Water usage and disposal in informal settlements

Boitumelo Malunga

1226916

Supervisors: Ian Siemers & Prof Andrew Thatcher

University of the Witwatersrand

Department of Human and Community Development

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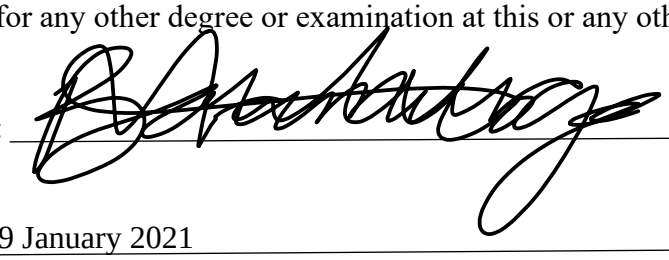
Declaration

"I Boitumelo Malunga declare that this research is my own work. It has not been submitted before for any other degree or examination at this or any other university"

Signed: 

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Abstract

Setswetla, Alexandra is an informal settlement which is situated in Johannesburg and characterized by dilapidated make-shift housing, inadequate sanitation and a lack of grey water treatment systems. The latter has led to the streaming of soiled water across the settlement, which could have severe health implications for the population. A constructed wetland has been proposed as the plausible solution to this problem and although these are easy to build as they do not require displacement of the population, contextual information about the patterns of water use are crucial for the functioning of the wetland. Therefore, this study aimed to collect contextual information about the water acquisition, storage, use and disposal patterns of the Setswetla population such that it could be used as feed information for the design phase of the project. Secondary to this, the study also sought to gain a greater understanding of the social factors that influence water use in Setswetla. The research found that a large portion of the sample collected water from communal taps in the Settlement and stored water in 20l buckets. Majority of the sample alluded more to indoor water use as opposed to outdoor water use and ranked laundry as the activity for which they used most of their water. The sample also mentioned that they disposed of their water and their solid waste in the streets. Lastly crime and unemployment were observed as the two core social factors that influenced the use of water in Setswetla.

Key words: informal settlements, water acquisition, water use, water disposal, solid waste management, constructed wetland, consumer behavior

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Dedication

To:

Nomonde Jaqueline Malunga

Dr Gaongalelwe Stanley Sewedi

&

Mmanuku Witness Malunga

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CHAPTER ONE: INTRODUCTION

'The air was thick with smoke of coal fires in tin braziers and stoves. A single water tap served several houses. Pools of stinking, stagnant water, full of maggots collected by the side of the road' (Nelson Mandela, 1994, p.88, as cited in Willson, 2003)

1.1 Overview and Rationale

Informal settlements are an important feature of the modern world and they face a number of challenges. Some of these problems include rapid expansion due to urbanisation and the state's inability to provide adequate housing and sanitation facilities. These conditions lead to overpopulated and underserviced informal settlements with limited access to basic sewage and grey water treatment systems (Water International Cooperation, 2017). This kind of unjust living condition has materialized in Setswetla, Alexandra, an informal settlement located in the greater Johannesburg metropolitan area. The lack of drainage systems in this area has consequently led to grey water streaming through its streets and pathways. The streaming of water in this way could potentially pose a threat to the health of those who are actively exposed to it (Govender, Barnes and Pieper, 2011). It is therefore crucial that the necessary steps be taken to appropriately deal with the streams of polluted water which flow through the streets of Alexandra (Water International Cooperation, 2017).

Ensuring a community's health and safety despite the prevalence of wastewater presents a big challenge in informal settlements. Given that conventional infrastructure approaches do not consider the unplanned nature of these slums (Nevhutalu, 2018), traditional engineering solutions may not be effective in dealing with the current wastewater problem in Alexandra. A constructive wetland, engineered to use natural functions like vegetation and soil to treat wastewater (Water International Cooperation, 2017), has therefore been proposed as the plausible infrastructure development solution. The wetland will provide a repository for the grey water, filter it and subsequently discharge the effluent into the Jukskei River.

Contextual information about water use is crucial for the design and functioning of components of the constructed wetlands (Lakay, 2013). This was affirmed by Kalantzis et al., (2016) who

indicated that the incorrect water volume could compromise the capacity of a wetland. In relation to this, Jorgensen et al. (2009) suggested that the use and consumption of water were fuelled by a host of contextual considerations, arguing that no two population groups consume and utilise water in the same way. Such considerations fall within the domains of consumer psychology, which looks at how consumers acquire, use and dispose of a product. Therefore, providing premise to use such core principles to inform the study of water acquisition, use and disposal within an informal settlement. Furthermore, informal settlements are heterogeneous complex settings where residents follow behavioural patterns that are not consistent to other social settings (Brown- Luthango, Reyes and Gubevu, 2017).

The above-mentioned concerns inform the prime interest of the current study. Similarly, these highlight the shortcomings of existing literature and warrants the need to conduct contextualized research pertaining to the water consumption, usage, storage and disposal patterns of Setswetla's population.

Studies conducted after the development of a constructed wetland in Langrug, Stellenbosch, produced relevant results pertaining to solid waste management patterns and their influence on the efficacy of constructed wetlands. The research indicated that the residents disposed of their kitchen water into the drainage system without removing food waste which, combined with the municipality's ineffective collection of solid waste, led to polluted streets. Both the food and the solid waste would subsequently clog the drains, leading to the system functioning inadequately. Based on these findings a waste management section was added to this study, which focused on ascertaining how and when the community of Setswetla disposed of their solid waste. This information will further assist the system's designers to develop waste solutions which can control the potential blockages in the system.

Lastly, research pertaining to the end use of water for suburbia and rural areas is readily available; however, the same cannot be said for the water end use models of informal settlements (Shaban et al., 2007; Nyong & Kanaroglou, 1999). Similarly, research on water end use tends to be centred on water conservation and not so much on the importance of such research for water supply and drainage planning (Fan et al., 2013). This research therefore aims to bridge this gap by contributing to literature and exploring water use in an informal settlement. In the addition, these results will serve as feed-in information for the design element of the proposed constructed wetland.

1.2 Aims of the study

The main aim of the study is to identify patterns of water acquisition, storage and disposal from a sample of participants living in Setswetla, Alexandra. In addition to identifying and describing these water usage patterns; the study seeks to ascertain the factors influencing these patterns. This research also aims to ascertain information about solid waste management in Setswetla. In furtherance of the aforementioned aims, the section that follows considers literature on water use, storage and disposal patterns from a variety of societal and economic contexts.

CHAPTER TWO: LITERATURE REVIEW

The overall function of a constructed wetland is heavily reliant on the end use of water in the proposed setting. Although the end use of water has been widely researched across the board, very little research has been done on the end use of water in urban informal settlements. The sparse research that does exist indicates a significant difference in water demand, use and disposal in informal settlements when compared to the end use of water in suburban areas. These differences are fuelled by socio-economic factors such as the lack of infrastructure in informal settlements. This section will define informal settlements and simultaneously describe the current state of Setswetla in Alexandra.

2.1 What are informal settlements?

Major cities all around the world, including those in South Africa, have been subject to evident expansion. This expansion is further exacerbated by urbanization, defined here as the push and pull dynamic that causes the influx of people from more rural, underdeveloped parts of a country to move to more developed cities (Nevhutalu, 2018). Urbanization has aided in the advancement of the country's business sectors, but it has also eroded many urban social settings. The influx of people is not met by an increase in infrastructure from the state, and this leads to the mushrooming of slums/informal settlements in the peripheral areas of the cities (Nevhutalu, 2018).

Informal settlements are residential areas that emerge at an alarming rate on land which has not been set aside for residential use, and fall short of local authority requirements (Chikoto, 2009). Informal settlements usually persist in socio-economic climates that are incapable of providing adequate housing, infrastructure and land. This is often exacerbated by rapid urbanization and subsequently the inability of the state to keep track of all those who are in need of basic services (Chikoto, 2009). In response to the state's lag in the provision of housing, these informal communities have, for decades, displayed initiative by creating their own structures in the interim (Zandamela, 2016). Furthermore, informal settlement communities are heavily underserviced and have limited access to basic sewage and grey water treatment systems (Water International Cooperation, 2017). These are also described as non-sewered areas as they do not have on-site waterborne sanitation and employ the use of dry sanitation (Carden, Armitage, Shichone and Winter 2007).

Alexandra is the focus area for this project and is not exempt from the conditions described above. Late Nelson Mandela's auto biography describes Alexandra as a "slum living testimony to the neglect of the authorities" (Nelson Mandela, 1994, p.88, as cited in Willson, 2003). As much as its conditions have certainly worsened over time, Alexandra's narrative did not start off as the overcrowded settlement that we know today.

2.2 Describing Alexandra

2.2.1The history of Alexandra

Alexandra is an informal settlement in the greater Johannesburg area. The shanty town is located four kilometres east of Sandton and twelve kilometres north-east of the Johannesburg CBD area (Willson, 2003). Alexandra started off as a white suburb in 1904 and gradually evolved into an area populated by black people who came in their numbers to Johannesburg in search of employment (Willson, 2003). In the early stages of its establishment, the area could be said to have been a beacon of hope for the community as it was one of the few settlements where black people could buy and own land. This was, of course, before the 1913 land act was brought into power, prohibiting black people from buying and owning land (Willson, 2003).

Alex (as it is commonly known), is one of the many settlements that suffered at the hand of the apartheid system. There was minimal investment by the state and when urban planning efforts were made in the 1960's, these too proved to be of an inferior kind (Willson, 2003). In this time, Alex was a place of refuge for many seeking employment in the Johannesburg area and gradually expanded to the overcrowded township we know today.

2.2.2 Alexandra today

Alexandra is segmented by the Jukskei River, with the east bank mostly developed and the west densely populated and underserviced (Owusu-Asante & Ndritu, 2009). The estimated population of Alexandra was 166 971 according to the 2001 population census. According to Census 2011, this number has increased from 166971 to 179624. This translates to a population density of 477 persons/ha and 80 dwelling units/ha (Owusu-Asante & Ndritu, 2009). The east bank is serviced by a water-borne sewage system; however, the sewage in the west is serviced with the aid of chemical toilets.

Alexandra has a history of experiencing problems with water pollution. The lack of drainage infrastructure, coupled with water consumption and disposal patterns, has resulted in the streaming of soiled water across the township (Water International Cooperation, 2017). This

water flows through the streets and pathways, and deposits directly into the Jukskei River. The streaming of polluted water in this manner could breed dangerous water borne diseases that compromise the health of those exposed to them. A study by Govender et al. (2011) investigated the effects of failing sanitation, poor housing conditions and faecal pollution in runoff water in a low-cost housing community in Cape Town. Here low-cost housing is defined as units of houses provided to residents living in make-shift dwellings (shacks) in informal settlements. This study found large amounts of E.coli in the water (Govender et al., 2011). The E.coli counts ranged from 750 to 1580 000 000 per 100 millilitres. The study also reported that about 14% of the sample suffered one or more diarrheal attacks in the weeks leading up to the interviews for the projects (Govender et al., 2011). These results describe the harsh conditions to which people in low-cost housing communities are exposed. It could thus be argued that possibility of water contamination in an informal settlement would be much higher than that in low-cost housing communities. It is with this that a constructed wetland has been proposed to address the water pollution problem.

2.3 Proposed solution

Considering the description concerning Alexandra's conditions, a constructed wetland has been proposed as a plausible solution for the described context. This research report will hereafter refer to the proposal of a constructed wetland, and the projects that surround it, as the overarching study. The aim of the overarching study is to aid in the promotion of the constitutional right to a clean and safe environment (Water International Cooperation, 2017). Section 24(a) of the Bill of Rights in the Constitution states that "everyone has a right to an environment that is not harmful to their health or well-being" and has the right to "(b) (i) have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation" (The Constitution of the Republic of South Africa, 1996).

Secondly, the overarching study aims to ensure that the recommendations of the South African National Development Plan have been met. The National Development Plan (NDP) is a policy document based on the constitution of South Africa and the Housing Act. Established in 2012, the NDP provides strict margins for the development of informal settlements and obligates the state to use taxpayers' money to realize this goal.

One of the aims of the NDP is to reduce inequality and to eradicate poverty by 2030, by redeveloping informal settlements on more derisible land (National Development Plan 2030,

South African Government, no date cited in Nevhutalu, 2018). The NDP has stipulated the roles of each sector in the government in the fulfillment of its goals. There is also an emphasis placed on collaborative work amongst the sectors and departments of the state, which further solidifies the need for all those involved to have a full understanding of the overarching goals of the plan.

The NDP aims to both build an inclusive economy with local capacity and to promote leadership, which can be achieved by working with the citizens of South Africa (Presidency, 2012, cited in Nevhutalu, 2018). The following recommendations have been prescribed by the NDP to help with the future developments of the set goals:

- Upgrading in-situ with minimal disruption to existing communities.
- Considering the long-term use of spatial resources.
- The upgrading of infrastructure needs to factor in local community needs with an acknowledgement of the uniqueness of each community.
- Instead of using conventional methods, an incorporation of innovation and the use of sustainable approaches should be considered.
- Challenges related to water supply, sanitation, solid waste, drainage, housing etc. should be interlinked as these problems do not exist in isolation. (National Development Plan 2030, South African Government, no date cited in Nevhutalu, 2018).

The overarching study encapsulates the above-mentioned points. The overarching study aims to provide in-situ infrastructure development in Alexandra. This entails developing the area without displacing the population of Alexandra, which speaks to the first point made above. The objective of the NDP would be further ascertained through the overarching study as well as this present study because the proposed constructed wetland is classified as an unconventional method of development which would be designed and constructed using information obtained through this study as feed-in information.

Lastly, on a more international scale, the overarching study is aligned with the sixth United Nations Sustainable Development Goal. The sixth Sustainable Development Goal is directed at ensuring the availability and the sustainable management of water and sanitation for all. The first goal within UN SDG6 is “universal and equitable access to safe and affordable drinking water for all” by 2030 (United Nations Sustainable Development Goal Knowledge Platform).

In South Africa, great strides have been made in this regard: 94% of the population has access to a supply of safe drinking water from a tap within 200 m of their home. However, this pace of development has not been matched by the intrinsically linked goal of "adequate and equitable sanitation and hygiene for all" and "improved water quality by reducing pollution, eliminating dumping and minimizing the release of hazardous chemicals and materials, halving the proportion of untreated wastewater" by 2030 (Water International Cooperation, 2017). Only black water has been considered, and while open defecation has been largely replaced by pit latrines or communal ablutions, the unintended consequences of tap water services include rivers of untreated grey water coursing through dense, informal settlements (Water International Cooperation, 2017).

2.4 Defining Constructed Wetlands

2.4.1 What is a constructed wetland?

A constructed wetland is an engineered system that uses natural functions like vegetation and soil to treat wastewater. Constructed wetlands have extensive links to green ergonomics, with particular focus on making the interaction between natural and human systems more effective (Kalantzis et al., 2016). The constructed wetland for the overarching project will be made up of interconnected drainage systems that collect grey water. Furthermore, its main function will be to filter out some of the harsh chemicals and pathogens in the water so that the effluent can be channelled into the Jukskei River (Water International Cooperation, 2017). The proposal for the constructed wetland in Alexandra was inspired by a constructed wetland built in Langrug a few years ago. A short insert about the project is provided below.

2.4.2 The Langrug case

Langrug is an informal settlement that was formed illegally in 1993 (Nevhutalu, 2018). The settlement is located in the scenic wine farm areas of Franschhoek and falls under the Stellenbosch municipality. The area is largely underserviced as there are 49 people per working toilet and 72 people per working tap. This infrastructure is also very poorly maintained (Nevhutalu, 2018). Because there were no formal drainage systems in the settlement, the community disposed of their grey water in the streets, causing the water to stagnate and threaten the health of the community members. The untreated effluent would then flow into the Stiebeuel River, which feeds into the Berg River, polluting the water and, by extension, the crops dependent of this water source (Nevhutalu, 2018). The genius of SPACE project, like the

overarching project in question, was boarded to curb the negative effects the untreated water was having on the rivers. This project will be discussed below to provide context.

2.4.2.1 The genius of SPACE project

This project formed part of the Western Cape green initiative which prioritized the Berg River. It aimed to develop an innovative solution to the Berg River pollution dilemma, by developing a system that would treat the grey water at its source using biomimicry methods (Nevhutalu, 2018).

2.4.2.2 The layout of the system

The system included the installation of 27 plastic drums where residents could dispose their wastewater (Nevhutalu, 2018). Each of the drums contained a sponge and sieve material. These materials were the filtering devices which would help filter any solid particles in the grey water before it was conveyed to the piped network. Once it had been filtered, the water would then be conveyed through a pipe which would feed into the tree gardens. The gardens would subsequently slow down the discarded water and function as a sustainable food source for the community (Nevhutalu, 2018,). In addition to this system permeable pavements were installed. The pavements allow for the water to seep through and collect in an underdrain (Nevhutalu, 2018).

As started above, the Langrug SPACE project and the system design provided a premise for the overarching project; however, the system could not be adopted without considering the context of Alexandra. The next section will discuss the importance of contextual information when designing and building a constructed wetland

2.4.3 Constructed wetlands and contextual information

Many water use studies start off by highlighting the importance of understanding water consumption behaviour prior to the design of water use strategies (Fan et al., 2013; Oageng & Mmopelwa, 2014). These studies provide information needed for the design of effective water usage strategies. This pre-development planning is also considered relevant when constructing wetlands. Before the construction of the wetland, a comprehensive planning phase is essential (Davis, 1995). This is done to ensure that the design elements of each constructed wetland are context and site specific. This planning phase could consist of characterizing the quantity and quality of the wastewater to be treated, ascertaining discharge standards, selecting the site, and

determining seasonal weather changes (Davis, 1995). For this particular study, characterising the quantity and quality of wastewater will take priority.

To begin quantifying the wastewater, understanding hydrology is imperative. Hydrology is considered the driving force enabling the effective functioning of a wetland (Lakay, 2013). It describes the quantity and temporal distribution of flow into the constructed wetland. This is closely related to the volume, frequency extremes (peaks and troughs) and the movement of the water through the wetland (Davis, 1995).

Wetlands are shallow bodies of water that are exposed to the elements (Davis, 1995). Temperature and rainfall can affect the overall functioning of the wetland where high flows caused by heavy rain and low temperatures decrease the treatment efficiency of the wetland as it results in increased flow velocities and reduced hydraulic retention time (HRT) (Lakay, 2013). Lakay (2013, p30) stated that "High flows may dilute some dissolved pollutants, while increasing the amount of suspended material". This means that the increase in rain could increase the rate at which the water flows through the system which in turn affects the holding time of the water in the system. Minimum temperatures limit the ability of wetlands to treat some pollutants" This is directly related to the hydro flow, which can be described as the seasonal water level fluctuations characterised by a carefully balanced inflow-outflow cycle.

The use of constructed wetlands spans over a range of applications (Lakay, 2013), and the described volume conditions unpacked above are crucial for the optimal functioning of each wetland. Given the intended use of the proposed constructed wetland, it can thus be argued that gathering information related to the volume each household has at their disposal is vital for the overall functioning of the wetland. Moreover, each constructed wetland is unique and context specific in that the functioning of the wetland can be disturbed by the natural elements. Embedded in this is the notion that no two systems are identical. This further extends the argument for contextual data focused on the water usage patterns of Alexandra. This kind contextual consideration can be seen in a study done by Kalantzis et al. (2016) in Australia.

In the study a wetland is described as an interconnected system which combines rain, water harvesting and grey water treatment (Kalantzis et al., 2016). The grey water is gravity fed through the wetland where the process of filtration takes place. The wetland is made up of a gravel bed as well as a variety of plants and micro-organisms (Kalantzis et al., 2016), where

gravel filters out sand and the grey water provides nutrients to the roots of the plants. This allows for the filtration of sand as well as the removal of degraded contaminants (Kalantzis et al., 2016).

The system included the collection of rainwater as well; this meant that the designers had to monitor rainfall patterns to avoid compromising the capacity of the wetland (Kalantzis et al., 2016). This suggests that the water use patterns identified prior to the designing stage of the wetland were crucial for the functioning of the system (Kalantzis et al., 2016). This further suggests that the information was used to inform the capacity of the wetland, the kinds of micro-flora included in the systems and other materials which were used as filtering agents in the system.

Zuma et al. (2009, p. 41) states that the system has to be robust enough to handle the different grey water compositions and that the micro-flora would have to be resilient enough "to survive consecutive drying/wetting cycles, as well as extended starvation periods". This recognizes that effluents from different areas have varying composition structures, and that information about specific environments is important when designing the system (Zuma et al., 2009). These arguments provide part of the rationale for the current project.

This section defined constructed wetlands, explored how they have been used in informal settlements and reviewed literature on constructed wetland standards. As noted, the current study seeks to develop an understanding of the water acquisition, use and disposal patterns of Setswetla. Thus, the following section will seek to unpack the variables and by extension report on some empirical findings based on past research closely related to the study at hand.

2.5 Consumer Behaviour and water consumption

2.5.1 What is Consumer Behaviour?

Consumer behaviour theory can be described as the behavioural patterns of consumers which precede and determine subsequent decisions regarding the search for, purchasing of, use, evaluation and disposal of products, services and ideas (Strydom, 2005). These processes reflect core dimensions of the study at hand.

Consumer behaviour is explained by a host of different models however for the purposes of this study the Engel, Kollat and Blackwell (EKB) model will be discussed (Osei and Abenyin, 2016). According to the EKB model consumer behaviour is understood as an element of choice, where decisions are made by selecting a product from a range of possible alternatives. The model is premised on information processing which includes: the type of information used by the customer, how the information is processed and how this affects the decisions made at the end (Osei and Abenyin, 2016). In addition, the EKB is comprised of five sequential information processing steps which include: recognition of an unsatisfied need, gathering information on possible alternatives, evaluation of alternatives, purchasing of the product and lastly post purchase evaluation (Suelin, 2010).

Information processing has been said to be influenced by an individual's social setting. According to Engel, Blackwell and Miniard (2001) (as cited Osei and Abenyin, 2016), consumer decision making is influenced by individual differences, psychological processes and environmental influences. Environmental influences could include culture, social class and personal influences (Suelin, 2010). It is therefore posed that the thought process of acquiring, using and disposing of water could be unique for a group of people who share the same social statues and in the same environment.

2.5.2 Water acquisition.

Section 27(1) (b) of the Bill of Rights prescribes that "everyone has the right to have access to sufficient water" (The Constitution of the Republic of South Africa, 1996), and although this has been achieved for large parts of South Africa, the access to clean an sufficient water remains limited for residents in informal settlements.

"Access to water in informal settlements is generally limited to communal water sources" (Tissington, 2011). This can be corroborated by the results of the 2011 census which showed that 12% of the households under the management of city of Cape Town municipality relied on a communal tap as their main water source (Tissington, 2011). Similar findings were obtained in a recent study done in Ekhuruleni, a city in the Gauteng region of South Africa, which focused on acquiring information about water accessibility, sanitation, water use and grey water disposal in the informal settlements of Ekhuruleni (Mofokeng, 2008). Results from this research indicates that most of the residents acquired most of their water from communal taps except for one settlement (Harry Gwala) where most of the homes had illegal in-house connections traced back to the communal pipes (Mofokeng, 2008).

The standpipes supplied by the municipality are often limited and situated in the peripherals of the settlement. This would often mean that the residents would have to carry 20*l* buckets from their homes to the taps to collect water. Research shows that women and children often have to carry the burden of collecting water for their households as men commonly collected water for short term use. And therefore the placement of stand taps/communal taps in inconvenient locations can be viewed as a potential risk for violence and sexual assault for the 'bearers of water'(Tissington, 2011).

2.5.3 Water demand

Residential water use can be affected by a host of different factors, these will be discussed below.

2.5.3.1. Demographic variables.

Demographics describe the way in which the population is structured. Some examples of demographic variables include (but are not limited to) race, gender, age, economic status and level of education (Pretorious, 2016). Research has revealed that water demand is elastic to changes in demographic variables. Household size has particularly been viewed as a demographic variable that has the potential to affect the water demanded at the household level; however, the arguments about the way in which this variable can affect water demand are inconsistent (Pretorious, 2016). Some studies report on a positive relationship between water demand and household size, which translates to an increase in water demand as household size increases (Pretorious, 2016). This was confirmed by Gato-Trinidad et al. (2011), as a positive association was made between the water used for laundry and dishwashing and family size. The water used for these two activities increased with family size. Conversely, Corbella and Pujol (2009 as cited in Pretorious, 2016) argue for an inverse relationship between the two variables and state that a per capita increase in household size is met by a decrease in water demand. This discord further qualifies the need for a context specific data.

2.5.3.2 Income

The oxford dictionary defines income as the inward flow of revenue received from work (Pretorious, 2016). At the household level, income speaks to the combined revenue of each employed person in the household. Income has been reported to positively correlate to the outdoor use of water. This relationship is qualified by the association between high income

levels and elevated living standards (Pretorious, 2016). Similarly, standardized property value has been used as proxy for income, commonly referred to as stand size.

2.5.3.3 Stand size

This term is mostly used in the civil engineering field when water demands are being estimated. Research shows that water demand is highly responsive to stand size, indicating that a household with a high property value will demand more water than a household with a lower property value (Jacobs, Geustyn and Loubser, 2006).

2.5.3.4 Climate

Climate is described as the prevailing weather conditions in a region represented by average temperature, humidity and precipitation (Pretorious, 2016). Rainfall and temperature are two climate variables most frequently used to describe water demand. Rainfall has been found to affect the outdoor use of water, as an increase in rainfall decreases the volume of water demanded for gardening (Jacobs et al., 2006). Similarly, an increase in temperature has been associated with an increase in water demand, particularly for hydration and personal hygiene purposes (Jacobs et al., 2006).

2.5.3.5 Variations in water demand and related demand patterns

Temporal variation in water demand can be influenced by the time of the day and the day of the week (Pretorious, 2016). There seems to be two distinct peaks during the course of each day: in the morning and the evening (Pretorious, 2016). The morning peak (which is most prominent) starts at 06:00 am and stretches to about 08:30 am. The evening peak begins at 16:00 pm and smoothes out at about 20:00 pm. These peaks could be related to hygiene and cooking.

2.5.3.5.1Weekly variations

Weekly variations are dependent on the days of the week (Pretorious, 2016). The peaks discussed above tend to be more persistent during the week and smooth out during the weekend. The changes in the spread can be attributed to the presence of more people in the house during the daytime (Pretorious, 2016). The water use patterns in these non-sewered areas are strongly related to the socio-economic environment of each household. Pretorious (2016) found that in non-sewered areas activities like laundry were only done once a week, most likely on a Saturday when all the members of the household were at home.

2.5.3.5.2 Monthly variations

This factor tends to be closely related to climate. Monthly variations are seasonally driven, as research shows a peak in water demand during the summer months (Pretorious, 2016). This trend was also reported by Gato-Trinidad et al. (2011). The study reported seasonal trends, such as the absence of gardening during winter and an increase in the number of showers taken in a day (Gato-Trinidad et al., 2011).

The factors considered above focus on the demand for (and by extension, usage of) water that affects all income and socio-economic status groups. Some research, however, has specifically focused on water demand and usage in low-income groups. Such research is considered below.

2.5.4 Water demand in low-cost housing areas

Literature on water demand in low-income areas is not well represented and the existing research draws mostly on daily variations (Pretorious, 2016). Research has found that water use peaks differ from higher income residential areas with the absence of an evening peak (Pretorious, 2016). The morning peaks gradually increase throughout the morning and peak at about 11:00 am. This can be related to the high levels of unemployment in these areas, which translates to a large portion of the populous starting their day slightly later (Pretorious, 2016).

In a study directed at improving water estimations for adequate water supply in a low-cost housing settlement (Pretorious, 2016), two distinct peaks in the water use distribution were found. The first peak lasted for about two and a half hours starting from 05:00 am to about 07:00 am. The second peak was realized later in the evening and stretched from 16:45 pm to 19:30 pm. In addition to these daily peak factors, the study also revealed weekly peak factors which indicated that the morning weekday peak range was wider compared to the morning weekend peak range. Furthermore, the results showed an evening weekday peak range which was wider than the evening weekend peak range. Lastly, seasonal factors were found to be insignificant as the two distinct peaks remained constant throughout the year.

A recent study done in Ekurhuleni, Gauteng, focused on acquiring information about water accessibility, sanitation, water use and grey water disposal, also reported on some water demand factors (Mofokeng, 2008). This research was conducted over a period of nine months

and was adequately representative as it was conducted in four well-known settlements, namely: Harry Gwala, Gugulethu, Mkhanca and Soul City (Mofokeng, 2008).

From the data collected, it was concluded that most of the residents acquired most of their water from communal taps except in Harry Gwala, where most of the homes had illegal in-house connections traced back to the communal pipes. There was a preference for the use of the 20l plastic bucket to collect the water as opposed to the aluminium bucket, which was found to rust up at an accelerated rate. The plastic 20l bucket was also preferred because it was easier to carry. The report revealed that most of the water was collected by the women in the community. This association was qualified by the observation that men would collect water for short term use, whereas women collected it for more long term uses.

The findings provide a clear indication that there are various factors that affect water demand in any given context, but that location-specific data is required if water usage patterns are to be understood. This further warrants the need for the current study.

2.5.5 Water use

Water use can be defined as water used for any and all household purposes (Pretorious, 2016). Water use at the residential level can be divided into various end use categories, the most common categories being outdoor and indoor usage. Cooking, cleaning and laundry washing are common examples of indoor water use, while garden watering and filling the pool are some examples of outdoor use (Pretorious, 2016). As noted, the water usage pattern of each household is reliant on context specific socio-economic factors (Jorgensen et al., 2009). However, after a pool of literature was reviewed, common water usage patterns were found across the urban suburbia and rural contexts.

A study centred on the end use of water for single family households in Melbourne, Australia, analysed water consumption in relation to indoor and outdoor use (Gato-Trinidad et al., 2011). Under indoor use, the following factors were considered for analysis: toilet flushing, bathing, showers, baths, washing machine, dishwasher and taps - with gardening considered during the outdoor analysis (Gato-Trinidad et al., 2011). The study found that the average daily water use per household was quantified as 66% for indoor use and 29% for outdoor use. Shower use accounted for 31% of the daily use, the laundry 26% and 19% for toilet flushing (Gato-Trinidad

et al., 2011). Similar results were reported for a study on water use in Gold Coast, Australia, and for a study centred on water use in major cities in India.

These water use patterns, particularly those for bathing and laundry, were also described in a study aimed at determining the relationship between domestic water use and socio-economic factors at the household level in a village in Bangladesh (AL-Amin et al., 2011). Bathing and washing clothes accounted for 46.6% of the water consumption. This was followed by cleaning houses at 12%, and cooking and washing dishes at 8.4% per day (AL-Amin et al., 2011). This argument is corroborated by Nyong and Kanaroglo (1999), who reported 29% of total water usage for bathing, followed by 24% for laundry and 17% for dish washing per day in the rainy seasons. This trend is consistent for dry seasons too.

The results described above are from the two extremes: the urban and the rural areas. Much has been done to understand the water use patterns of these contexts; but less research explores informal settlements, especially in the South African context. A few relevant examples are considered below.

Table 1

	Water use in urban suburbia %			**Water use in rural areas %**	
Variables	Melbourne Australia	Gold Coast Australia	Major Indian cities.	Village in Bangladesh	Village in Nigeria
Bathing	29	33	29	46%	29%
Laundry	26	19	18.6		24%
Tap use		17			
Toilet flushing	19	13			
Washing dishes			16.3		17%
Cleaning				20.4	

2.5.5.1 *Water use in informal settlements in South Africa*

As noted by Chikoto (2009), the state's inability to track the exponential growth of informal settlements leads to the growth of under-developed settlements that have very little access to reliable water sources. In the same breath, provision has been made for portable water in the form of communal taps and central wash points (Nevhutalu, 2018). These do provide a stable water source; however, these provisions are poorly maintained. This sporadic water supply affects the supply and consumption of water at the household level (Nevhutalu, 2018). While much of the research has been done in the urban suburbia and rural context; there is some research that has been done relating to water use in the South African informal settlement context. The Ekurhuleni study discussed previously reported that on average 28 litres per day was used for laundry in all the settlements in the study, followed by an average of 15 litres per day for bathing (Mofokeng, 2008). Nine litres per day was estimated for dishwashing and minimal quantities were used for cooking and drinking. Interestingly, there appears to be a discord between the contributors to grey water and water use results. From the contributors to grey water, cleaning water contributed the most followed by, washing dishes and then laundry (Mofokeng, 2008).

Studies reviewed above show some common ratios for bathing and laundry across the board, however it can be argued that these trends are relative to the water supply each population receives and therefore alters the residents' use of water. A study by AL-Amin (2011) argued that increased water access led to increased water consumption. He showed this by confirming a water consumption increase after some houses in the study had been provided with piped water. This argument can be confirmed by Fan (2013), who suggested that houses with continuous piped water often exhibited frequent water use for personal hygiene, water appliances and watered the garden. This finding was also supported by Jacobs et al. (2006), who applied the end use water model to data obtained in residential areas in Cape Town Jacobs et al. (2006) and found disparities in the per capita water consumption of residents in two different contexts. Per capita results for the high-income earning households came in at 229 litres per day while the per capita water consumption of the low-income households came in at 49 litres per day (Jacobs et al., 2006). Moreover, the increased availability of water decreased the likelihood of water sharing in these households, meaning members of the household are less than likely to reuse water. These contextual disparities further highlight the need for contextual information pertaining to the water use in Setswetla.

2.5.6 Water disposal

As highlighted previously, informal settlements are not developed with proper drainage systems, which makes it very difficult for the residents to dispose of their grey water. Although water disposal in informal settlements has not been widely explored, a few studies show that convenience is one of the core factors that drive water disposal in informal settlements. Some of these areas of convenience include yard surfaces, garden areas and dug drains (Hamel, 2006, Murphy, 2006, as cited in Mofokeng, 2008). This on-site pattern of water disposal was also found in a study aimed at investigating the use and disposal of grey water in 39 informal settlements in South Africa (Carden et al., 2007). Although this kind of water disposal was perceived to be socially acceptable, the residents indicated that there were considerable health risks involved in the disposal of water in this manner. Some of these health risks included mosquito infestations from stagnant water and children falling ill after playing in the water (Carden et al., 2007).

The Water International Cooperation (2017) suggested that residents in informal settlements disposed their water in the street. This, however, was not consistent with other research findings. The Ekurhuleni study reported on a host of different disposal preferences for each of the settlements. In Harry Gwala, the majority of the residents indicated that they discarded of their water in the storm water channel and when asked if their neighbours also mirrored this behaviour, the respondents agreed (Mofokeng, 2008). In addition to this information, the participants also mentioned some problems with the current disposal method and noted the potential health hazards that this could cause for the settlement (Mofokeng, 2008). In Gugulethu, Makhanca and Soul City, Mofokeng (2008) found that most of the residents disposed of their water in their yards, with some disposing of their water in the fields (Mofokeng, 2008). Gugulethu's community also gave some insight to this pattern of behaviour; they believed that bath water is something to be respected and should not be discarded of into the streets. Mkhanca on the other hand had a man-made trench system which allowed the water disposed of in the yard to flow from one house to another and into the storm water channels (Mofokeng, 2008).

This study also revealed an important component which could potentially affect the soiled nature of the water (Mofokeng, 2008). In terms of sanitation, majority of the residents stated that they used the pit toilets they had. This was with the exception of Soul City, which used a bucket system that was maintained twice a week by the municipality (Mofokeng, 2008). It was

also found that females use the toilet facilities only during the day and opted for a bucket at night for safety reasons. These inconsistent findings highlight the different contexts found within these informal settlements. This further warrants the need for context specific information.

The next section will deal briefly with solid waste in informal settlements and how this could potentially affect the constructed wetland.

2.5.7 Waste management in informal settlements

Waste can be defined as disposed solid waste generated from everyday human activity such as cooking and food consumption. Waste can further be described as substances which manifest in surplus and can either be reused or recycled (DEA, 2011). Waste removal is a huge problem in informal settlements and poses a big heath threat to the residents living in these harsh settings.

A study done in Panchayat, an informal settlement in India, found that the informal settlement did not have its own landfill disposal site and thus the residents resorted to disposing their waste in the streets (Ashalakshmi1 & Arunachalam, 2010 as cited in Zandamela, 2016). Waste disposed of in this manner leaves the community vulnerable to a host of illnesses and simultaneously creates an unhealthy and unhygienic environment (Ashalakshmi1 & Arunachalam, 2010 as cited in Zandamela, 2016). These ineffective waste removal patterns and effects on health were similarly identified by Zandamela (2016), who conducted a study on waste removal in Cato Cristo, an informal settlement in the eThekwini municipality (South Africa). The study also found that the overt pollution also has the potential to pollute the ground water sources and similarly obstruct storm water runoff. The latter point further warrants the need for this study, as the waste disposal patterns and preferences would render the overarching project's efforts to tackle the pollution and infrastructure problem ineffective if not controlled for (Zandamela, 2016). It is thus paramount that these be adequately understood, such that provision can be made to ensure the functioning of the system (Zandamela, 2016). Barring the health and potential effects waste could have on water infrastructure, the ineffective waste removal in informal settlements could have some negative effects on the constructed wetland. The next section will unpack these potential effects further.

2.5.7.1 The effects of waste disposal on a constructed wetland

A conducted after the construction of the wetland in Langrug, focusing on the functioning of the wetland indicated that some of the drains were being blocked by the pollutant waste in the area. The Stellenbosch municipality provided large skips that were to be used as disposal points for people in the community, however these were not regularly serviced (Nevhutalu, 2018). This led to the waste flowing off the skips, leading to pollution in the surrounding areas and sometimes even clogged drains (Nevhutalu, 2018). Although waste removal in informal settlements is not widely studied, research done by Zandamela (2016), also highlighted similar ineffective waste collection patterns by the eThekwini municipality.

The study found that the community utilized a communal dumping site to dispose of their solid waste because they had limited access to the main road where the waste was collected by a removal company on a daily basis. Respondents revealed that paper was the most generated waste, followed by plastic and spoiled food (attributed to the lack of fridges in these settlements) (Zandamela, 2016). The households also indicated that the waste would be packed in a small plastic shopping bag and be disposed of in the nearest dump once it was full. Besides disposing of the waste in the dump, the respondents indicated the use of the long drop, their yard or any surrounding vicinity as a disposal point (Zandamela, 2016). The residents also mentioned burning the waste as an option, arguing this was the only solution to the lack of solid waste management on the part of the municipality (Zandamela, 2016). They furthermore stated that they would often use this strategy to pressurize the municipality into keeping to their scheduled rubbish-collection times.

The common thread of ineffective waste disposal and waste collection in Lanrug and Cato Cristo is a potential indicator of dysfunctional waste disposal patterns in other informal settlements. Furthermore, given the effects that pollutant waste could have on the wetland, it becomes imperative to gather information about Setswetla's waste disposal patterns. This need is also further exacerbated by reports and site visits which confirm that the settlement is heavily polluted by solid waste. Therefore, getting a clear picture of how they manage their waste would help the design team's control for these factors in the construction of the proposed constructed wetland.

To conclude, reviewed literature highlighted the context specific nature of constructed wetlands, and that the functioning of each wetland is informed by a well thought out design

which sets out parameters for the system. Moreover, these parameters are heavily reliant on information relating to population density and water use and disposal patterns. Studies reviewed show water use similarities across various socio-economic contexts; however, these trends are relative to water supply. AL-Amin (2011) argues that water supply has the potential to affect overall water consumption. This is quite important in an informal settlement context where communal taps are poorly maintained. Disparities reported pertaining to the end use of water indicate that pre-existing water use patterns modelled in different studies cannot be used for this research as feed in information. This is because every environment is unique and using information based on another study could undermine fundamental factors that explain that population's water use patterns. Similarly, water disposal has not been adequately researched. The limited research suggests a host of different disposal points which include the streets, backyard surfaces and garden patches. Therefore, contextualised information about each household's disposal patterns needs to be ascertained to ensure the success of the project.

2.6 Research questions

Given the literature considered above, the objectives of the proposed study are to identify patterns of water acquisition, storage, use and disposal from a sample of participants living in Setswetla, Alexandra. In addition to identifying and describing these water usage patterns; the study also aims to ascertain the socio-economic factors influencing these patterns. As an added component, the research also aims to identify patterns of solid waste disposal as this information will be vital for the design component of the overarching project.

Main Research questions

What are the water acquisition patterns reported by participants?

- What social and economic factors impact how participants acquire water?

What are the water storage methods reported by participants?

- What social factors and economic impact how participants store water?

What are the water usage patterns reported by participants?

- What social and economic factors impact upon how participants utilise water?

How do participants dispose of water?

- What social and economic factors impact upon how participants dispose of water?
- What risks to participants associate with current disposal patterns?

How do participants dispose of solid waste?

- What social and economic factors impact upon how participants dispose of solid waste?

CHAPTER THREE: METHOD

The following section will give account of the research design, sample and sampling techniques used in the study, the procedures followed, the instrument which was used, ethical considerations and lastly, the data analysis undertaken during the process.

3.1 Research design

The current research project made use of a mixed methods design which had quantitative and qualitative components. Both approaches will be further unpacked below.

3.1.1 Quantitative approach

A small part of this current study used a quantitative, non-experimental, cross-sectional, survey research approach. A portion of this study was considered quantitative because it utilised numeric data (Bryman, 2014). This study is non-experimental because the research questions were broad and exploratory, they did not make reference to a causal relationship between two or more variables, there was no random assignment, the sample was not split into two or more groups and each participant did not have an equal, non-zero probability of participating in the study (Price et al., 2017). This study only had one group which consisted of fulltime residents who lived in Setswetla, Alexandra. The independent variable was not manipulated by the researcher and there was also no comparison of outcomes with another group. A survey was used to collect the data. This study was aimed at exploring the water acquisition, use, storage and disposal patterns of Alexandra. The primary purpose of this study was to describe and portray these phenomena. The survey aided this process because, it is commonly used to measure the attitudes, characteristics and behaviours of a group of people (Cook and Cook, 2008). Lastly, this was a cross sectional study because data was collected at a single point in time (Price et al., 2017).

3.1.2 Qualitative research approach

The current study was also an interpretive qualitative research study. It is considered a qualitative study because it was similarly reliant on linguistic data and focused on the subjective perspectives and knowledge of a group of people (Bryman, 2014, Kielmann, 2012). The aim of this research was to explore the water acquisition, storage, usage and disposal patterns of an informal settlement in the greater Johannesburg area. This required an in-depth understanding of the community's social reality on the overarching topic of water usage and why these patterns of water usage persist in that area. The latter qualified the study as an interpretive study because, the study explained a specific phenomenon, divulged why the phenomenon existed and took a closer look at how it unfolded over time (Kielmann, 2012).

3.2 Sample and sampling

The research consisted of two research samples. One group of 228 participants, who took part in the quantitative element of the study and another group of 7 participants who took part in the qualitative component. The total sample amounted to 235 participants who were full time residents of Alexandra. All the residents were from Setswetla informal settlement, which is an underdeveloped and underserviced area on the west bank of the Juskei river. All the participants were adults, with an age range stretching from 18 to 61 years. The sample included both males and females, all of which identified as black Africans.

3.2.1 Sampling technique

The project made use of a non-probability purposive sampling technique to source participants for both the quantitative and qualitative components. The non-probability purposive sampling technique is a widely used qualitative sampling technique where the researcher's judgment is used to select the sample participants. This involves identifying individuals that are well vested and knowledgeable in the phenomenon of interest. The advantage of this purposive selection includes allowing the researchers to purposely choose a sample that is likely to yield focused and valuable data to explain pre-conceived research questions. As noted, the participants for this study were 235 adults who reside in the area proposed for the constructed wetland. This kind of sample provided rich information about water related patterns in Setswetla.

The non-probability purposive sampling technique was used in conjunction with a snowball sampling technique. Snowball sampling is a sampling technique which uses a series of networks to get hold of people who are most suitable for the sample. It is a process which involves the participant giving the researcher a name of a potential participant, who in turn provides the name for the next participant. This technique is most efficient when a set criterion for the sample is required for the research to be a success. This sampling technique was used in a water access study conducted by Ojo (2018), to source the relevant government officials as well as participants for the research. Ojo's study set criterion parameters for the sample. The participants needed to be residents of the Iscor informal settlement for a minimum of three years and they also had to be between the ages of 30-60 years (Ojo, 2018). This was said to enhance the richness and validity of the data (Ojo, 2018). The participants for the sample of the study at hand were adults who currently live in Setswetla. The first ten participants were recruited by one of the counsellors in the Setswetla area after he had been informed of the prospective plans of the overarching project. The counsellor approached his community youth leaders to help with the interview process. He selected ten of the youth leaders who were fluent

in English and who were trustworthy (based on their ability to complete tasks on time from previous projects). The group of ten were trained by the main researcher and the supervising researchers (to be explained in the following sections). Once they were done completing the survey, they were each tasked with finding 15 to 20 adults who would be willing to block out some time to do the interviews. The following section will review the demographic data extrapolated from the surveys.

3.2.1.1 *Demographic results*

The demographic variables explored in the survey included gender, age, race, home language, education, employment and Location. Some of the demographic questions were not answered by the participants, which created a percentage of missing values in the data set. The missing values however didn't affect the analysis, and these have been included in the sample demographic tables below.

The sample consisted of 133 females who made up 58% of the overall sample and 83 males, who made up 36.4% of the sample shown in Table 1. These statistics indicate that there were more females than males who participated in the study. The participants' ages ranged between 19 years and 61 years (M= 32.36, SD= 8.3) (please see table 2). Table 3 indicated that the sample comprised entirely of black adults from Setswetla (100%). Although homogeneous in terms of race, the survey indicated a degree of heterogeneity when home language was taken to account. A large portion of the sample spoke Sepedi (34.6%) followed by Xitsonga (31.1%), Tshivenda (7.5%), IsiXhosa (5.7%), IsiZulu (5.7%), Setswana (4.8%), Sesotho (3.9%), Siswati (1.8%), Shona (1.3%) Isindebele (0.9%) and Portuguese (0.4%) (Please see table 4). With regards to education, majority of the sample had acquired their Grade 12 certificate; this was followed by those who had achieved their grade 11 (21.5%), grade 10 (14.4%), higher certificate (10.9%), grade 9 and below (10.5%), an undergraduate degree (0.9%), and a post graduate degree (0.4%). Only one participant did not have any formal school training (0.4%) (Please see table 5). In terms of employment, an average of 1 person per household was employed (M= 1.15, SD=0.664) (please see table 6). Table 7 shows that the average household size was reported to be 3 members per household (M=3.04, SD= 1.488) and lastly table 8 indicated that a 15.4% of the sample resided in Setswetla Bridge. This was followed by Setswetla Mazinyo (9.2%), Sethoba 1(9.2%), Mashemong, Sethoba 2, Sethoba 3, Setswetla, Setswetla Giyani (8.8%), Silver Town (7.9%), Sethoba (4.8%) and The Greenhouse (3.1%). These various locations are all located west of the Jukskei River and therefore provides a rich

representative sample for the research. Please see appendix I which is a map consolidated using the locations of the participants. This map also maps out the various taps and water supplies in the settlement.

Table 1

Sample Demographic Characteristic: Gender

Gender	Frequency	Percentage
Missing	12	5.3
Female	133	58.3
Male	83	36.4
Total	**228**	**100.0**

Table 2

Sample Demographic Characteristic: Age

Age	Frequency
Missing	24
Mean	32.36
Standard Deviation	8.933
Total	**228**

Table 3

Sample Demographic Characteristic: Race

Race	Frequency	Percentage
Black	228	100
Total	**228**	**100.0**

Table 4

Sample Demographic Characteristic: Home Language

Home Language	Frequency	Percentage
Missing	5	2.2
English	0	0
Afrikaans	0	0
IsiZulu	13	5.7
IsiXhosa	13	5.7
Sepedi	79	34.6
Sesotho	9	3.9
Setswana	11	4.7
SiSwati	4	1.8
Tshivenda	17	7.5
Xitsonga	71	31.1
IsiNdebele	2	0.9
Portuguese	1	0.4
Shona	3	1.3
Total	**228**	**100.0**

Table 5

Sample Demographic Characteristic: Highest qualification

Highest Qualification	Frequency	Percentage
Missing	7	3.1
Grade 9 and below	24	10.5
Grade 10	32	14.0
Grade 11	49	21.5
Grade 12	73	32.0
Higher Certificate	24	10.5
Diploma	14	6.1
Undergraduate Degree	2	0.9
Post Graduate Degree	1	0.4
Total	**228**	**100.0**

Table 6

Sample Demographic Characteristic: Number of employed adults

Number of employed adults	Frequency
Missing	35
Mean	1.15
Median	1.00
Mode	1
Standard Deviation	0.664
Total	**228**

Table 7

Sample Demographic Characteristic: Household size

Household size	Frequency
Missing	5
Mean	3.42.36
Standard Deviation	1.488
Total	**228**

Table 8

Sample Demographic Characteristic: Settlement Location

Settlement Location	Frequency	Percentage
Missing	15	6.6
Greenhouse	7	3.1
Mashemong	20	8.8
Sethoba 1	21	9.2
Sethoba 2	20	8.8
Sethoba 3	20	8.8
Sethoba 4	11	4.8
Setswetla	20	8.8
Setswetla bridge	35	15.4
Setswetla Giyani	20	8.8
Setswetla Mazinyo	21	9.2
Silvertown	18	7.9

Total	**228**	**100.0**

In-depth interviews were conducted after the survey results were analysed for the qualitative portion of the study. This sample consisted of 7 adults (5 females and 2 males) from Setswetla. All participants identified as black and only 3 participants were employed while the rest were unemployed.

3.3 Procedure

The following procedure was used by the researcher to secure the intended sample as well as to collect the pertinent data. Firstly, the researcher applied for ethical clearance from the University of the Witwatersrand Human Research Ethics Committee (HREC Non-Medical) to acquire permission to conduct the study. Once this permission was granted (see appendix J), the researcher conducted a pilot study in Langrug during a site visit. The purpose of the pilot study was to determine the appropriateness of the questions in the instrument. Once the results from this pilot study were analysed and the necessary changes were made to the instrument, the researcher then approached the relevant gatekeepers to seek permission to secure the intended sample.

The researcher approached the Sestswela community council to negotiate access into the community. The committee was comprised of 5 council members and a few additional members and the meeting took place at the greenhouse meeting room (see figure 1a). In the meeting the council members were simultaneously introduced to the project team and informed of the overarching initiative using the access letter as a guide (see appendix A). Once rapport had been established and the access had been granted, the committee agreed to take the team on a tour of the informal settlement. It was during this tour that the researcher noted the possible language barrier and requested translators to help with the process. By the second meeting, the leader of the council committee had recruited 10 participants for the project who were then also further recruited as research assistants for the data collection process. In a bid to ensure that the items on the schedule were accurately communicated, the 10 participants were trained extensively on the instrument. The researcher explained the aim of the project to them as well as their role in the project. Once the scene setting was complete, the researcher took all the research assistants through the schedule and explained the context of each question this was very important as they would have to translate these questions to some of the participants who were not fluent in English. Once the training was complete each assistant was requested to find

15 to 20 other people to who would be willing to volunteer to participate in the study. Each assistant was allocated a specific area to collect the data. This was done to ensure that the data was all encompassing and represented the population of Setswetla. 195 interviews were conducted by the assistants (who were compensated for each interview they conducted) and 29 were conducted by the main researcher with help of two translators. The interviews were comprised of standardised questions in order to control for variation which further ensured reliability (Gill, Stewart, Treasure, Chadwick, 2008). The instrument also included a set of possible probing questions which were administered after the participant has responded to the question. These probing questions were similarly used as a guide for participants who struggled to understand the nuance of the question. The interview responses were scribed on the survey sheet. These were then recorded on a excel spread sheet and transferred to SPSS where the relevant analyses were conducted. A summary of the findings was made available to participants at a scheduled feedback session (see figure 1b). The aim of the session was also to give feedback to the community and to verify the results. As such, the session served to enhance the accuracy of the data obtained.

Figure 1a: Greenhouse meeting room and the Greenhouse.

Figure 1b: Feedback session at the greenhouse

For the qualitative element of the research, the main researcher reviewed the results from the survey and extrapolated the most interesting results. Once these were extracted, the researcher drew up questions pertaining to the some of the socio-economic factors that could potentially drive the observed behaviour. This was done to gain a better understanding of the water acquisition, use and disposal patterns of the Setswetla community. The researcher then went further to source 7 participants from the feedback sessions to conduct the in-depth interviews. Interviews were conducted in Setswana and Sesotho as these were the first languages of all the participants who were interviewed.

3.4 Instruments.

The survey instrument was adapted from a survey utilised by the department of water and engineering from the Loughborough University. This instrument is divided into 6 sections: demographics, water acquisition, water storage, water use water disposal and solid waste management. As noted, a pilot study was conducted in Langrug which helped highlight some of the problematic and ambiguous questions in the survey. Once the data collection process was launched, new amendments were made to control for some of the ambiguity (see appendix E and F) The final instrument was drawn up in English and was not translated; however, the interviews were administered in the participants' preferred language.

The second instrument was an interview schedule drawn up using the responses from the survey as a guide. The instrument explored the socio-economic factors related to water use in informal settlements with a specific focus on water shortages, water acquisition, water use (peak factors) and health concerns. The interviews were conducted at the feedback session over

two days. The researcher conducted all the interviews in Sesotho and Setswana and translated the findings to English after the data collection process was completed (see appendix G).

3.5 Data analysis

The quantitative survey results were captured and coded into Microsoft Excel and subsequently exported to an IBM statistics 25 program. Descriptive statistics and frequencies were generated and used to analyse the closed ended questions and a quantitative content analysis was used to analyse open-ended responses. Given that this study made use of both quantitative and qualitative research methods, a thematic analysis was used to analyse the qualitative data.

3.5.1 Descriptive statistics

Descriptive statistics are brief summaries of the spread of a given data set. These are similarly used to describe the sample population (Nicholas, 2006). Descriptive statistics can be broken down into measures of central tendency and measures of variability (spread). The measures of central tendency were the primary measures used for this study and these include the mean, median, and mode. In this current study, frequencies were used to examine all the variables measured in the data set, and standard deviations and means were used where applicable. Frequency distributions are a useful way to describe and display data (Mahbobi & Tiemann, 2016). These are commonly displayed in a table with two columns; one listing the variables in the data set and the second including the number of times that variable was observed (Mahbobi & Tiemann, 2016).

3.5.2 Quantitative Content analysis

Berelson (1952 as cited in Rourke and Anderson, 2004), defined a quantitative content analysis as a quantitative research technique which described the surfacing content of communication in an objective and systematic manner. The utterances from the open-ended survey results were analyzed in a three-step process. This process included a process of description, where the information is segmented into units. This was followed by assigning each unit into a category and subsequently providing a frequency count for each category (Rourke and Anderson, 2004).

3.5.3 Thematic analysis

Thematic analysis was used to analyse the qualitative data obtained in the face-to-face interviews. Thematic analysis is a systematic approach to analysing qualitative data which allows for the generation of codes and themes that emanate from a sample of data (Alhojailan, 2012). The six effective steps for conducting a thorough and rigorous thematic analysis were used. These six steps prescribed by Braun and Clarke (2006) include: familiarising the researcher with data, generating initial codes, searching for themes, reviewing themes, defining

and naming themes and finally producing the report. According to Braun and Clarke (2006), one of the key advantages of a thematic analysis is that it is quite flexible. Using this form of data analysis assisted the researcher in obtaining the key perspectives of the participants and similarly allowed for patterns and themes to unfold across the data.

3.6 Ethical considerations

The Human ethics research ethical committee granted ethical clearance for the project (see appendix J) which allowed the researcher to commence relationship management and data collection in Setswetla. Once the researcher gained acquired informed consent by the gate keepers and gained access into the community the data collection process (in the form of interviews) commenced. Informed consent was obtained before the interviews. The researcher gave detailed explanation of the study to each participant after which a consent form was handed to the participant to sign (see appendix B). Participants were informed that the interview will be recorded, transcribed and used for analysis. The participants were then asked to consent to this by signing the tape-recording form (see appendix C). Further the participants were notified that verbatim quotes will be extracted from the recordings for analysis and consent for this was authorised by signing the quotation extraction form (see appendix D). As the research entailed face-to-face interviews, confidentiality was not assured to the participants. Anonymity was however ensured by allocating numbers to each participant. Finally, the participants were assured that the data which was collected would be stored in a password protected computer, and that only the main researcher and the URBWAT team would have access to the data.

CHAPTER FOUR- RESULTS

This results section will report on and interpret the statistics produced by IBM SPSS Statistics version 25. This section will also include a content analysis and a thematic analysis generated from the open-ended questions from the survey and the in-depth interview responses respectively.

4.1 Quantitative results

4.1.1 Frequencies and Descriptive variables.

The researcher ran frequencies to consolidate and interpret the results from the survey.

4.1.1.1 Water Acquisition.

Majority of the sample indicated that they only had one main water source and therefore this section will only be reporting of the primary water source results. Majority of the sample indicated that they collected water from a communal tap. Table 10 shows that 212 (93.0%) participants collected water from the nearest communal tap. Three (1.3%) people indicated that they acquired water from a community center, and the same amount of people reported that they collected water from their neighbour and paid a small fee for it. Two (0.9%) people stated that they collected water from their neighbour and the same was reported for people who collected their water from a tap outside their homes. Lastly one (0.4%) person indicated that they collected water from a public space.

Table 10

Sources of water: Primary source

Primary water sources	Frequency	Percentage
Missing	5	2.2
Communal tap	212	93.0
Community centre	3	1.3
Neighbours with cost	3	1.3
Neighbours without cost	2	0.9
Public space	1	0.4
Tap outside building	2	0.9
Total	228	100.0

The sample's water source preferences were explored. Table 11 indicates that 154 (67.5%) of people preferred a certain source because it was the only water source available. This was followed by 30 (13.2%) people who indicated distance as a factor of preference, 17 (7.5%) people who stated reliability of the water source as a factor, 10 (4.4%) people who stated availability of water as a factor and 8 (3.5%) people who indicated that the quality of water from their preferred water source as a driving factor. Participants were also asked to give account of the distance between their homes and the water source. 115 (50.4%) participants collected water a few dwellings away. This was followed by 56 (24.6%) people who collected water inside or just outside their homes, 31 (24.6%) participants who walked a short distance to their primary water source and 8 (3.5%) people who tracked a long distance to their primary source of water (table 12). To add to this, table 13 below shows that the acquisition time for these preferred water sources ranged from 0.05 minutes to an hour (M= 7.69 minutes, SD=8.98).

Table 11

Reason for preference of water source: Primary water source

Reason for preference of water source	Frequency	Percentage
Missing	9	3.9
Availability of water	10	4.4
Distance	30	13.2
Only source	154	67.5
Quality	8	3.5
Reliability	17	7.5
Total	228	100.0

Table 12

Distance of water source from participant's house: Primary source

Distance of water source from participant's house	Frequency	Percentage
Missing	18	7.9
A few dwelling away	115	50.4
A long distance	8	3.5
A short distance	31	13.6
Inside or just outside the dwelling	56	24.6
Total	228	100.0

Table 13

Variable	Mean	Minimum	Maximum	Range	Standard deviation	N
Water acquisition time (in minutes)	7.69	0.050	60.00	59.95	8.98	78

The availability of the water from the primary water source was explored. Table 14 showed that 140 (61.4%) participants indicated that water is always available at their preferred water source. This was followed by 45 (19.7%) participants who indicated that water is mostly available, 35 (14.8%) of people who stated that water was sometimes not available and 2 (3.1%) participants who indicated that water as often not available at the primary water source. The sample was asked about who collected the water and how the water was transported. 213 (93.4%) and 4(1.8%) participants carry the buckets of water themselves which was followed by 4 participants who carry their buckets of water in wheelbarrow (table 15). Table 16 showed that 111 (48.6) participants indicated that they collected the water followed by 55 (25%) people

who indicated that the adults of the household collected water, 30 (12.6%) indicated that another household member assists them in collecting the water, 12 (5.1%) who said that the children in the house collect the water and 11 (4.8%) who said that everyone in the household collects water.

Table 14

Availability of water: Primary source

Availability of water	Frequency	Percentage
Missing	**18**	**3.1**
Water sometimes not available	35	14.8
Water always available	140	61.4
Water mostly available	45	19.7
Water often not available	2	3.1
Total	228	100.0

Table 15

Water acquisition

Water acquisition	Frequency	Percentage
Missing	7	3.0
In wheelbarrow	4	1.8
Transported by individual (on their head)	4	1.8
Transported by individual	213	93.4
Total	228	100.0

Table 16

Individuals collecting water

Individual collecting water	Frequency	Percentage
Missing	9	3.9
Adults	55	25
Everyone	11	4.8
Children	12	5.1
Participant	111	48.6
Participant and another individual	30	12.6
Total	228	100

The sample was asked to give account of the number of buckets used to collect water. 187 (82.0%) participants use 20*l* buckets to carry their water. This was followed by 15 (66%) people who stated that they used 10*l* buckets, 7 (3.1%) participants who indicated that they used 25*l* buckets and 4 (1.8%) participants who indicated that they used 5-liter buckets to collect their water (table 17). To accompany this data the participants were asked to quantify the frequency of their water acquisition. 114 (50.0%) participants indicated that they collected water once a day. This was followed by 92 (40.4%) participants who collect water twice a day, 4 (1.8%) participants who collect water once every two days and 3 (1.3%) participants who collect only when needed. 1 (0.4%) participant stated that they collected water once a week, 1 (0.4%) participant indicated that they collect water any time, 1 (0.4%) participant indicated that they collected water whenever the water runs out, 1 (0.4%) participant indicated that they collected water 6 times a day and lastly 1 (0.4%) participant stated that they collected water depending on how much they need (table 18).

Table 17

Containers used for water acquisition

Containers used for water acquisition	Frequency	Percentage
Missing	15	6.6
5 liter	4	1.8
10 liter	15	6.6
20 liter	187	82.0
25 liter	7	3.1
Total	228	100.0

Table 18

Frequency of water acquisition

Frequency of water acquisition	Frequency	Percentage
Missing	10	4.3
Once a day	114	50.0
Twice a day	92	40.4
Once every two days	4	1.8
Only when needed	3	1.3
Once a week	1	0.4
Any time	1	0.4
Depends on how much I want to use	1	0.4
When the water is finished	1	0.4
6 times a day	1	0.4
Total	228	100.0

4.1.1.2 Water storage

The participants were asked to give account of their water storage methods as well as the duration of water storage. Tables 18 and 19 below indicate a range of different responses however only the most prevalent results will be reported on in this section. Table 18 indicates that 213 (93.4%) participants stored their water in buckets inside their homes. Table 19 indicates that 124 (54.6%) participants stored their water for 1 day, while 35 (15.3%) people stated that they stored their water for 2 days.

Table 18

Storage location

Storage location	Frequency	Percentage
Missing	9	4.00
In the bucket inside the shack	213	93.4
In the bucket outside the house	5	2.2
Does not store	1	0.4
Total	228	100

Table 19

Duration of storage

Duration of storage	Frequency	Percentage
Missing	12	5.2
1 day	124	54.6
Half day	15	6.6
I and a half days	4	1.7
2 days	35	15.3
3 days	14	6.1
4 days	3	1.3
1 to 5 hours	10	4.4
When the bucket if empty	11	4.8
Total	228	100

4.1.2.3 Water use

One of the core variables explored for this research paper was water use. As described earlier, water use can be defined as: water used for any and all household purposes. Participants were asked to give account of the number or buckets collected in a day as well as the size of bucket used to collect water. These two values were then multiplied by each other and further multiplied by 7. Descriptive analysis indicates that the average water consumption for a week in each household ranged from 70 litres to 1400 litres (M= 393.41, SD= 260.03) (table 20). The participants were asked if they purified the water before they used it. 214 (94.3%) participants stated that they do not clean their water before they use it. This is followed by 2 (0.9%) people who boiled their water, 2 (0.9%) participants who cleaned their water with chemicals, and 1(0.4%) person who treated their water with light before they use it (table 21).

Majority of the participants indicated that they use their water for cooking (95%), cleaning (89.9), drinking (95.6%), laundry (94.7%), bathing (96.6%) and to clean the chimba bucket (78.5%). Conversely a large portion of the sample made no indication of using their water for gardening and for their animals with 114 (93.8%) people stating that they do not use water for gardening purposes and 226 (99.1%) people who did not use their water for animals (table 22). In a bid to explore the potential contents of the grey water, the participants were asked to comment on the products they for hygiene and household upkeep purposes. A wide range of

soaps were provided by the participants however, for the purposes of this study, only the most frequently used will be reported. The results are available in table 22a.

For bathing purposes, 73 (31.1%) participants indicated that they used the sunlight green bar which was followed by 44 (19.3%) participants who used Lux and 29 (12.7%) participants who bathed with Life Boy soap. 84 (36.8%) people stated that they used Maq washing powder to do their laundry, followed by 58 (25.4%) participants who used OMO washing powder and 24 (11.0%) people who used sunlight washing powder to do their laundry.

Taking a close look at the products the participants used for cleaning their homes, Sunlight liquid was the most mentioned as 98 (42.9%) people referred to it. This was followed by 26 (11.4%) participants who used Maq liquid and 26 (11.4%) people who used Handy Andy to clean their homes. Lastly the participants were asked about the detergents used to wash their chimba bucket and 46 (20.2%) people said that they used sunlight liquid, followed by 26 (11.4%) people who used Maq liquid and 18 (7.9%) who used Domestos to wash their chimba bucket.

Table 20

Average water consumption (weekly)

Variable	Mean	Minimum	Maximum	Range	Standard deviation	N
Average water consumption in a week (in litres)	393.41	70	1400	1400	260.03	204

Table 21

Purification of water before use

Purification of water before use	Frequency	Percentage
Missing	6	2.6
Boiled before use	2	0.9
Cleaned with chemicals	2	0.9
No cleaning process used	215	94.3
Boiled for washing dishes and bathing	2	0.9
Treated with light	1	0.4
Total	228	100.0

Table 22

Water use variables

Variable	Frequency	Percentage
Cooking		
Yes	217	95.2
No	11	4.8
Cleaning purposes		
Yes	205	89.9
No	21	10.1
Drinking		
Yes	218	95.6
No	10	4.4
Laundry		
Yes	216	94.7
No	12	5.2
Bathing		
Yes	221	96.6
No	7	3.1
Gardening		

Yes	14	6.1
No	114	93.8
Water for animals		
Yes	2	0.9
No	226	99.1
To clean the chimba bucket		
Yes	179	78.5
No	49	21.4

Table 22a

Products used for household chores

Products used for household chores	Frequency	Percentage
	Bathing	
Missing	21	9.2
Bath soap	1	0.4
Bingo	1	0.4
Deep clean	1	0.4
Dettol	24	10.5
Johnson baby	1	0.4
Life boy	29	12.7
Lux	44	19.3
Pearl	1	0.4
Protex	25	10.9
Securex	4	1.8
Sunlight green bar	73	31.9
Sunlight pink bar	1	0.4
Total	228	100
	Laundry	
Missing	22	9.6
Ariel	9	3.9
Dettol	1	0.4

Handy Andy	3	1.3
Maq washing powder	84	36.8
Omo washing powder	58	25.4
Sunlight washing powder	25	11.0
Surf washing powder	24	10.5
Total	228	100
	Cleaning	
Missing	40	17.5
Arieal	1	0.4
Dettol	6	2.6
Domestos	4	1.8
Handy Andy	26	11.4
Jik	1	0.4
Maq liquid	26	11.4
Mr muscle	1	0.4
Omo	6	2.6
Pine gel	12	5.3
Sunlight liquid	98	42.9
Sunlight green bar	1	0.4
Surf	2	0.9
Washing powder	1	0.4
Washing powder Maq	1	0.4
Total	228	100
	Cleaning chimba bucket	
Missing	76	33.3
Bleach	1	0.4
Chemical	2	0.9
Dettol	1	0.4
Domestos	18	7.9
Handy Andy	14	6.1
Jays fluid	2	0.9
Jik	11	4.8
Maq Liquid	26	11.4

Omo washing powder	10	4.4
Pine gel	10	4.4
Sta-soft	1	0.9
Sunlight liquid	46	20.2
Sunlight green bar	1	0.4
Surf	4	1.8
Washing powder	2	0.9
Total	228	100

4.1.1.4 Water disposal

Given that informal settlements are not fitted with formal ablution facilities and adequate infrastructure, it became crucial to ask questions which pertained to the community's water disposal patterns. Honing in on the frequency of water disposal (table 23) 148 (64.9%) participants indicated that they disposed of their water after each use which is followed by 63 (27.6%) people who disposed of their water after several house hold chores and 9 (3.9%) people who threw away their water in the morning after it has been used to clean night soil. Participants were further asked about the location on which their dispose of their water. 90 (39.5%) participants stated that they discarded their water in the street; this was followed by 70 (31.2%) people who disposed of their water in a drain, 16 (7.0%) people who used storm water drains to dispose of their water, 12 (5.3%) participants who threw away their water in front of their homes, and 5 (2.2%) into their toilets (table 24).

Table 23

Frequency of water disposal

Frequency of water disposal	Frequency	Percentage
Missing	8	3.5
After each use	148	64.9
After several household chores	63	27.6
In the morning after it was used for cleaning night soil	9	3.9
Total	228	100.0

Table 24

Location of disposal

Location of disposal	Frequency	Percentage
Missing	32	14.0
Distance	1	0.4
In front of the house	12	5.3
In the street	90	39.5
Into drainage	70	31.2
Into storm water drains	16	7.0
Into toilets	5	2.2
Used for watering plants	1	0.4
Total	228	100.0
Other		
Missing	200	87.7
Into the Jukskei river	28	12.3

Participants were also asked to give account of the time it took for them to dispose of their water. Table 24 indicates that majority of the participants (127 (53.3%)) stated that it took them between 0-5 minutes to dispose of their water, followed by 15 (6.6%) people who indicated that it took between 10-15 minutes, and 14 (3.9%) people who walked between 1-10 meters to dispose of their water. Conversely 1 (0.4%) person indicated that s/he walks about 2 kilometers to dispose of their water (table 25).

Table 25

Water disposal: distance

Water disposal: distance	Frequency	Percentage
Missing	15	6.00
0-5 minutes	127	53.5
6-10 minutes	11	4.8
10- 15 minutes	15	6.6
1-10 meters	14	3.9
2 kilometers	1	0.4
A few dwellings away	10	4.3
A long distance	4	1.8
A few steps away	13	5.5
A short distance	10	4.3
Just outside the house	7	3.1
Total	228	100

4.1.1.5 Problems and opportunities for better disposal

The sample was asked about the challenges they experienced with their current water disposal location and 133 (58.3%) people indicated that the water problem is a health hazard for the community. This was followed by 40 (17.5%) people who expressed concern about the safety around the water disposal location, 34 (14.9%) who stated that the location was too far and 4 (1.7%) people who made no mention of any challenges (table 26). Participants were asked to comment on some of their concerns about the streaming of water in the streets. Table 26 indicates that 113 (49.6%) people said that the water smells, 53 (23.3%) people stated that the water fills the streets and makes it difficult to maneuver in the streets and 26 (9.6%) participants who selected all the possible options. When asked about to give suggestions on what could

make water disposal easier, 208 (91.2%) participants expressed the need for a drainage system in the community while 1 (0.4%) person indicated the need for a personal drain and 1(0.4%) other participant stated that there is a need to maintain the drains (table 28).

Table 26

Challenges with water disposal location

Challenges with water disposal location	Frequency	Percentage
Missing	17	7.5
Distance	34	14.9
Health concerns	133	58.3
No challenges	4	1.7
Safety around the site	40	17.5
Total	228	100.

Table 27

Problems associated with water disposal for the community

Problems associated with water disposal for the community	Frequency	Percentage
Missing	14	6.1
It smells	113	49.6
It makes people sick	26	11.4
Fills the streets with water and makes it difficult to walk	53	23.3
It smells, makes people sick and fills the street	22	9.6
Total	228	100.0

Table 28

Opportunities for better water disposal

Opportunities for better water disposal	Frequency	Percentage
Missing	18	7.9
Drain system	208	91.2
Maintain drain	1	0.4
Personal drain	1	0.4
Total	228	100.0

4.1.1.6 Waste management

In a bid to gain some much-needed environmental context data for the constructed wetland, the sample was asked some questions around their waste management processes. Participants were asked to describe their waste disposal location and 105 (46.0%) people indicated that they disposed of their solid waste in the streets, 49 (21.5%) people said that they discard of their waste with their water, 31 (13.6%) people threw away their solid waste in a garbage bin, 8 (3.5%) people used the central garbage container as a disposal point and 6 (2.6%) people dispose of their waste at a land fill (table 29). Conversely a small portion of the sample indicated that they disposed of their waste in the Juiskei River. Table 30 indicates that 28 (12.3%) people indicated that they disposed of their solid waste in the Juksei River. Furthermore, the participants were asked to give account of the frequency at which they disposed of their waste. Table 31 indicates that 139 (60.9%) people disposed of their waste every day, 38 (24.5%) people every other day, 19 (8.3%) people once a week, 3 (1.3%) twice a day, 2 (0.9%) people three times a day and lastly 1 (0.4%) person said that they disposed of their solid waste 4 times a day.

Table 29

Solid waste disposal

Solid waste disposal	Frequency	Percentage
Missing	29	12.7
In a garbage bin	31	13.6
In the streets	105	46.0
At a close by land fill	6	2.6
Central garbage container	8	3.5
Throw away with any water	49	21.55
Total	228	100

Table 30

Solid waste disposal: other

Solid waste disposal: other	Frequency	Percentage
Missing	200	87.7
Into the Juksei river	28	12.3
Total	228	100.0

Table 31

Frequency of solid waste disposal

Frequency of solid waste disposal	Frequency	Percentage
Missing	7	3.1
Every day	139	60.9
Every other day	38	24.5
Once a week	19	8.3
Twice a day	3	1.3
Three times a day	2	0.9

4 times a day	1	0.4
Total	228	100.0

4.1.2 Content analysis

A qualitative content analysis was used to decode the open-ended questions which were a part of the survey. The results were quantified and produced in table 30 which can be found below. The content analysis revealed 9 codes which are broken up into 2 broad codes: water acquisition and water disposal. These will be discussed further below.

Water acquisition

Daily peaks

When questioned about the sample's water acquisition patterns throughout each day, a range of factors influencing possible peaks where identified. Whilst only 112 participants specifically alerted the researcher to a daily water acquisition peak, several more participants provided responses that suggested the possibility of two daily peaks. The drivers behind each of these peaks, however, maybe somewhat different.

A preference for collecting water during the morning, suggesting the possibility of a morning peaks, often surfaced themes related to high crime rates in the community at night, or alternatively a sense of community and shared work during the day.

"I cannot collect water at night because of the crime",

"*we only collect water during the day because we can help each other*"

A preference for collecting water in the later evening or night, suggesting the possibility of a second peak, tended to elicit themes related to infrastructural deficiencies and individuals' work and social responsibilities.

"*we collect water at night because the water pressure is very low during the day*"

"We collect water at night so that we can bath and get ready for work in the mornings"

Weekly peak

The researcher asked the sample to describe their weekly water acquisition patterns by asking the following question: "*Do you collect the same amount of water during the week as during the weekend*?". Responses to this question were highly polarized with half of the sample indicating an absence of a weekly peak (109 participants), while the other half (108) participants indicated a weekly peak in water acquisition. The peak described by the latter was commonly associated with doing laundry and more chores during the weekend (see example in table 28). Apart from this laundry factor, some participants spoke of an expansion of the household during the weekend. Participant 69 noted that: "*we collect more water during the weekend because we have more visitors and we do more laundry*".

Seasonal peaks

A Question enquiring about the seasonal water acquisition patterns was included in the survey. Responses pertaining to this question were dispersed. A large portion of the sample (134 participants) made no reference to a seasonal peak and made no effort to further unpack the absence of a peak. Whilst this accounted for more than half of the sample a moderate to large portion of the sample eluded specifically to a seasonal collection peak. 87 participants described a seasonal peak to the researcher. The most frequent seasonal peak described by the participants was a summer peak, and while some of the contributing factors to this peak was laundry, most of this cohort collected more water in summer for hygiene and drinking purposes.

> *"I do more laundry in summer, so we collect more water in summer"*
>
> *"we use more in summer because we bath twice a day"*
>
> *"I collect more water in summer because I drink more water"*

Water disposal

Daily peaks

The sample was asked to describe and explain their water disposal patterns. The researcher asked the following question: **"***Can you throw away your water at any time of the time of the day?"* 159 participants made no mention of a daily peak in water disposal. On the other hand, 60 participants reported that they could not dispose of their water at night because it was too dangerous. Participant 194 noted that: "*not at night, it is too dangerous I am sacred*".

Table 31

Content analysis codes

Code	Description	Example	Frequency
Water acquisition			
Daily peaks	The residents allude to a polarized water collecting pattern which speaks to either collecting water only during the day or only during the night	"I collect water during the day because it is dangerous at night" "We collect water at night because there is no one at home during the day to collect water"	112
Absence of daily peak	The participant can collect water at any time of the day	"I can collect water at any time"	104
Constant weekly water acquisition	Residents collects the same amount of water throughout the week	"we collect the same amount of water throughout the week because my wife does the laundry at the tap"	109
Weekly peak	Participants collect more water more water on certain days of the week.	"We collect more water during the weekend"	108

		"we collect more water during the weekend because we do our laundry and more chores"	
Absence of seasonal peak	Residents collects the same amount of water throughout the year	"it doesn't change"	134
Seasonal peak	Residents collect more water during certain seasons	"we collect more water in winter because we have more washing" "I do more washing in summer, so I collect more water in summer"	87
Water disposal			
Absence of daily peak	People are able t throw their water away at any time of the day	"yes I can throw away my water at night" "yes because there is no other place I can throw it away"	159
Daily peaks	Participants prefer disposing of their water at specific times of the day.	"No I cannot throwaway my water at night because it is dangerous"	60

4.2 Qualitative Results

4.2.1 Thematic analysis

A thematic analysis is a systematic approach to analysing qualitative data which allows for the generation of codes and themes that emanate from a sample of data (Alhojailan, 2012). After conducting the six steps prescribed by Braun and Clarke (2006), 7 themes were extrapolated which are: *Water is available, Low water pressure (infrastructure concerns), Summer peak, The effects of employment (State of employment), Lack of infrastructure, The impact of crime,* and *health effects* (see appendix H for Qualitative Analysis Audit trail). The sample data was collated after the quantitative results were examined and after the researcher had identified key areas that required further clarification within the data set. The data collected honed in on the water acquisition and water use pattern of the community of Setswetla as well as some of the health concerns the community had which pertained to the dirty streaming water in the streets. Similarly, the interview schedule focused on understanding some of the social factors that drove these patterns and concerns.

Theme 1: Water is available

As mentioned, this current study was aimed at understanding the water acquisition, use and disposal patterns of the community members of Setswetla. In a bid to understand the extent to which the availability of water resources affected the collection of water in the community, the researcher asked participants questions relating to potential water shortages. The sample (7 participants) made reference to an infrequent water shortage pattern. The residents attributed this shortage in water to maintenance activity usually conducted by the municipality.

Extract 1- Participant 1

"Last month the government informed us of a scheduled water shedding program. There was not water from 9am to 2pm every day. But other than that we usually don't have any water cuts."

Extract 2- participant 4

"Sometimes we have water cuts when a pipe has burst or when the municipality cuts the water if they are fixing some pipes, but it doesn't happen on a daily basis. If the municipality cuts the water, the water goes away for a few hours, the water was switched off at 8 am and it returned at 3 pm. The last time this happen was a month ago"

Extract 3- participant 5

"We do but not always, it only happens when they (municipality) are fixing the pipes, but they usually alert us when they want to do some maintenance that maybe 'on Friday we will have a water cut from this time to this time. They usually tell the community leader or they will tell us using a sousaphone that there will be a water cut and the municipality usually sticks to their times and it has never gone over a day."

Theme 2 - low water pressure (infrastructure concerns)

As divulged above, participants were asked about the potential water shedding activity they could have been subject to in the community. Participants spoke of an infrequent shortage pattern. Utterances from the sample also further eluded the researcher to another socio-economic problem which relates to the lack of infrastructure in informal settings. A couple of participants spoke of a daily water pressure problem which they attributed to the compromised infrastructure in the settlement.

Extract 1- participant 3

"We usually have water shortages every day and the reason is that we have attached our main water pipe to an existing one so sometimes the water runs out or the water pressure is always low. I have also extended the water pipe to the shack which we have connected to the washing machine, and because of the water pressure problem I can't do my laundry during the day."

Extract 2- participant 4

"We usually have water shortages during the weekends, and on holiday, because many people choose to do their laundry on those days. I also think that it is because of the expansion rates in our community. The pipes were only built to sustain a certain amount of people so as the population increases our infrastructure gets strained. I also think that the pipes are not being maintained or expanded to meet the growing demand, which means that the demand supersedes the supply of water"

Theme 3- Summer peak

The survey results suggested that there could be a summer peak as many people indicated that they collected more water during the warmer months of the year. This trend was confirmed by all the participants as they all spoke of drinking more water bathing more often and doing more laundry during summer.

Extract 1- participant 2

"I drink a lot of water in summer I usually drink about 8 glasses of water in a day which means I collect 2 jugs"

Extract 2- participant 3

"Yes we use a lot more water in summer, I drink a lot of water and we usually wash twice a day in the morning at 9 and later when its cool, because I sweat throughout the day"

Extract 3- participant 4

"I agree because we do a lot of laundry in summer because the clothing gets dirty faster because we sweating and we drink a lot of water in summer"

Extract 4- participant 5

"Yes I use most of my water in summer for drinking and bathing, I can bath twice in summer and only once during the winter months. And I do laundry twice a week"

Theme 4- Employment

One of the most pronounced themes in this study is centered on employment. Employment drove water acquisition patterns in the community. The participants spoke predominantly of collecting water in the early hours of the morning (5-6 am) in order to ensure that their partners and children could get ready for work and school on time. A secondary reason which informs early water acquisition is related to the long line participants are usually confronted with when they go collect water after 7am and sometimes 8am.

Extract 1- participant 1

"I usually collect my 3 buckets of water early in the morning before 7am, this is because there is usually commotion at the taps, the women come with huge bath tubs and buckets and they do their laundry at the tap and other people who need to get water to get ready for work"

Extract 2- participant 3

"I collect water in the morning and later during the day, I use only one 25 l bucket and I can't carry it when it is filled to the brim so I fill it half way in the morning then my husband and my children use that to bath, when he leaves he fills it half way for me so I can do some chores"

Contrary to the above described water acquisition patterns some participants mentioned that they had taps in their homes or within close proximity of their homes, thus exempting them from the conditions described above.

Extract 3- participant 4

"I have a tap in my shack, I installed it because I bought a washing machine. I collect all my water from that tap"

Extract 4- participant 7

"I have a tap right outside my house. We have a fens around our shacks (+-20 households) to protect the kids and keep them safe. I collect water 3 times a day in the morning in the afternoon and in the nighttime"

4.1. The state of employment –water use: laundry

Upon analysis of the data, the researcher noticed that those who were unemployed did their laundry during the week. One of the factors that seemed to inform this decision is the understanding that the taps would be over occupied during the weekend because that is when all the employed people would do their laundry. This understanding was further confirmed by some of the employed participants. Moreover, the results suggest that this kind of reasoning is preferred because a lot more water is used to do laundry and choosing to do laundry during the weekends could delay the process because of the low water pressure and the longer lines.

Unemployed participants

Extract 6- participant 3

"I have a washing machine …I do my washing 3 times a week because I can't do all the washing all at once. I usually do my washing at night when there is water pressure and it is usually during the week. I never do washing during the weekend because we share the lines so I need to give others that work during the week a change to do washing and hang their cloths"

Extract 7- participant 5

"I use about 240 litres of water to do my laundry… I do it during the week because there are so many other people during their laundry during the weekend because they are off from work. Sometimes it can take 2 hours before you start doing the laundry because of the line. So even if I am working I prefer to do the laundry during the week at around about 10"

Employed participants

Extract 8- participant 1

"My daughter and I use about 3 to 6 buckets to do laundry… We always do our laundry every Saturday. This is because I don't work on Saturdays and my daughter is at home so we can do the laundry"

Extract 9- participant 4

"I have a 120l washing machine which fills itself twice to wash and to rinse I do my washing during the weekends, because I am off from work"

One of the participants alerted the researcher to a system that was designed by herself and her neighbours. The female participant lives in a self-made gated community in Setswetla and they had a tap installed in their compound. Their system takes employment and parenthood into account and dictates how water is used in the compound.

Extract 10- participant 7

"In our yard we take turns to do washing. If you have a child (toddler) you can wash twice a week but if you don't you have to wash once a week and the only people allowed

to do washing during the weekends are employed people. I use 2 buckets to wash my cloths and I rinse with 3 buckets and I wash twice a week"

4.2. The state of employment –water use: bathing

Another practice which appears to be ruled by the state of employment is bathing. Majority of the participants were unemployed and when asked about their bath time, many of them noted that they usually bathed mid-morning or even late afternoon. They attributed this to the need to do all the chores in the early hours of the morning. Converse to this all the employed participants spoke of bathing in the early hours of the morning such that they could get ready for work. The results also indicate that most people who are employed bath twice a day. This was often corroborated by some of the unemployed participants when describing their partners' bathing habits

Unemployed participants

Extract 11- participant 3

"My husband and children bath early in the morning to get ready for work and school. I usually do the chores first and bath at about 9 am"

Extract 12- participant 7

"I collect water for my husband to wash in the morning he baths at past 5 am because he goes to work. I usually bath at 9 am because I do chores and later in the evening again. Me and my husband bath twice a day"

Extract 13- participant 6

"My husband baths in the morning because he has to go to work and when he comes back he also has to bath so I need to make sure there is always water in the house. I usually bath after 12 pm because I have chores to do but I usually just wipe my face in the morning. I usually bath the child at any time because the child doesn't go to crèche"

Employed participants

Extract 14- participant 4

"I usually bath first thing in the morning when I have to go to work. I also bath at night because where I work I sweat and we get dirty so I have to bath before I sleep"

Extract 15- Participant 1

"Me and my daughter both bath in the morning, the reason for her is because she has to get ready for school in the mornings and I wash in the morning because I work as a council member, which means I am always needed in the community. So every morning I wake up and bath because I know there will always be work for me to do"

Theme 5- lack of Infrastructure

Results from the quantitative survey indicated that 93% of the participants acquired water from communal taps. This prompted the researcher to explore the accessibility of water from these communal taps, given the underserviced nature of informal settlements. Results from the interviews suggest a constant use of the taps so much so that all the participants spoke of standing in long ques to collect water. The long que is an indication of a lack of communal taps in the community. The congestion at the taps is also related to people doing their laundry as well as their dishes at the tap area, which further highlights the lack of water resources in in the community.

Extract 1- participant 5

"I collect water in the morning, around 7 and 8, I go at that time because I know that if I go there after these times, I'll have to stand a line because we don't have a lot of taps. Sometimes people also connect hosepipes to the taps or wash their cars at the tap."

Extract 2- participant 3

"there are always many people collecting water and doing their laundry at the taps. It is usually a hassle to get water because people leave their washing tubs"

Extract 3- participant 5

"there are always people doing their laundry, collecting water and even washing their dishes at the taps"

Theme 6- Crime

The results from the survey suggested that many participants preferred not to collect water at night. Further probing produced answers like *"I can't collect water at night because it is*

dangerous". Conversely an equally large portion of the participants indicated that they had no problems collecting water at night. In a bid to further understand the preference for water acquisition participants were asked to comment on the survey results which suggest that it is dangerous to collect water at night. Five of the 7 participants agreed with the survey results while the other two disagreed because they had taps inside or just outside their homes.

Extract 1- participant 1

"Yes, I prefer to get water early in the morning, if it so happens that the water run out I usually go before it gets too dark"

Extract 2- participant 3

"Yes I share the same view, we stay in a very unsafe place so I don't go out at night because I am scared of what could happen to me. We always hear of people being attacked so this makes me scared. I collect my last bucket of water at half 5 pm because it is not safe to go when the sun is down"

Extract 3- participant 4

"I installed the tap in 2012. Before then I used to collect water from the communal tap and I found that people are scared to go to the tap at night because it is so dark there are not street lights"

After further probing, participants revealed to the researcher that there is a huge crime problem in their area. Many participants spoke of petty crime such as the stealing of phones and buckets during the quieter hours of the night. More serious crimes such as sexual assault, theft of passports and house break-ins were also divulged by the participants.

Extract 4- participant 1

"Most people report of being held at either knife or gun point by the criminals and they usually request for phones and money. There is a new wave of crime in the streets where criminals attach people at night and demand for their IDs."

Extract 5- participant 3

"A couple of week ago we heard of a rumour that 3 women were raped at the toilets. Another boy was also attacked at the toilet, and they took his phone"

Extract 6- participant 5

"I once had my buckets stolen from the tap at night all I did was go throw away my rubbish and when I came back my bucket was gone… Nowadays they target the households where the man leaves for work in the morning, because they know the women very rarely wake up to lock the gate. We also had a case last week where they got into the house after the husband left and they told the women to pack all the cloths in a bag and the forced her to walk then to the taxi stop so they wouldn't set of any alarms in the community"

Theme 7- Health effects.

The rationale of the overarching study is to provide infrastructure for the community and to ensure that they have a safer and less hazardous environment by installing a constructed wetland. One of the issues with streaming water is that it could potentially be hazardous to those exposed to it. The results from the survey echoed this notion as a large portion of the sample indicated that they are worried that their water could compromise their health. In order to gain a further understanding of these concerns the researcher asked them some questions about their experience with the dirty water to which they have been exposed. After the results were thoroughly analyzed the research found that most of the participants were bothered by the smell but made no mention of any negative health consequences caused by exposure to the water. Two of the participants mentioned that they had experienced negative consequences which were caused by exposure to the water.

Extract 1- participant 2

"I would say that this water made me ill because the dirty water would seep into my house especially when it rains"

Extract 2- participant 7

"Many of the children in the compound would get flue or diarrhea and we suspected that it could be the water that is why we build the fence"

Given that majority of the participants made no mention of their personal experiences, the researcher probed questions about experiences they might have heard of in the community. Many of the participants spoke of children playing in the dirty water and subsequently falling

ill. One of the extreme cases recorded was the death of a child caused by ingestion of the soiled water. Some of their responses are reported below.

Extract 3- participant 1

"I have not gotten sick from the water, but being a council member we always hear about children who get sick. Most of the children get diarrhea, some months back we had a case where a child died because they ingested dirty water. The doctors attributed the sickness to the dirty water or rather the bacteria in the water"

Extract 4- participant 3

"I haven't gotten ill from the water, but I know that a couple of children have gotten ring-worms from consuming and playing with the dirty water"

Extract 5- participant 5

"Many children get sick, one child got sick from playing with the water, she started vomiting and developed a skin rash. After they to the to the clinic the doctor attributed the illness to the dirty water"

This chapter summarized the survey results as well as the results from the in-depth interviews. Both sets of results identified clear water use patterns as well as some socio-economic factors that underpin these patterns. The next chapter will discuss these results in relation to the reviewed literature to identify communalities with previous research, but also to highlight context-bound drivers of behavior in Setswetla.

CHAPTER FIVE: DISCUSSION

5.1 Introduction

This study aimed to explore the water acquisition, use, storage and disposal patterns of Setswetla, Alexandra. The study also explored the perceptions of the streaming water in the streets from a health perspective, as well as the solid waste disposal patterns of the community. In addition to this, this current study aimed to obtain a greater understanding of some of the socio-economic factors which underpin the use of water in this informal settlement.

This section will discuss the results of the quantitative results of the study which include; descriptive variables, frequencies and quantitative content analysis themes. These findings will be integrated with the 7 themes *(Water is available, Low water pressure (infrastructure concerns), Summer peak , The effects of Employment (State of employment), lack of infrastructure, Crime, and Health effects)* extracted from the qualitative component of the research as well as previous literature findings to give a well-rounded view of the current study.

5.2 Water acquisition and storage

A large portion of the results indicated that the primary source of water for the participants were communal taps (figure 2 depicts examples of communal taps). This result addressed one of the questions relating to the acquisition of water which was “where do you collect most of your water from?”. Furthermore, this result suggests that other sources of water included in the survey such as the river, rainwater acquisition and purchased bottled water are less popular choices.

Figure 2: communal taps

Literature on water acquisition and collection in informal settlement highlight the underserviced nature of these “shanty towns”. A couple of studies based on water use in informal settlements indicate that residents typically source most of their water from communal taps (Mofokeng, 2008; Tissington, 2011). These findings correlate with the results of the present study. 93% of the sample reported that they sourced water from a communal tap. The remainder of the sample collected water from public spaces and their neighbours apart from 0.9% of the participants who collected water from faucets outside their homes. When asked why they preferred communal taps, 67.5% of the sample noted that the communal tap was the only water source available to them.

The outcomes of this research also indicated that standpipes supplied by the municipality were often limited (Tissington, 2011). These findings coincided with the lack of infrastructure theme. Participant 5 stated that she collects water between 7 and 8 am as she would have to stand in a long line if she goes any time after this time period. She attributed this to the lack of taps in the settlement. Her latter point was common throughout the data as participants 1, 2, 3, 4 and 6 mentioned that the taps were always busy. Participants 2 and 6 also mentioned that the long lines are often caused by people who do their laundry at the taps, an example of this can be seen in figure 3. Participant 4 further mentioned that some residents connect their hosepipes to the tap which inconveniences everybody and usually causes conflict. The lack of infrastructure was further reinforced by the low water pressure (infrastructure concerns) theme. Participant 3 made mention of many illegal pipe connections which have been made onto the main water pipe. This compromises the water pressure for people further down who are dependent on the water from a tap connected to that water pipe.

Figure 3: woman doing laundry at the communal tap

Although there is a clear lack of infrastructure in Setsewetla, there seems to be an adequate availability and perceived quality of water from these taps. 61.2% of the residents indicate that there was always water available and an over whelming 93.4% or the participants said they do not clean the water before they use it as they perceive it to be clean. These results were mirrored in theme 1; water is available. All the participants noted that they had a constant flow of water although interrupted by infrequent water cuts. Participant 4 mentioned that the water would usually be switched off by the municipality for maintenance purposes. When this happens, the water would be off for about 8 hours and would return in the afternoon. Participant 5 went on further to say that the water was not switched of often but, when it did, they were usually informed by the community leaders and were thus able to plan accordingly.

The research done by Tissington (2011), also found that communal taps were often located in the peripherals of the settlement however, this current study found results in discord with this finding. When asked how long it took them to collect water 50.4% of the participants indicated that the water source was a few dwellings away and 24.6% indicated that the source was inside or just outside their homes. These findings were crossed checked by asking participants to give account of the time it took them to collect water. The results show that on average, participants take 7.69 minutes to collect water. Though 8 minutes is a stretch to walk for a basic need and to a degree infringes on the right and access to water, it could still be argued that significant strides have been made to cater as much as possible for the urban poor as 94% of South Africa's

population is said to have access to a supply of safe drinking water from a tap within 200 m of their home (Water International Cooperation, 2017).

An additional factor related to water acquisition is the frequency of water acquisition. When asked how often they collected water, 50% of the sample indicated that they collected water once a day while 40% of the sample collected water twice a day. These findings were also common in theme 3: Summer peak. Participant 1 stated that he collected his 3 buckets of water before 7 am in the morning while participant 3 stated that she collected water twice a day: in the morning and later during the day. These collection patterns coincided with the storage data ascertained from this study. Participants were asked to give account of their water storage patterns and 54.6% of the sample indicated that they stored their water for one day. Reinforcing the notion that more than half of the sample collects water only once a day.

Water peaks

Results addressing the overall water consumption of Setswetla suggested the possibility of daily, weekly and seasonal peaks. These results highlight the variability of water use in Setswetla. According to Pretorious (2016), temporal water variations are commonly influenced by the time of the day, the week and seasonal changes. Homing in on the daily temporal factors, results from the content analysis found that 112 participants perceived there to be a water acquisition peak. This peak was related to water use factors such as bathing. Interestingly, 104 participants made no mention of a daily peak. According to Pretorious (2016), the morning peak in low-cost housing areas gradually increases throughout the morning and reaches its peak at about 11:00 am. This he suspects could be related to the high levels of unemployment in these areas which translates to a large portion of the populous starting their day a bit later (Pretorious, 2016). These suspicions were confirmed in the data found in the effects of employment theme. The results indicated that the state of employment played a big role in how water is used in the household. All the unemployed participants spoke of collecting water in the early hours of the morning to ensure that their partners could bath and get ready for work. When asked about their bath times, most of them mentioned a time later in the day. Participant 7 said that she bathed around 9 because she preferred doing the chores first before she bathed. This was similarly echoed by participant 3 who said that she bathed at 9am, and participant 6 who bathed after12pm for the same reason.

Weekly variations are dependent on the days of the week and Pretorious (2016), found that laundry was most likely the main peaking factor for informal settlements. Evidence of this kind

of peak factor was found in the context of this study. 108 participants mentioned an increase in water acquisition on specific days of the week. Results from the content analysis as well as the thematic analysis indicate that this peak is influenced by laundry. Further analysis of the data found the social factor of employment being reiterated. Majority of the employed participants, such as participants 1 and 4, alerted to doing their laundry on the weekend because they were off from work during the weekends. Conversely the unemployed participants spoke of doing their laundry during the week. Participant 5 indicated that she does her laundry during the week because the taps are relatively free, making it more convenient for her to wash her cloths. This response was echoed by participant 3. She has a washing machine and prefers to do her laundry during the week. She substantiated this by saying "I never do washing during the weekend because we share the lines so I need to give others that work during the week a chance to do washing and hang their cloths"

Conversely more than half of the survey sample made no mention of a weekly peak. The constant weekly water acquisition theme shows that 109 participants collected the same amount of water throughout the week and some participants said that this was related to people doing their laundry at the taps. Although the results do not suggest a weekly peak in water acquisition, employment could still influence when the people would go do their laundry at the faucet.

A large portion of the results from the content analysis indicate no trends of a seasonal change in water consumption. 134 participants reported no change in water acquisition across the seasons. These responses were juxtaposed by 87 participants who indicated a seasonal peak in water acquisition. The researcher found that the peak factors were attributed to high volumes of laundry either in winter or summer. These baffling results prompted the researcher to explore the topic further and the latter view was confirmed. The summer peak theme of the thematic analysis bolsters the notion of a possible seasonal peak. Participants confirm that more water is used to do laundry in summer and argue that this could be because clothing is soiled at a faster rate. Furthermore participants 2, 3 and 4 reported on increased water consumption and bathing habits and attributed this to the high temperatures. Results from the thematic analysis mirrored findings obtained by Pretorious (2016) & Gato-Trinidad et al. (2011). Similarly, both studies report on a peak in water consumption during summer and ascribes this to frequent hygiene practices.

The conflicting results and lack of unanimity found across the 3 peak factors highlight the subjective nature of self-reporting data. Perhaps a more precise and objective measures of water consumption could help provide clarity in future studies.

Crime in informal settlements

In-depth interviews uncovered crime as a socio-economic driver of the water acquisition patterns observed. According to Brown-Luthango, Reyes and Gubevu (2017), large populations which have been afflicted by poverty, malnutrition, discrimination and restricted access to land, are more susceptible to high crime levels and a lack of safety. This is also further exacerbated by the rapid urbanisation associated with informal settlements. Harrison and Rosa (2017), goes on further to suggest that poverty, rapid population growth and density and inequality that contribute to a context of risk and vulnerability, are in some ways prerequisites for crime. The most prevalent kind of violence in informal settlement is murder. Research done by Wakefield and Tait (2015), indicate that South Africa has one the highest murder rates in the word and most of the causalities are reported from the informal settlement. To put this into perspective South Africa has murder rates 5 times higher than the global norm with settlements like Khayelitsha reporting rates ranging between 150 to 200 murder per 100 000 persons. This relationship between informal settlements and crime was also reported by the World Bank. According to the Word Bank (2010), (as cited in Brown-Luthango, Reyes and Gubevu 2017), the lack of infrastructure such as lighting and inadequate sanitation breeds an environment of violence and crime. Moreover, these conditions leave women and children most vulnerable to rape and other kinds of physical assault. Similar results were found in this current study. Participants 1 and 3 noted that they preferred to collect water during the day and made sure that they collected their last bucket of water before the sun goes down as it is not safe. After further probing participants 1, 3 and 5 referred to a host of different crimes which range from: attacks at the taps late at night to sexual assault near the toilets.

Crime as an emergent theme, has also managed to illuminate certain restraints built into the informal settlement model. The World Bank (2010) (as cited in Brown-Luthango, Reyes and Gubevu, 2017), noted that the lack of infrastructure such as access to sanitation and proper street lighting breeds an environment which is vulnerable to crime. As noted above participants reported that people have been attacked at the taps and sexually assaulted near the toilets. These are example of how crime further restricts the residents from being able to use basic resources. Moreover, these examples show how crime moderates the life experience of the urban poor.

5.3 Water use

Descriptive results pertaining to water use reported that the average water consumption ranged from 70*l* to 1400*l* with a mean average of 393.4*l* per week. This result was ascertained by multiplying the number of buckets used per day by the total volume each bucket could carry. This result was then further multiplied by 7, representing the number of days in the week.

The results bring into focus the possible influence that stand size has on water demand. As discussed in the literature, stand size can be defined as the size of the property owned by a family or individual. A study conducted in Cape Town found that higher income earning households consumed about 229*l* per day while the lower income earning households consumed on average 49*l* of water per day (Jacobs et al., 2016). Results from this current study mirror the results found in Jacobs et al. (2006). When the 49*l* is multiplied by 7, the weekly consumption of water comes in at 343*l*. This is relatively close to the 393.41*l* consumed in Setswetla. Jacobs et al. (2006) showed that water demand was highly responsive to the size of the property, suggesting that water demand increased with the size of the property. A similar water demand pattern was also found by AL-Amin (2011) and Fan (2013) who both argued that water consumption was subject to water supply further suggesting that households with continuous piped water, typically found in your high-income residential areas, used water more frequently for hygiene purposes, water appliances and for watering the garden. These theories further reinforce the motion that residents in low income areas consume far less water than residents in high income areas.

Water use can be defined as water used for any and all household purposes. Investigation of water use patterns in Setswetla signalled that majority of the participants used their water for: cooking, cleaning purposes, drinking, laundry, bathing and for cleaning the Chimba bucket. On the contrary only 0.9% and 6.1% of the sample indicated that they used their water for their animals and gardening respectively. The lack of outdoor usage patterns strengthens the argument that the usage of water is influenced by the socio-economic environment and is consistent with literature on water use in informal/ rural settlements. Nevhutalu (2018) and Mofokeng (2008), report on the orthodox uses of water such as laundry, bathing and cleaning however make no mention of any outdoor usages for water.

Figure 4, however, depicts a garden that is not a common sight within the settlement. The lack of outdoor water use confirmed by the results, potentially alludes to a greater socio-economic problem related to the access of land and food security. Access to land has been associated with

food security in informal settlements. This is because the residents could use the land to grow produce which could help reduce the persistence of malnutrition and growth stunting in children (Van Averbeker, 2007). However, given the limited availability of land in settlements like Setswetla as well as the rapid urbanisation, sustainable initiatives like urban farming cannot be undertaken. This further highlights the rationed nature of informal settlements and how they further perpetuate a malnourished society.

Figure 4: one of the few produce gardens in Setswetla

Participants were asked to rank 8 water use factors such as laundry, cleaning and bathing from 1 to 8, with 1 being the factor they used most of their water for and 8 being the factor that consumed the least water. Based off of the survey results, laundry was ranked 1st which was followed by bathing, cleaning, cooking, drinking, cleaning the chimba bucket, gardening and lastly animal care. Similar water use patterns were also found in a study conducted in the 4 main settlements of Ekhuruleni. This study found that most people reported that they used most of their water for laundry followed by bathing and dishwashing. To ascertain more detailed data, this pattern was further explored during the in-depth interviews. Rough estimates for laundry were requested from the participants, participant 5 indicated that she used about 240 litres of water to do her laundry while participants 1 and 7 noted that they used about 120 and 100 litres of water respectively. These results are based on weekly usage as it was established that laundry is commonly done once a week in the settlement. These findings mirrored the results found in the Ekhuruleni study as 28 litres/day were used for laundry on each day. When this is multiplied by 7, the total weekly usage come to 140 litres/week.

5.4 Water disposal

39.5% of the sample indicated that they disposed of their grey water in the streets. This was followed by an equally large 31.2% of the sample who reported that they disposed of their grey water into a drain (dug trenches) - see figure 5 for an example of a manmade trench. The researcher also found small pockets of data which indicated that 5.3% of the sample disposed of their water in front of their homes and another 7% which disposed of the water into storm water drains. Outside of the abovementioned options, participants could provide other locations which were not included in the survey. From these results 12.3% of the sample chose the Juksei River as their disposal location. These were very interesting results, especially given the lack of empirical research done on water disposal in informal settlements. Furthermore, some of the results mirrored pervious empirical findings. Research found that like the results from this current study, people disposed of their water in dug trench drains (Hamel, 2006, Murphy, 2006, as cited in Mofokeng, 2008).

Figure 5: manmade trench stretching across the settlement

Participants were asked to give account of the frequency of water disposal and 64.7% of the sample said that they disposed of their grey water after each use. This means that more than half the participants dispose of their water after it has been used for either cooking, cleaning

bathing or any of the use factors. The result could also suggest that this portion of the sample does not consider the time of day when disposing of their water. This suggestion was confirmed in the daily peak theme of the content analysis as 159 participants stated that they could dispose of their water at any time. This was however juxtaposed by 60 participants who mentioned that they couldn't throw out their water at night and attributed this to the high crime levels in the community.

The sample were also asked to note the time it took them to dispose of their water and 53.4% of the sample indicated that it took them between 0 to 5 minutes to walk to the disposal location. Furthermore 90 participants mentioned the streets as their disposal point while 70 participants noted dug trenches which stretched across the settlement as their water disposal point. These results are consistent with previous literature findings. Hamel (2006), Murphy (2006) (as cited in Mofokeng, 2008) mentioned that residents who live in informal settlements dispose of their water in their back yards or the streets and concluded that this decision was driven by the notion of convenience.

At surface level the "convenience" argument could suffice and possibly even encapsulate the urban poor's experience however; the patterns found both in previous literature and this current study allude to an environmental influence. Using the idea that residents in informal settlements do things in an unorthodox manner because of their social setting (Brown-Luthango et al., 2017), it could be maintained that the decision to dispose of their water in this hazardous way is not their ideal, but rather something that they are subjected to, given the lack of resources and infrastructure.

5.5 Health concerns and water disposal

Research shows that residents' in informal settlements are generally concerned about the way water is disposed of in their settlements. Some of these health risks included mosquito infestations from stagnant water and children falling ill after playing in the water (see figure 6 for example of stagnant water) (Carden et al., 2007). Similar results were found in this current study. More than half of the sample (58.3%), indicated that the main challenges associated with water disposal were related to health concerns. Further probing around the issue of water disposal revealed that 49.6% of the sample had a problem with the odour caused by the dirty water in the street and only 11.4% of the sample indicated that the water makes people sick. This discrepancy prompted the researcher to further investigate the issue of health concerns.

Figure 6: Stagnant water in Setswetla

After a thorough analysis of the results a clear theme about the health concerns emerged. This was consistent of two elements: personal experiences and word of mouth. With regards to the former, participant 7 mentioned that the children in her compound including her own used to play with the dirty water and would often land up in the hospital with diarrheal complications. On the other hand, many participants spoke of other water related health cases which they heard about from other residents. Some of these included children who developed ring worms and gastritis. Participant 1 also mentioned a case where a child died after she consumed the dirty water. These findings can be confirmed by a host of different sources.

A study conducted in China found that the consumption or active exposure to dirty water can cause gastric and liver problems and further stated that approximately 60000 people die from liver and gastric cancer on an annual basis (Tao & Xin, 2014). These conditions tend to be exacerbated by living conditions. Informal settlements are characterised by dilapidated, make-shift housing with constrained ventilation and high levels of indoor pollution (Weimann and Oni, 2019). Weimann and Oni (2019) further state "physical housing structure, the psychosocial and cultural home environment, the physical characteristics of the neighbourhood environment, and the social environment and services within the community" create a breeding

ground for ill health. Thus, it could be posed that the limited nature of informal settlements increases the risk of ill health. This notion was confirmed by Uwizeye, Sokoni and Kabiru (2014). These researchers stated that people who live in slums have a greater risk of ill health and a greater risk of contracting diarrhoeal related ailments. This is because they live in overcrowded settings which have limited access to safe water, toilet facilities and are subject to poor waste management. Children tend to be severely affected by this as the UNICEF reports that one in five children die before they reach the age of 5 from diseases like diarrhoea. Furthermore, in 2011, Diarrhoea caused by water contamination and poor bottle hygiene was reported as the leading cause of childhood deaths in the informal settlements of the Western Cape (South African Government, 2011). Children in informal settlements have also been reported to play with the stagnant water as well as the sprawled solid waste in the streets (Khumalo, 2012). And although they enjoy it as it allows them to explore the environment with their peer (Khumalo, 2012), it is often at the expense of their health. Below is an example of children planning with the solid waste in in settlement.

Figure 7: children planning with the solid waste in the settlement.

5.6 Waste management

Results from this study indicated that 46% of the sample disposed of their solid waste in the streets, an example of this can be seen in figure 8. These results addressed the question on solid waste disposal. Other locations included: garbage bins (13.6%), central garbage bins (3.5%) and landfills (2.6%). Participants were also given an opportunity to describe other disposal locations which were not included in the survey, from this 12.3% of the sample indicated that they disposed of their waste in the Juksei River. Similar results were ascertained in previous studies. Ashalakshmi1 & Arunachalam, 2010 (as cited in Zandamela, 2016) as well as Zandamela (2016) found that the informal settlements in question did not have access to refuse removal services. To add to this Zandamela (2016), discovered that the informal settlement did not have any land fill sites. This pushed the residents to resort to disposing of their waste in the streets which further created a pollution problem. This overt pollution was also noticed by the researcher in Setswetla and can also be attributed to the frequency of waste disposal. 60.9% of the sample stated that they dispose their solid waste daily and a further 24.5% indicated that they disposed of their solid waste 'every other day'.

Figure 8: solid waste disposal in Setswetla, Alexandra

The common thread embedded in the reviewed literature is the impact of the physical environment on the overall experience of the residents in these settings. Research by Brown-

Luthango, Reyes and Gubevu (2017), Harrison and Rosa (2017), Uwizeye, Sokoni and Kabiru (2014), shows that the experience of crime and ill health are by-products of the environment. The same can be said for the water use patterns observed in this study. The current research findings describe how residents collect water from stand taps, store water in 20l buckets, do their laundry at the standpipes, and disposal of their water and solid waste in the streets. These unorthodox patterns of water use are all regulated and influenced by the lack infrastructure in the settlement. It could therefore be argued that the installation of the constructed wetland could provide a beginning to the much-needed infrastructure upgrades required.

5.7 Psychology and water consumption studies

This study was also approached from a psychological perspective as the study sort to understand how residents' socio-economic realities and the perceptions they hold of their environments shape water-use related behaviours. Whilst this research did not directly embed itself within any specific psychological field the Consumer behaviour theory and the EKB model were presented as the most applicable theoretical models for this research.

As discussed in the chapters above, the Consumer behaviour theory and the EKB model are rooted in information processing and pays special attention to the recognition of an unsatisfied need, gathering information on possible alternatives, evaluation of alternatives, purchasing of the product and lastly post purchase evaluation (Suelin, 2010).

Using water acquisition as an example, results from the study indicated that 93% of the residents collected water from communal taps in the settlement. Traces of information processing and decision making were found in the study because a small percentage of the sample indicated that they preferred the water source because of the quality of the water, while others indicated that their preferred water source was related to its reliable nature. This was however only observed for a small portion of the sample group. About 67% of the sample mentioned that they collected water from a communal tap because it was the only water source available to them. These choices are quite different from water related choices made in high income earing households. A study aimed at understanding the perceptions of bottled water of urban municipalities in Brazil found that bottled water was preferred because it was more practical, more stylish and better treated (de Queroz, Doria, Rosenburg, Heller and Zhouri, 2013). Conversely, tap water was considered good but not good enough to drink because residents didn't think that the water infrastructure was adequately maintained (de Queroz et al., 2013). Although these results are not representative of the South African context, they give insight into the decision-making processes of a group of people who have options and alternatives. It could thus be reasoned that both information processing and decision making are regulated by the environment that the customer is exposed to.

As noted in the chapters above, consumer decision making is influenced by individual differences, psychological processes and most important for this study, environmental influences. (Engel, Blackwell and Miniard (2001) (as cited Osei and Abenyin, 2016)). Where environmental influences could include culture, social class, personal influences, family and the situation (Suelin, 2010). Honing in on the social class, it can be defined as socio- economic divisions within society where individuals share similar values, interests and behaviours. Given

the socio-economic environment it could be maintained that the residents in Setswetla would have a different and somewhat constrained decision-making process because of limited affordances for their environment. An example of this is that 93% of the sample indicated that they obtained the water from a communal tap and no one in the sample indicated that they consumed bottled water. This could be that bottled water is seen as a luxury item especially because there is a cost attached to it. They also perceived the water to be clean as most of the sample indicated that they did not clean the water before they used it. When the results are viewed from this lens, it becomes apparent that contextual information for this kind of study is crucial to making sense of individual's choices and behaviours. It also coincides with the rational of the study which sought to provide context specific information about the water use patterns of Setswetla that will serve as feed in information for the proposed constructed wetland.

5.8 Potential relevance of results for the overarching study

The aim of this study was centred on the exploring the water-use patterns in Setswsetla. Although not exhaustive, the results obtained in this study were able to unearth interesting water-use patterns, which are very common to this settlement. This study was also able to extract rich data which will be used in the design process of the Constructed wetland. This section of the report will, therefore, focus on the implications of these findings on the overall functioning of the proposed wetland. Part of this discussion which will be informed by the insights provided by a wetland expert who was interviewed after the data was collected from participants (see appendix G for schedule).

5.8.1 Water use

The amount of water consumption obtained for the current study ranged between 70*l* and 1400*l*. As a response to this information, the constructed wetland expert indicated that a constructed wetland could be built to house this estimated volume. Branching off from this, the constructed wetland expert mentioned that the flow rates were far below Global rates however; that this was not too concerning. What was however more concerning for the expert, was the lack of continuous water flow across the settlement and the potential high loadings of phosphate contaminated water into the system.

Results from the survey and the in-depth interviews suggest that people used a large portion of their water for laundry and bathing purposes. This is an indication that a large amount of the grey water being disposed of contains high levels of phosphate. In response to this the Constructed Wetland expert indicated that the high loadings of phosphate water could potentially kill the plants in the system. He further added that this is not too much of a concern as the system would still have a gravel bed, which would become the primary filter of the system. This ties in with the literature which highlights the importance of having a resilient system (Zuma et al., 2009, p. 41) and investigating community behaviour as an input to the design.

Another major concern regarding the disposal of laundry and bathing water was related to the reality of the water flowing through the system in a very sporadic way. Taking laundry as an example, participants mentioned that water acquisition is often delayed because of the women who do their laundry at the tap. This has been related to the lack of resources within the settlement. Although this kind of water use and disposal is common, it is not predictable. The expert called this kind water flow “pulses” and argued that it would make designing a suitable constructed wetland for the settlement very difficult, as this would mean he would have to

design for an unforeseen and unknown event. Figure 9 shows how this could be a reality as we see how people dispose of large amounts of laundry water which then stagnates in one area. The expert then went on further to suggest that he would have to control for this pulsing by installing by-pass systems within each system. According to the constructed wetland expert, a by-pass system is an added pipe- like structure within the constructed wetland which would allow for an overflow component that would kick in whenever there is an excess amount of storm water or grey water within the constructed wetland. The bypass system ties in with the literature that states that the system needs to be able to withstand wetting and drying seasons and would similarly make the system resilient to external factors (Zuma et al., 2009, p. 41).

Figure 9: stagnant laundry water

5.8.2 Water disposal

Water disposal results indicate that participants use water to clean the 'Chimba' bucket. Based on conversations with community members the 'Chimba' bucket is a makeshift loo which is commonly used by women and children at night to ease themselves. This urinal matter is then disposed of in the toilet, however the water used to clean the bucket is often disposed of in the dug trenches which run across the settlement. According to the constructed wetland expert, this

could be beneficial for the system and more specifically for the plants. He substantiated this by stating that the traces of urinal matter could act as a fertilizing agent for the plans but, cautioned that this kind of disposal should be limited to the cleaning water as the unfiltered urine could convert the wetland into a sewage treatment system.

5.8.3 Waste management

Results from this study indicated that close to 50% of the sample disposed of their solid waste in the streets while only 19.7% disposed of their solid waste in garbage bins, central bins and landfills. These environmental circumstances are consistent with those found in Lanrug. The community of Langrug has central garbage bins scattered across the settlement, however these are not regularly serviced. These overflow and lead to the sprawling of the solid waste across the settlement. This overt pollution has also led to the clogging of the drains which are connected to the constructed wetland and given the solid waste trends found in Setswetla, it could be argued that the proposed constructed wetland runs the risk of being negatively affected in the same way as the system in Langrug. Furthermore, 13.6% of the sample indicated that they disposed of their waste with their water. This exacerbates the pollution threat as the solid waste could be directly disposed of in the system drain and could compromise the overall functioning of the system.

5.8.4 Social factors

Results show that 93.4% of the sample indicated that they collected the water for their respective households. Taking this a step further, frequency results indicate that 53.8% of the sample were females. Therefore, it could be posed that most of the water is collected by the females in this settlement. Moreover, these results could imply that the females are a possible target demographic for this project and that they should be involved in the development and the maintenance of this project.

During the in-depth interview process, Participants 4 and 7 alluded to a theme of intra community cooperation. Both participants positioned their use of water in the context of those with whom they shared their resources. Participant 4 mentioned that she washed her cloths during the week to give those who are off during the weekends a change to do their laundry. In the same breath participant 7 spoke of her “gated community” where they have a system set in place which dictates how many times a household can do its laundry. The constructed wetland expert thought that these two setting would be most ideal for the constructed wetland as the people would take pride in the structure and make it their responsibility to maintain it because, they already have established systems they have been using.

5.9 Limitations and future directions

Language was one of the main limitations of this study. Research assistants were hired to assist with the data collection as it became clear that the main researcher was not going to be able to translate the survey into some of the languages. Although the assistants were skilled in the main languages of the settlement which included: Sepedi, Xitsonga, Isizulu and IsiXadhosa, the main researcher found that the nuances were lost in some of the translation as the assistants did not speak English as their first language. This rendered a large portion of the "ranking" results uninterpretable as there was a misunderstanding of the question. A possible recommendation for this would be to employ a researcher who is able to speak adequate English as well as all the main languages spoken in the settlement, to ensure that the survey is translated accurately.

A large portion of the data for this study was obtained using a group of 10 research assistants. This helped gain coverage of the settlement however these assistants could have been bias in their sampling and could have only approached individuals based on existing relationships or convenience. This could have possibly excluded a large portion of the population and could have similarly skewed the outcomes.

This research utilised a self-reporting instrument which enquired about the household usage of water in Setswetla. This means that residents could only provide the researcher and research assistants with rough estimates of their water demand and usage. Although this information is useful in designing for the capacity of the wetland, more accurate results would have been more beneficial. Further research in this field could use a metered system which measures the average water flow from each tap. This would allow for more accurate measures of the water demand.

5.9.1 Long-term effects of the constructed wetland in an informal settlement like Setswetla.

The desired outcome of this research project was to get a better understanding of the water use patterns of the residents of Setswetla. This formed part of a greater project which sought to provide solution to the settlement's water drainage issue by building a constructed wetland. This constructed wetland was positioned as the best way of developing the settlement without displacing the community. Furthermore, this solution would not only decrease the volume of streaming water in the streets and alleys but, would be a source of sustenance, as the wetland would be fitted with fruit producing plants/herbs which they could enjoy or sell for an income. This project certainly has positive far reaching consequences for the community of Setswetla,

and though this cannot be disputed, one cannot help but ponder on the double edged natured of this project.

By building the wetland in Setswetla and shifting the responsibility of maintenance to the community is both stagnating and liberating for the community. On the former, the shift could brew complacency on the part of the government which could further perpetuate the disadvantage of the community. The government may misconstrue these actions taken as "self sufficiency" and as an indication that they no longer need the government's help. This could lead to a decrease in maintenance and development in the settlement, a fatal outcome for the poverty stricken community. On the latter, the ability to walk to a drain and dispose of their household water which may or may not be soiled is liberating for every individual and by extension the whole community. Many of the community members we spoke to, spoke about the struggles of having to cope with the streaming water which affected the health of their children. Therefore, being able to develop the area and provide for their basic sanitary needs, rids this community of a huge burden like exorbitant medical fees.

Though the project could lead to a stagnation in the development of the settlement through complacency by the government, there if still s strong case for the project as everyone has the right to a healthy and clean living environment.

CHAPTER SIX: CONCLUSION

The current study sought to gain insight into the water acquisition, storage, use and disposal patterns of the residents in Setswetla, such that the findings could be used as feed-in-information for the constructed wetland. This aligns with the NDP's goal to upgrade all infrastructure in a manner that factors in the unique community needs. Though findings pertaining to these variables were easily accessible from previous research, it was imperative that context specific information be obtained to ensure the fit and functionality of the proposed constructed wetland. Moreover, the study contributed to the existing however, limited literature concerning the use patterns of water in informal settlements in the South African context.

Water collection

This study found that a large portion of the sample collected water from communal taps in the settlement. When the researcher interrogated this preference further, more than half of the sample indicated that the communal taps were their only water source. These results were consistent with findings in similar studies. Literature also suggested that these communal taps were located in the peripherals of these settlements. This study found results converse to these as, the participants from this study took on average 7 minutes to collect water and indicated that the tap was a few dwellings away. The study also found that residents collected water during the day. This was influenced by the crime issues persistent in the settlement. From a wholistic point of view, half the sample indicated that there was a daily and weekly peak while the other half made no mention of both. The content analysis revealed that more than half the sample did not indicate a seasonal change in water collection. However further investigation through the in-depth interviews revealed a summer peak.

Water storage

The results found that all participants used a plastic bucket to collect water. This plastic bucket also doubled as a storage container. Furthermore, the results showed that the water was only stored for short periods of time and correlated with the number of times each household collected water in one day.

Water use

Results from the study indicated that majority of the households used their water primarily for indoor purposes with only a small percentage of the sample indicating that they used their water for gardening and for nurturing their pets. Laundry was ranked first where water consumption was concerned, followed by bathing. Both water use variables were found to be regulated by employment as people who were unemployed preferred doing their laundry during the week. This was done to avoid the long lines caused by those doing laundry over the weekend because they are off from work. Similarly, employed participants indicated that they bathed early in the morning while the unemployed participants stated that they bathed later during day when all the chores were done. These results coincide with literature which suggests that the daily water peak for informal settlements would be a gradual slope which would peak at about 11 am as opposed to the steeper slope peaking at 6am found in high income areas.

Water disposal

A large portion of the sample indicated that they disposed of their water after each use. Interestingly most of the sample indicated that they disposed of their water in the streets while a small portion of the sample mentioned that they disposed of their water in the Juksei river. When asked about concerns regarding water disposal in the streets, most participants indicated that they were concerned about their health and the health of their children. Further investigation revealed that several diarrheal cases in children have been linked to exposure and injection of the dirty water in the streets. When asked what could be done to alleviate the problem, participants indicated that a drain would help create a safer environment.

Waste management

Results from the survey indicated that most of the sample disposed of their solid waste daily and indicated that they disposed of the waste in the streets.

Commentary from the Constructed wetland expert.

The constructed wetland expert mentioned that the system will not be difficult to build. He was however most concerned of the uncertainty of the water disposal patterns considering that some people do their laundry at the taps and that could potentially flood the system.

Another major concern for him was that a portion of the sample indicated that they threw away their solid waste with their water. He mentioned that this could potentially clog the system and could affect its ability to function.

Lastly, this study was able to highlight the importance of obtaining context specific information for infrastructure design and how socio-economic conditions can alter behavioral patterns.

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APPENDIX A – ACCESS LETTER

Psychology

School of Human &
Community Development

University of the Witwatersrand

Private Bag 3, Wits, 2050

Tel: 011 717 4503
Fax: 086 553 4913

To whom it may concern,

My name is Boitumelo Malunga and I am currently in the process of completing my Masters degree in Organisational Psychology at the University of the Witwatersrand. As part of the degree there is research component I have to complete.For the research, we are interested in looking at patterns of water collection, usage and disposal in Alexandra.

My study will make use of an in-depth interview which will aim to establish a greater understanding of how the population collects, uses and disposes of their water. This interview will be approximately an hour long and will be recorded to ensure verbatim transcriptions. The study in question needs to be as representative as possible and generalizable as possible, thus an adequate sample size of about 20 to 30 heads of households will be needed. Ethical clearance has been ascertained to go forth with this study from the University of the Witwatersrand. The interviews will be organised at a time which suits the participants best, assuming your organisation grants the necessary access.

Non-participation in the study will result in no negative consequences for any of the participants. Similarly, no benefits will be given to those who do participate in the study. Demographic variables will be collected to help describe the sample; however no identifiable characteristics will be discussed in the write-up of the study. The research entails face-to-face interviews thus, confidentiality cannot be assured, howeverparticipants will be given pseudonyms to ensure anonymity in the reporting of results. The data will be kept in a password protected computer and only relevant stakeholders will have access to the data ensuring confidentiality is maintained. A participant information sheet will be given to all participants which will include contact details should the participants require any further information.

Your assistance in relaying this information to prospective participants would be greatly appreciated. I would also formally like to request the use of your facility to conduct the interview. Attached below is a consent form which your organisation can complete should you express interest in assisting me. This form will be collected the on our next visit. Both our contact details are provided below, should there be any elements of the above described project please do not hesitate to contact either of us.

Thank you for your time
Kind regards,

_____	_____
Miss BoitumeloMalunga	Mr Ian Siemers
Cell: +27 72 980 6930	Tell 011 717 4547
E-mail: malunga.b437@gmail.com	E-mail: ian.siemers@wits.ac.za

APPENDIX B – PARTICIPANT INFORMATION SHEET

Psychology

School of Human &
Community Development

University of the Witwatersrand

Private Bag 3, Wits, 2050

Tel: 011 717 4503
Fax: 086 553 4913

Dear Sir/Madam

My name is Boitumelo Malunga and I am currently in the process of completing my Masters degree in Organisational Psychology at the University of the Witwatersrand. As part of the degree there is research component I have to complete. For the research, we are interested in looking at patterns of water collection, usage and disposal in Alexandra.

This letter serves as a formal invitation to participate in this study. Participation in this study would involve a face to face interview of approximately one hour. All information provided will not be disclosed to others outside of this study. These interviews will be recorded using a recording device. This information will be acquired solely for the purposed of transcribing during the analysis stage. Only my supervisor, relevant stakeholders and I will have access to data and the data will be stored in a password protected computer. You may only answer the questions which you feel most comfortable answering and you may withdraw any information from the study up to the point of the conclusion of the interview without any consequence. There are no benefits or disadvantages associated with participation in the study. Demographic variables will be collected to help describe the sample; however no identifiable characteristics will be discussed in the write-up of the study. Participants will be allocated a number i.e. Participant 1 or 2. Therefore, anonymity and confidentiality of all participants and responses will be kept.

Should you have any further questions about the project before the interview process or requests regarding the results of the study, please contact me or my supervisor; details have been provided below.

Thank you for considering to take part in my research

Kind regards,

_____	_____
Miss Boitumelo Malunga	Mr Ian Siemers
Cell: +27 72 980 6930	Tel: +011 717 4547
E-mail: malunga.b437@gmail.com	E-mail: ian.siemers@wits.ac.za

APPENDIX C – CONSENT FORM (Interview)

Psychology

School of Human &
Community Development

University of the Witwatersrand

Private Bag 3, Wits, 2050

Tel: 011 717 4503
Fax: 086 553 4913

I, _____ (insert name here), consent to be interviewed by Boitumelo Malunga for the study: Water collection, usage and disposal patterns in informal settlements. I understand that my participation is voluntary, I am able to refuse response to questions that I am uncomfortable with, and I am able to withdraw from the study at any time up to the point of the completion of the interview. I understand that my identity, as well as any information disclosed will remain confidential. I understand that the write-up of my responses will allocate each participant a number i.e. Participant 1 or 2. I am aware that there are no benefits or disadvantages associated with participating in the study. I recognise that the results of this study will be reported in a research report required for the completion of a Masters degree in Industrial/Organisational Psychology. I understand that direct quotations may be used from this interview. Finally, I understand that this research may be presented at any local/international conferences and/or published in a journal or book.

Name: _____ Signature: _____

Date: _____

APPENDIX D – CONSENT FORM (Recording)

Psychology

School of Human &
Community Development

University of the Witwatersrand

Private Bag 3, Wits, 2050

Tel: 011 717 4503
Fax: 086 553 4913

I, _____ (insert name here), give consent for this interview with Boitumelo Malunga to be recorded for the study: Water collection, usage and disposal patterns in informal settlements. I understand that this recording will be confidential where only Miss Boitumelo Malunga. Mr Siemers and other relevant stakeholders will have access to the data collected. I understand that the write-up of my responses will make use of a pseudonym, for example Participant A or B, and no identifiable characteristics will be discussed. I understand that the transcripts and recordings of my interview will be stored in password protected computer.

Name: _____ Signature: _____

Date: _____

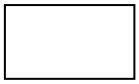
Appendix E: LANRUG SUREY SCHEDULE

Demographic Details of Participants (recorder by interviewer)

1. Gender of participant

- ☐ Male
- ☐ Female

2. Age of participant



3. Race or ethnicity of participant? (observation only)

- ☐ Black
- ☐ White
- ☐ Indian
- ☐ Coloured
- ☐ Asian
- ☐ Other (please specify) _____

4. Home language of participant.

- ☐ English
- ☐ Afrikaans
- ☐ IsiZulu
- ☐ IsiXhosa
- ☐ Sepedi
- ☐ Sesotho
- ☐ Setswana
- ☐ SiSwati
- ☐ Tshivenda
- ☐ Xitsonga
- ☐ IsiNdebele
- ☐ Other (please specify) _____

5. Highest qualification obtained.

- Grade 9 and below
- Grade 10
- Grade 11
- Grade 12
- Matric
- Higher Certificate
- Diploma
- Undergraduate Degree
- Postgraduate Degree
- Other (please specify) _____

Household descriptors

6. Number of adults in the household

a. Age of each adult in household (excluding the participant)

b. how many of the adults are employed?

Make note of the description of the participant's household

7. Number of children in the household

a. Age of each child in household

8. Number of years living in current location

Structured interview schedule

A. Acquisition of Water (sources of water and collection)

Primary Water Source

1.) Where do you obtain most of your water? – Can you identify this point on the map provided (mark with an X1)

Sources of Water	Mentioned by participant (✓)
River	
Communal Tap	
Rain Water Collection	
Neighbour/s (with cost)	
Neighbour/s (without cost)	
Petrol Station	
Community Centre	
Church	
Public Space	
Purchased bottled water	
Other (please specify)	

1.1) Why do you choose this particular water source?

Reason	Mentioned by participant (✓)
Only source available	
Distance	
Availability (volume) of water at source	
Reliability of water at source	
Price/cost	
Quality	
Other (please specify)	

1.2) How far is the water source from your house? (rough estimate from participant)

Distance	Mentioned by participant (✓)
Inside or just outside the dwelling,	
A few dwellings away,	
A short distance away (i.e. more than a few dwellings),	
A long distance away	

Take note if participant mentions time instead of distance

1.3) Are there times were you find no water at this water source? If yes, how often does this happen?

Water always available	Water mostly available	Water sometimes not available	Water often not available	Water is more often not

				available than it is available

Secondary Water Sources

2.) Are there any other sources of water that you use?

Sources of Water	Mentioned by participant (✓)
River	
Communal Tap	
Rain Water Collection	
Neighbour/s (with cost)	
Neighbour/s (without cost)	
Petrol Station	
Community Centre	
Church	
Public Space	
Purchased bottled water	
Other (please specify)	

2.1) Why do you choose this particular water source?

Reason	Mentioned by participant (✓)
Only source available	
Distance	
Availability (volume) of water at source	
Reliability of water at source	
Price/cost	
Quality	
Other (please specify)	

2.2) How far is the water source from your house?

Take note if participant mentions time instead of distance

2.3) Are there times were you find no water at this water source? If yes, how often does this happen?

Water always available	Water mostly available	Water sometimes not available	Water often not available	Water is more often not available than it is available

Collection of Water

3.) How do you transport water from the source to your household?
3.1) How many containers do you transport at a time?

Options	Mentioned by participant (✓)	Number of containers transported
Transported by individuals		
Transported in a wheelbarrow		
Transported in a vehicle		
Other (please specify)		

4.) What kind of container do you use to collect the water from the water source to your house? (Ask them to show you, and take a picture of the container(s) if it is appropriate)
   4.1) How many containers do you use?
   4.2) Why do you use this container?

Options	Mentioned by participant (✓)	Number of containers used	Reason given for use
2l bottle			
5l bottle			
10l bottle			
bucket			
Other (please specify)			

5.) How often do you collect water?

Options	Mentioned by participant (✓)
Once a day	
Twice a day	

Once every two days	
Once a week	
Only when needed	
Other (please specify)	

6.) Does the time of day impact how you collect water and how much water you collect? If yes, how so?

7.) Does the day of the week impact how you collect water and how much water you collect? If yes, how so?

8.) Does the season of year impact how you collect water and how much water you collect? If yes, how so?

9.) Who is responsible for collecting water in the household?

B. Storage of Water

1.) Where do you store your water after it has been collected?

2.) How long do you store water for before it is used?

C. Usage of Water

1.) Do you clean/purify water before using it? If so, how?

Options	Mentioned by participant (✓)
No cleaning processes used	
Treated with light	
Boiled before use	
Cleaned with chemicals	
Other	

2.) What do you use most of your water for?

Options	Mentioned by participant (✓)	Rank	Detergents, soaps or other chemicals used dually with water
Cooking			
cleaning purposes			
drinking			
Laundry			
Bathing			
gardening			

Water for animals			
Other			

3.) What is the first thing you do with water once you've collected it (excluding purification)?

4.) Do you use the same water for multiple purposes? If yes, how so?

5.) Is there a pattern (regularly repeated process) to how you use water?

D. Disposal of water

1.) When is water thrown away?
2.)

Options	Mentioned by participant (✓)
After each use	
After several house hold chores	
In the Morning after it was used for night-soil	
Other (please specify)	

3.) Where do you discard of water once it has been used?– Can you identify this point on the map provided (mark with an O

Options	Mentioned by participant (✓)
Into toilets (if available)	
Into drainage (if available)	
In front of the house	
In the street	
Into storm water drains	
Into open man-holes	
Used for watering plants	
Other (please specify)	

4.) How far do you walk to throw away water?

5.) Does the time of day impact how you dispose of water? If yes, how so?

6.) Does the season of year impact how you dispose of water? If yes, how so?

E. Problems and opportunities for better disposal

1.) What is your biggest challenge with water disposal at the moment?

Options	Mentioned by participant (✓)
distance	
Safety around the site	
Health concerns with standing water around	
Other (please specify)	

2.) Do you think the water that is thrown away causes problems for you or for your community? If yes what problems?

3.) What do you think would make disposal easier or better?

4.) If there were a small system installed where you could dispose of water at certain points, and it was treated by a 'natural area' where there were flowers you could harvest is that something you might want to use and sell?

5. Solid waste management at disposal point
    a) Where do you dispose of the solid waste caught in a disposal point?

b) How often do you dispose of it?

F. Solid Waste management

1.) Food waste

a) Where do you dispose of your food waste?

Options	Mentioned by participant (✓)
In a garbage bin	
In the streets	
At a close by land fill	
Central garbage container	
Throw away with my water	
Other (please specify)	

b.) How often do you dispose of your household waste?

Every day	Every other day	Once a week	Notes (time of day)

2.) Other household waste (plastic, papers, other garbage)

a.) Where do you dispose of your other waste?

Options	Mentioned by participant (✓)
In a garbage bin	
In the streets	

At a close by landfill	
Central garbage container	
Other (please specify)	

b.) How often do you dispose of your other household waste?

Every day	Every other day	Once a week	Notes (time of day)

G) LANGRUG ONLY- ***these will be asked in after D***

1.) Have you ever used one of the wetland disposal points to dispose of your water?

Options	Mentioned by participant (✓)
Yes	
No	

1.) If yes why, If no why not?
Open ended question

3.) If yes has your use of these disposal points changed over time?

Options	Mentioned by participant (✓)
Increased over time	
Decreased over time	
Stopped using	
Other (please specify)	

2.) If yes why?

3.) Do you use the land in and around the wetland, the tree wells, or the disposal points for other things? If yes what (e.g., food production including fruit trees, flowers, storage of building materials….. etc)

4.) Is there something that would make using the wetland, tree wells, or disposal points better? If so what?

Appendix F- REVISED ALEXANDRA SURVEY

SCHEDULE

Demographic Details of Participants (recorded by interviewer)

1. Gender of participant (observation by the interviewer only)

- ☐ Male
- ☐ Female

2. Age of participant

3. Race or ethnicity of participant? (observationby the interviewer only)

- ☐ Black
- ☐ White
- ☐ Indian
- ☐ Coloured
- ☐ Asian
- ☐ Other (please specify) _____

4. Home language of participant.

- ☐ English
- ☐ Afrikaans
- ☐ IsiZulu
- ☐ IsiXhosa
- ☐ Sepedi
- ☐ Sesotho
- ☐ Setswana
- ☐ SiSwati
- ☐ Tshivenda
- ☐ Xitsonga
- ☐ IsiNdebele
- ☐ Other (please specify) _____

5. Highest qualification obtained.

- Grade 9 and below
- Grade 10
- Grade 11
- Grade 12
- Higher Certificate
- Diploma
- Undergraduate Degree
- Postgraduate Degree
- Other (please specify) _____

Household descriptors

6. Number of adults in the household (in Alexandra , excluding you)

c. Age of each adult in household (excluding the participant)

d. how many of the adults are employed

7. Number of children in the household

b. Age of each child in household

8. Number of years living in current location

Structured interview schedule

G. Acquisition of Water (sources of water and collection)

Water Source

10.) Where do you get most of your water? – Can you point to this on the map provided (mark with an X1)

Sources of Water	Mentioned by participant (✓)	**Secondary Sources of Water**	Mentioned by participant (✓)
River		River	
Communal Tap		Communal Tap	
Rain Water Collection		Rain Water Collection	
Neighbour/s (with cost)		Neighbour/s (with cost)	
Neighbour/s (without cost)		Neighbour/s (without cost)	
Petrol Station		Petrol Station	
Community Centre		Community Centre	
Church		Church	
Public Space		Public Space	
Purchased bottled water		Purchased bottled water	
Other (please specify)		Other (please specify)	

1.1a) Why do you choose this particular water source?

Reason (primary source)	Mentioned by participant (✓)	**Reason (secondary source)**	Mentioned by participant (✓)
Only source available		Only source available	
Distance		Distance	

Availability (volume) of water at source		Availability (volume) of water at source	
Reliability of water at source		Reliability of water at source	
Price/cost		Price/cost	
Quality		Quality	
Other (please specify)		Other (please specify)	

1.4) How far is the water source from your house? (rough estimate from participant)

Distance (primary source)	Mentioned by participant (✓)	Distance (secondary source)	Mentioned by participant (✓)
Inside or just outside the dwelling,		Inside or just outside the dwelling,	
A few dwellings away,		A few dwellings away,	
A short distance away (i.e. more than a few dwellings),		A short distance away (i.e. more than a few dwellings),	
A long distance away		A long distance away	

Take note if participant mentions time instead of distance

1.5) Are there times were you find no water at this water source? If yes, how often does this happen? (circle the appropriate answer)

Primary source

Water always available	Water mostly available	Water sometimes not available	Water often not available	Water is more often not available than it is available

Secondary source

Water always available	Water mostly available	Water sometimes not available	Water often not available	Water is more often not available than it is available

Collection of Water

11.) How do you transport water from the source to your household?

Options	Mentioned by participant (✓)	Number of containers transported
Transported by individuals (such as carrying by hand)		
Transported in a wheelbarrow		
Transported in a vehicle		
Other (please specify)		

12.) What kind of container do you use to collect the water from the water source to your house?

3.1) How many containers do you use each time?

3.2) Why do you use this container?

Options	Mentioned by participant (✓)	Number of containers used	Reason given for use
5l bottle			
20l bucket			
10l bucket			
Other (please specify)			

13.) How often do you collect water?

Options	Mentioned by participant (✓)
Once a day	
Twice a day	
Once every two days	
Once a week	
Only when needed	
Other (please specify)	

14.) Can yo collect water water at during the day and at night?

15.) Do you collect the same amount of water throughout the week or does the amount you collect change during the weekend?

16.) Do you collect the same amount of water in summer and in winter or does the amount of water collected change as the seasons change?

17.) Who collects the water in the household?

H. Storage of Water

3.) Where do you store your water after it has been collected?

4.) How long does your water last before you have to refill your water bucket?

I. Usage of Water

6.) Do you clean/purify water before using it? If so, how?

Options	Mentioned by participant (✓)
No cleaning processes used	
Treated with light	
Boiled before use	
Cleaned with chemicals	
Other	

7.) What do you use most of your water for?

Options	Mentioned by participant (✓)	Rank/Order of importance	Detergents, soaps or other chemicals used with this task (Yes/No) or type
cooking			

cleaning purposes			
drinking			
laundry			
bathing			
gardening			
Water for animals			
To clean chimba bucket			
other			

8.) What is the first thing you do with water once you've collected it (excluding purification)?

9.) Do you use the same water for multiple purposes? Example do you use your bathing water to water your plants or do you use your dishwashing water to wash your floors?

J. Disposal of water

7.) When do you throw away your water?

Options	Mentioned by participant (✓)

After each use	
After several house hold chores	
In the Morning after it was used for cleaning night-soil	
Other (please specify)	

8.) Where do you throw away your water once it has been used?– Can you identify this point on the map provided (mark with an O)?

Options	Mentioned by participant (✓)
Into toilets (if available)	
Into drainage (if available)	
In front of the house	
In the street	
Into storm water drains	
Used for watering plants	
Other (please specify)	

9.) How far do you walk to throw away water?

10.) Can you throw away your water at any time of the time of the day?
[For example, do you throw away water in the same place at night?]

11.) Does the season of year impact how you dispose of water? If yes, how so?
[For example, in Winter when it is cold, or in Summer when it is raining outside?]

K. Problems and opportunities for better disposal

5.) What is your biggest challenge with water disposal at the moment?

Options	Mentioned by participant (✓)
Distance	
Safety around the site	
Health concerns with standing water around	
Other (please specify)	

6.) Do you think the water that is thrown away causes problems for you or for your community? If yes what problems? [For example, it smells, it makes people sick, fills the streets with water and makes it difficult to walk]

Options	Mentioned by participant (✓)
It smells	
It makes people sick	
Fthe streets with water and makes it difficult to walk]	
Other	

7.) What do you think would make water disposal easier or better?

Options	Mentioned by participant (✓)
Drain systems	
Other	

L. Waste management

b) Where do you throw away your garbage?

Options	Mentioned by participant (✓)
In a garbage bin	
In the streets	
At a close by land fill	
Central garbage container	
Throw away with my water	
Other (please specify)	

b.) How often do you throw away your garbage?

Every day	Every other day	Once a week	Notes (time of day)

Does the garbage ever clog up the water disposal?

Appendix G- QUALITATIVE INTERVIEW SCHEDULE

Interview schedule

Water shortages

1. How often do you have water shortages?
    a. How long do the shortages last for?

Water collection

2. The results show that most people get their water from the communal taps
    a. When do you collect your water every day and why do you choose to collect water at that time?
    b. Are there always people collecting water at the communal tap?
        i. If yes what do you do when the tap is busy?
    c. The results show that people are afraid to collect water at night because of the crime, do you share this view?
        i. What kinds of crimes commonly occur in your area that makes you scared to collect water at night?
        ii. What do you do when you need water at night?

Daily, weekly and seasonal peaks

3. Many people said that they usually bath with the water first once the water is collected
    a. How many liters does each person use to bath?
    b. When does everyone in the house usually bath and why
4. Many people said that they used a lot of water to do laundry,
    a. how many buckets of water do you use for doing your laundry,
    b. where do you do your laundry and why
    c. when do you do your laundry and why
5. The results from the survey show that most people collect more water in summer is this the same for you and why do you collect more water in summer.

Health concerns

6. The results from the survey indicated that most people are worried about the water streaming in the streets and how this could be dangerous for the community.
    a. Do you share this worry and why
    b. Probing questions
        i. Have you or any family members ever gotten sick from the dirty water in the streets?
        ii. What was wrong with them ?

Expert interview schedule

1. The results indicate that most of the residents use most of their water for laundry and bathing, how could this affect the constructed wetland?
2. The survey results indicated that that the mean water consumption for each household is 394L per week with a maximum of 1400L per week. How could this estimated volume affect the wetland?
3. It seems as though most of the people dispose of their water after each use, will the wetland be able to withstand the continuous flow of water and why?
4. Majority of the sample indicated that they use water to clean out the Chimba bucket which alludes to the possibility of human excreta entering the system could this be a potential threat to the system and why?

Appendix H- QUALITATIVE ANALYSIS AUDIT TRAIL

Interview 1

Interviewers: Boitumelo Malunga

Time: 09:00

Date: 13 November 2019

Duration: 25 minutes

Legend

Theme 1. Theme 2 Theme 3 Theme 4 Theme 5 Theme 6 Theme 7

Water shortages

1. How often do you have water shortages?
    a. How long do the shortages last for?

We usually don't have water shortages in Setswetla, but when we do it is usually because the dams are running dry. Last month the government informed us of a scheduled water shedding program. There was not water from 9am to 2pm every day. But other than that we usually don't have any water cuts.

Water collection

2. The results show that most people get their water from the communal taps
    a. When do you collect your water every day and why do you choose to collect water at that time?

I usually collect my 3 buckets of water early in the morning before 7am, this is because there is usually commotion at the taps, the women come with huge bath tubs and buckets and they do their laundry at the tap and other people who need to get water to get ready for work.

    b. Are there always people collecting water at the communal tap?
        i. If yes what do you do when the tap is busy?

Yes the taps are always busy even if you go there now it is busy. Well I usually get there and I stand in line and wait my turn. We all live together and respect each other so if I am late I usually just ask the people if I can cut in line to get some water because if am late.

    c. The results show that people are afraid to collect water at night because of the crime, do you share this view?

Yes, I prefer to get water early in the morning. I fill my 3 buckets for the day, which lasts us. But if it so happens that the water run out I usually go before it gets too dark.

i. What kinds of crimes commonly occur in your area that makes you scared to collect water at night?

Although I haven't experienced the crimes myself, because I am a council member, people usually come to me with complaints or we hear people complaining about being attacked at the tap or when they are just walking around at night. Most people report of being held at either knife or gun point by the criminals and they usually request for phones and money. There is a new wave of crime in the streets where criminals attach people at night and demand for their IDs. In most cases the criminal are people from Mozambique who are here illegally and need South African documentation to get social services.

ii. What do you do when you need water at night?

I usually make sure that I do not run out of water buy filling all the buckets in the morning before I leave for work so I hardly need to go back at night because I always have stand by water

Daily, weekly and seasonal peaks

3. Many people said that they usually bath with the water first once the water is collected
   a. How many liters does each person use to bath?

      Me and my daughter share a 25l bucket of water every morning when we bath

   b. When does everyone in the house usually bath and why

      Me and my daughter both bath in the morning, the reason for her is because she has to get ready for school in the mornings and I wash in the morning because I work as a council member, which means I am always needed in the community. So every morning I wake up and bath because I know there will always be work for me to do.

4. Many people said that they used a lot of water to do laundry,
   a. how many buckets of water do you use for doing your laundry,

      My daughter and I use about 3 to 6 buckets to do laundry. This is because the load varies from week to week.

   b. where do you do your laundry and why

      We do our laundry in the yard. I help my daughter collect the buckets from the communal tap and she fill the bath tubs to wash and rinse the cloths. We choose to do it at the house because there is always commotion at the tap and not enough space for everyone to do the laundry there. Also it's easier to discard the water into the storm water drain which is close by.

   c. when do you do your laundry and why

We always do our laundry every Saturday. This is because I don't work on Saturdays and my daughter is at home so we can do the laundry

5. The results from the survey show that most people collect more water in summer is this the same for you and why do you collect more water in summer.

   Yes it is the same for me. We drink a lot more water in the summer and we also bath more than once, because I am active in the community and always on my feet when I get home I feel very sweaty so I take a bath to keep clean and to cool off.

Health concerns

6. The results from the survey indicated that most people are worried about the water streaming in the streets and how this could be dangerous for the community.
   a. Do you share this worry and why

      Yes I do. The water is very dirty in the streets and the people I am mostly worried about is the children. They play in the water and they take what they play with to the mouth. We also have situations where the children play in the Juksei River which is very dirty and they can get sick from that. As the council we try by all means to encourage the parents to take the children to crèche so that the children do not roam the streets. We also encourage the parents to take children to parks around the settlements during the weekend so that they do not end up playing with the dirty water in the streets.

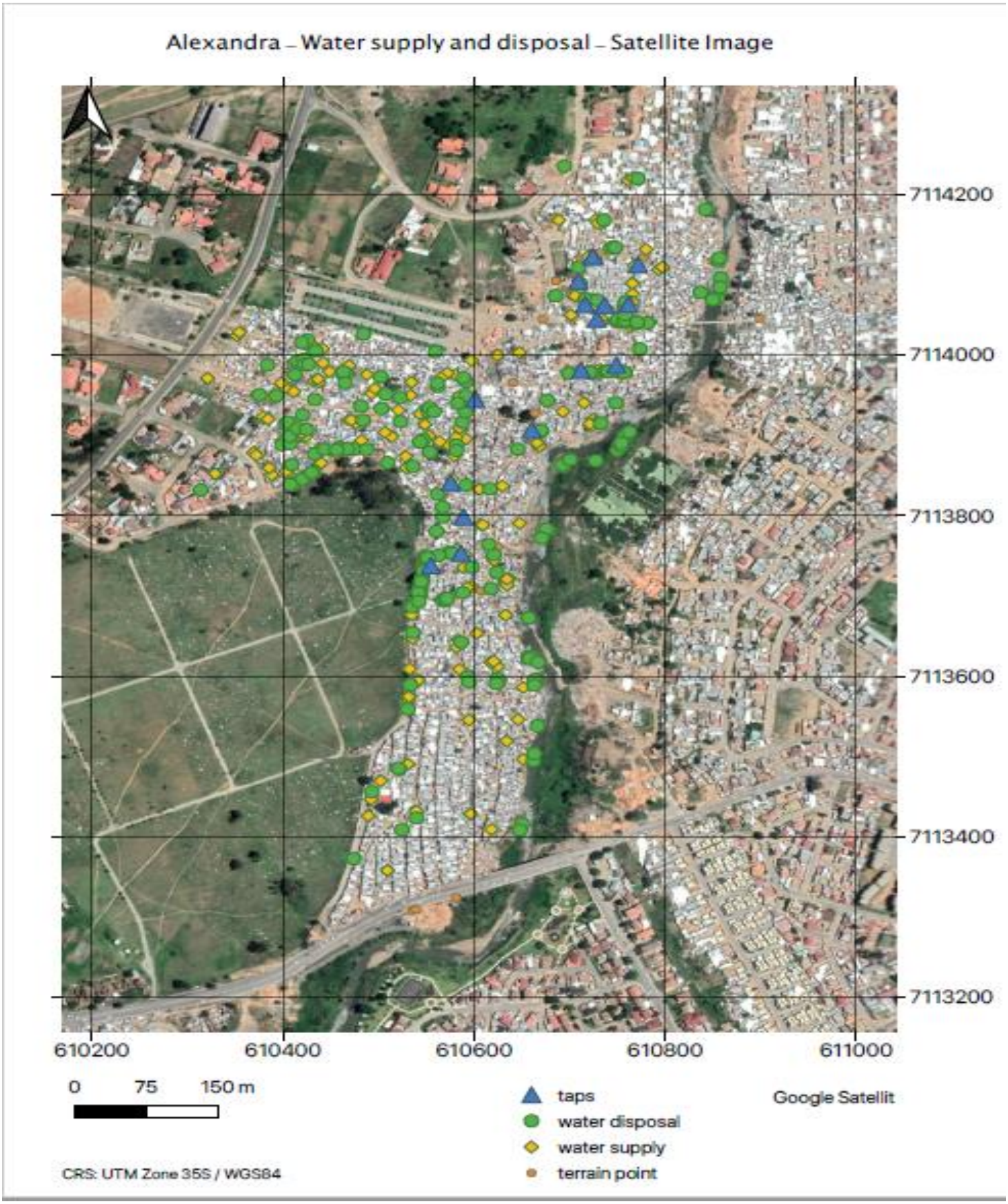
   b. Probing questions
      i. Have you or any family members ever gotten sick from the dirty water in the streets?

         I have not gotten sick from the water, but being a council member we always hear about children who get sick and when they get taken to the doctors they say that it is because of the water.

      ii. What was wrong with them?

         Most of the children get diarrhea, some moths back we had a case where a child died because they ingested dirty water. The doctors attributed the sickness to the dirty water or rather the bacteria in the water.

APPENDIX I- SETSWETLA MAP



APPENDIX J- ETHICAL CLEARANCE

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE (SCHOOL OF HUMAN & COMMUNITY DEVELOPMENT

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: MORG/19/008 IH**
PROJECT TITLE:	Water use and disposal patterns in an informal settlement
INVESTIGATORS	Malunga Boitumelo
DEPARTMENT	Psychology
DATE CONSIDERED	01/07/19
DECISION OF COMMITTEE*	Approved

This ethical clearance is valid for 2 years and may be renewed upon application

DATE: 01 July 2019

CHAIRPERSON
(Dr Colleen Bernstein)

cc Supervisor: Prof. Andrew Thatcher & Mr Ian Siemers
Psychology

DECLARATION OF INVESTIGATOR (S)

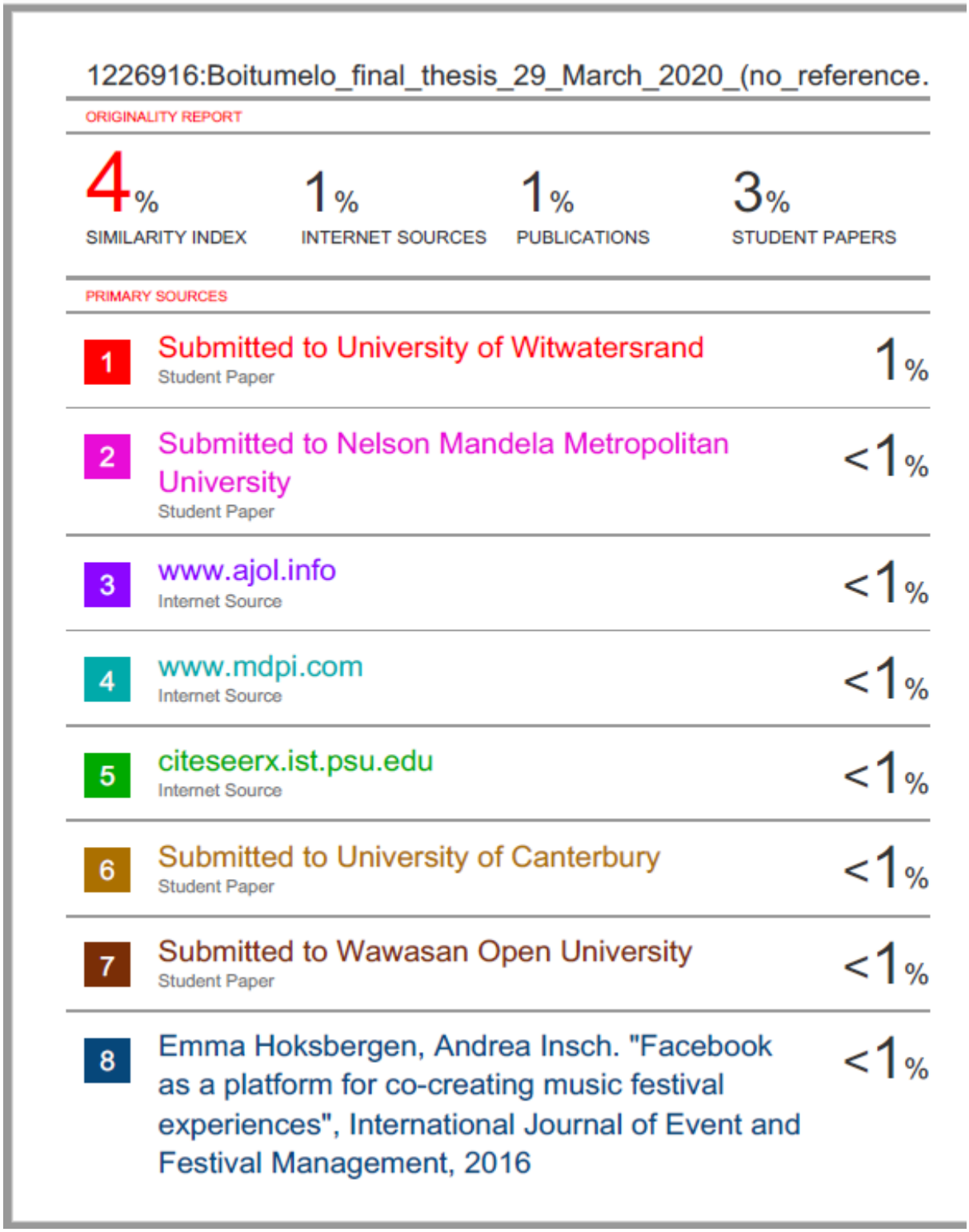
To be completed in duplicate and **one copy** returned to the Secretary, Room 100015, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure be contemplated from the research procedure, as approved, I/we undertake to submit a revised protocol to the Committee.

This ethical clearance will expire on 31 December 2021

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX K- TURN-IT-IN REPORT



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