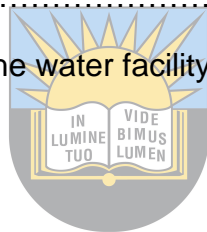
Flush toilet	
Pit latrines	
Ventilated improved pit toilets	
Bush/veld	
Other	

8. If your answer is other, please specify.

.....

9. How long does it take to reach the water facility?

1 – 10 minutes	
11 – 30 minutes	
31 – 60 minutes	
60 >	
Cannot estimate	



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10. How long does it take to reach the toilet facility?

1 – 10 minutes	
11 – 30 minutes	
31 – 60 minutes	
60 >	
Cannot estimate	

11. How often do you collect water?

Once a day	
Twice a day	
After 2 days	
After 3 days >	

12. How often do you visit toilet facility?

Once a day	
Twice a day	
After 2 days >	

13. What time of the day do you often visit the water facility?

Morning	
Afternoon	
Evening	
Night	



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14. What time of the day do you often visit the toilet facility?

Morning	
Afternoon	
Evening	
Night	

15. If it takes you more than 30 minutes to reach the toilet facility, how do you help yourself at night?

.....

.....

.....

D. WATER AND SANITATION PRACTICES IN INFORMAL SETTLEMENTS

1. Do you close the tap tightly after collecting water?

Yes	
No	

2. Do you flush the toilet and clean after yourself after using the toilet?

Yes	
No	

3. Do you wash your hands after visiting toilets?

Yes	
No	

4. What do you do when you see a tap leaking?

Ignore	
Try to stop the leakage	
Call the municipality	



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5. What do you do when you see raw sewage spilling?

Ignore	
Try to stop the leakage	
Call the municipality	

6. Where do you dispose waste?

Throw in the toilet	
Throw in the hole	
Throw in the river	
Throw in the veld	
Left alone	

Other	
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E. KNOWLEDGE, ATTITUDES AND EXPERIENCE ABOUT WATER AND SANITATION IN INFORMAL SETTLEMENTS

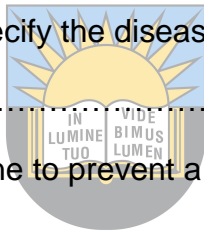
1. Do you wash your hands before handling food?

Yes	
No	

2. Has anyone in your family suffered from waterborne or sanitation diseases?

Yes	
No	

3. If your answer is yes, please specify the disease.



4. What do you think should be done to prevent a person from being infected by waterborne or sanitation diseases?

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F. VIEWS CONCERNING PROVISION AND CHALLENGES OF WATER AND SANITATION IN INFORMAL SETTLEMENTS

1. Are you satisfied with the water and sanitation services available in your area?

Yes	
No	

2. If your answer is no, explain why?

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3. What are the common water challenges that you experience in your area?

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4. What are the common sanitation challenges that you experience in your area?



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5. What do you think causes those water challenges you have mentioned in F3?

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6. What do you think causes the sanitation challenges you have mentioned on F4?

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7. Do you report the challenges you have mentioned in F3 and F4 to the local authority?

Yes	
No	

8. If your answer is no, please explain why.

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9. How long does it often take for the local authority to attend to the reported problems?



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10. What do you think should be done to minimise the water and sanitation challenges in your area?

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APPENDIX 2

QUESTIONNAIRE FOR THE WARD COUNCILLOR

Evaluation of Water and Sanitation challenges in informal settlements: A case study of Duncan Village, East London, South Africa

A. BIOGRAPHICAL PROFILE

1. Age

20-30		31-40		41-50		51+	
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2. Gender

Male	
Female	

3. Educational background

No formal education	
Primary	
Secondary	
Tertiary	



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4. Is the position of a councillor your first job?

Yes	
No	

5. If your answer is no, what was your previous job?

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6. Do you have another job apart from being a councillor?

Yes	
No	

7. If your answer is yes, what is your other job?

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8. Which Municipality do you represent?

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9. Which ward do you represent?

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10. How long have you been staying in your Municipality?

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11. What motivated you to run for local government elections?

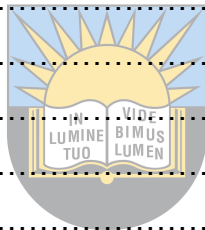
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B. UNDERSTANDING SERVICE DELIVERY IN INFORMAL SETTLEMENTS

1. What is the function of IDP?

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2. What is quality service delivery?

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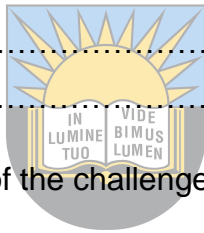
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3. Are there challenges pertaining water and sanitation service delivery in your ward?

Yes	
No	

4. If your answer is yes, what are those challenges?

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5. What do you think is the cause of the challenges you mentioned in B4?

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6. Do you think your municipality has capacity in terms of quality service delivery in informal settlements?

Yes	
No	

7. If your answer is No, what do you think should be done to improve that capacity of your municipality?

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C. ACCESS TO WATER AND SANITATION IN INFORMAL SETTLEMENTS

1. Are there adequate water and sanitation facilities in your ward?

Yes	
No	

2. If your answer is no, what do you think the challenge is?



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3. What do you think causes the challenge you mentioned in C2?

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4. What do you think should be done to minimise the challenge you mentioned in C2?

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5. What type of water facilities do people in your ward use in their households?

House connection tap	
Yard connection tap	

Communal tap	
River /dam	
Other	

6. If your answer is other, please specify.

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7. In your own opinion, do you think the water facilities in your ward are well managed?

Yes	
No	

8. If your answer is No, what do you think the challenge is?

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9. In your opinion, what do you think should be done to minimise the challenge mentioned in C8?

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10. What type of sanitation facilities do people in your ward use in their households?

Flush toilet	
Pit latrines	
Ventilated improved pit toilets	
Bush/veld	
Other	

11. If your answer is other, please specify.

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12. In your own opinion, do you think the sanitation facilities in your ward are well managed?

Yes	
No	

13. If your answer is No, what do you think the challenge is?

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14. In your opinion, what do you think should be done to minimise the challenge mentioned in C13?

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15. Could you please explain your understanding of the importance of proper management of water and sanitation?



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D. WATER AND SANITATION PROVISION BY THE MUNICIPALITY IN INFORMAL SETTLEMENTS

7. Does the IDP of your municipality cater for the provision of water and sanitation facilities in informal settlements?

Yes	
No	

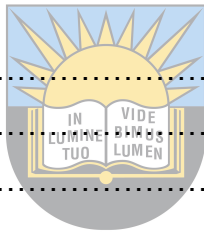
8. Do you think your municipality has the capacity to address the water and sanitation backlog in informal settlements?

Yes	
No	

9. Do you think your municipality has the capacity to address the water and sanitation challenges in informal settlements?

Yes	
No	

10. If your answer is No, what do you think should be done to address the water and sanitation challenges in informal settlements?



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11. How is your municipality prepared to address the water and sanitation backlog in informal settlements?

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12. How is your municipality prepared to address the water and sanitation challenges in informal settlements?

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APPENDIX 3

QUESTIONNAIRE FOR THE MUNICIPAL OFFICIAL

Evaluation of Water and Sanitation challenges in informal settlements: A case study of Duncan Village, East London, South Africa

A. BIOGRAPHICAL PROFILE

1. Age

20-30		31-40		41-50		51+	
-------	--	-------	--	-------	--	-----	--

2. Gender

Male	
Female	

3. Educational background

No formal education	
Primary	
Secondary	
Tertiary	



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4. Is the position under Water and Sanitation at Buffalo City Metro Municipality your first job?

Yes	
No	

5. If your answer is no, what was your previous job?

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6. How long have you been working at Buffalo City Metro Municipality under Water and Sanitation unit?

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7. What motivated you to apply for a water and sanitation job?

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B. UNDERSTANDING SERVICE DELIVERY IN INFORMAL SETTLEMENTS

1. What is the function of IDP?

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2. What is quality service delivery?

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3. What is the difference in providing water and sanitation in formal areas as opposed to informal areas?

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4. In your opinion, are there challenges of water and sanitation services in Duncan village informal settlements in your municipality?

Yes	
No	

5. If your answer is yes, what are those challenges?

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6. What do you think is the cause of the challenges you mentioned in B5?



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7. Do you think your municipality has capacity in terms of resolving the challenges you mentioned in B5?

Yes	
No	

8. If your answer is yes, how do you think your municipality can resolve the challenges you mentioned in B5?

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C. ACCESS TO WATER AND SANITATION IN INFORMAL SETTLEMENTS

1. Are there adequate water and sanitation facilities in Duncan village informal settlements?

Yes	
No	



2. If your answer is no, what do you think the challenge is?

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3. What do you think causes the challenge you mentioned in C2?

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4. What do you think should be done to solve the challenge you mentioned in C2?

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5. What type of water facilities do people in Duncan village informal settlements use in their households?

House connection tap	
Yard connection tap	
Communal tap	
River /dam	
Other	



6. If your answer is other, please specify

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7. In your own opinion, do you think the water facilities in Duncan village are well managed?

Yes	
No	

8. If your answer is No, what do you think the challenge is?

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9. In your opinion, what do you think should be done to solve the challenge mentioned in C8?

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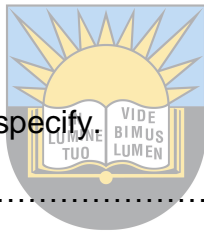
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10. What type of sanitation facilities do people in Duncan village informal settlements use in their households?

Flush toilet	
Pit latrines	
Ventilated improved pit toilets	
Bush/veld	
Other	



11. If your answer is other, please specify.

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12. In your own opinion, do you think the sanitation facilities in Duncan village informal settlements are well managed?

Yes	
No	

13. If your answer is No, what do you think the challenge is?

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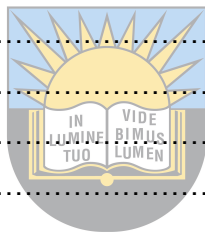
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14. In your opinion, what do you think should be done to solve the challenge mentioned in C13?

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15. Could you please explain your understanding of the importance of proper management of water and sanitation?

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D. WATER AND SANITATION PROVISION BY THE MUNICIPALITY IN INFORMAL SETTLEMENTS

13. Does the IDP of your municipality cater for the provision of water and sanitation facilities in informal settlements?

Yes	
No	

14. Do you think your municipality has the capacity to address the water and sanitation backlog in informal settlements?

Yes	
No	

15. Do you think your municipality has the capacity to address the water and sanitation challenges in informal settlements?

Yes	
No	

16. If your answer is No, what do you think should be done address the water and sanitation challenges in informal settlements?

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17. How is your municipality prepared to address the water and sanitation backlog in informal settlements?



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18. How is your municipality prepared to address the water and sanitation challenges in informal settlements?

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APPENDIX 4 – Ethical clearance



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ETHICS CLEARANCE REC-270710-028-RA Level 01

Project Number: SUM011SMUN01
Project title: Evaluation of water and sanitation challenges in informal settlements: A case study of Duncan Village, East London, South Africa.
Qualification: Masters in Geography
Principal Researcher: Khodani Munyai
Supervisor: Prof P Sumner
Co-supervisor: Dr S Mazinyo

On behalf of the University of Fort Hare's Research Ethics Committee (UREC) I hereby grant ethics approval for SUM011SMUN01. This approval is valid for 12 months from the date of approval. Renewal of approval must be applied for BEFORE termination of this approval period. Renewal is subject to receipt of a satisfactory progress report. The approval covers the undertakings contained in the above-mentioned project and research instrument(s). The research may commence as from the 13/11/19, using the reference number indicated above.

Note that should any other instruments be required or amendments become necessary, these require separate authorisation.
Please note that the UREC must be informed immediately of

- Any material changes in the conditions or undertakings mentioned in the document;

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- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research.

The Principal Researcher must report to the UREC in the prescribed format, where applicable, annually, and at the end of the project, in respect of ethical compliance.

The UREC retains the right to

- Withdraw or amend this approval if
 - Any unethical principal or practices are revealed or suspected;
 - Relevant information has been withheld or misrepresented;
 - Regulatory changes of whatsoever nature so require;
 - The conditions contained in the Certificate have not been adhered to.
- Request access to any information or data at any time during the course or after completion of the project.

Your compliance with DoH 2015 guidelines and other regulatory instruments and with UREC ethics requirements as contained in the UREC terms of reference and standard operating procedures, is implied.

The UREC wishes you well in your research.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Renuka Vithal'.

Professor Renuka Vithal
UREC-Chairperson
13 November 2019