Adoption of constructed wetlands in informal settlements

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Declaration

"I Hemal Jetha 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: ______________________________

Date: 15/03/2023

Abstract

The study aimed to assess the effectiveness of constructed wetlands as a solution to greywater treatment in the context of water use in Setswetla, Alexandra, an informal settlement in Johannesburg that is characterized by makeshift housing, poor sanitation, and a lack of proper greywater treatment facilities. The lack of such facilities has resulted in the disposal of contaminated greywater across the settlement, which poses serious health risks to its people. The installation of constructed wetlands was considered a feasible solution, given that they can be built without displacing the population. However, the successful implementation of this solution would require a change in the behaviour of the population regarding greywater disposal. Therefore, this study aimed to evaluate the adoption of constructed wetlands which were installed in one portion of Setswetla, Silvertown to gain a better understanding of whether installing constructed wetlands helps with greywater disposal. The study also sought to determine if there was any difference in water use behaviour before and after the installation of the constructed wetlands. The research revealed that there was not much behaviour change pre- and post-installation of the constructed wetlands. Some of the significant differences found was that more people reported that they do collect the same amount of water during both summer and winter. More participants indicated that they do not collect the same amount of water during the week and weekend. Less participants reported that they could collect water during the day and night.

Key words: Constructed wetlands, greywater, water disposal, informal settlement, water collection, water usage, water storage

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Chapter 1 – Introduction

1.1 Rationale

Informal settlements have become a common problem in developing countries. Households in informal settlements often do not have access to proper water sanitisation facilities (Nassar & Elsayed, 2018). These households are constantly exposed to polluted water. Contaminated wastewater that is not disposed of in a sanitary way poses a risk to the lives of people living in informal settlements and to the environment (Malunga, 2020). Many children play in the wastewater disposed of in the streets and as a result, get sick and at times and might even die from the diseases in the wastewater. When there is heavy rainfall within the informal settlements, the stagnant diseased wastewater flows into rivers and stormwater drains which results in broader environmental problems (Nassar & Elsayed, 2018). When the residents in the informal settlements were asked about what could be improved regarding wastewater disposal, many of them had stated that proper drainage and sanitation of water should be provided (Mofokeng, 2008). Water sanitation systems are important in creating a sustainable living environment.

Wastewater that comes from household activities such as bathing, cleaning, laundry, and washing dishes is called greywater (Mofokeng, 2008). Often greywater is thrown in the streets because there are no proper drain systems in place. The greywater that is thrown in the streets often streams into a nearby river or stormwater drain (Mofokeng, 2008). The untreated water contaminates these rivers and stormwater drains. Before water reaches a river or stormwater drain it should be treated to remove solid waste and contaminants. Thus, informal settlements need to have some sort of greywater treatment system to dispose of their greywater. This will help ensure a sustainable future. In Setswetla many households disposed of their greywater in the streets (Malunga, 2020). This results in stagnant diseased water that not only poses a health and environmental risk but also creates a bad odour within the settlement (Malunga, 2020).

The reason people in Setswetla and other informal settlements dispose of their greywater in the streets is because there is little to no infrastructure provided by the State (Nassar & Elsayed, 2018). This is because the houses in informal settlements are often built illegally and on land that was not provisioned for housing, thus proper drainage systems (and other services) were not built (Nassar & Elsayed, 2018). It has been argued that solutions to sanitation systems in informal settlements need to be low-cost and should require little maintenance (Armitage et al., 2009). This is so that the systems suit the socio-economic status of households and the environmental conditions found in informal settlements. Some solutions which have been previously proposed to treat greywater have been crate soakaways, constructed open drainage channels, irrigating flowerbeds, and constructed wetlands (Armitage et al., 2009).

There is not much comprehensive academic research done regarding greywater treatment in informal settlements. This study aims to fill this gap by determining what factors influence greywater disposal behaviours in informal settlements. The implementation of water disposal treatment systems in informal settlements requires a multidisciplinary team (Thatcher et al., 2022). This may be a reason for the lack of comprehensive research done within the field. This study is a part of a broader study conducted over the past three years. The research team involved in this study were from a variety of disciplines. Therefore, this study along with previous studies done in Setswetla, Alexandra (Malunga, 2020), concerning water use and constructed wetlands contributes to the gap in comprehensive research. This study looked at the use of constructed wetlands within the context of water usage in informal settlements. This study extends on Armitage et al. (2009) work by introducing constructed wetlands to a small portion of an informal settlement and determining if that small portion made any change in the informal settlement water usage behaviour.

This study looks at constructed wetlands as a solution to greywater treatment in informal settlements. Three horizontal subsurface constructed wetlands were installed in the Silvertown portion of Setswetla, Alexandra. This study aims to evaluate if the constructed wetlands have been successful in this portion of Setswetla.

1.2 Aims of the study

This research aims to assess the adoption of constructed wetlands by the Silvertown portion of Setswetla, Alexandra informal settlement. The adoption of the constructed wetlands can be assessed by the change in greywater disposal behaviour. In addition to assessing the adoption of the constructed wetlands, this research aims to evaluate the factors influencing the behaviour change.

Chapter 2 – Literature review

Change in water disposal behaviour is an important factor when considering the success of constructed wetlands in urban informal settlements. Water disposal behaviour and greywater treatment and reuse have been widely researched in urban and rural areas. The little research that is available in the context of urban informal settlements in South Africa does indicate that there is a significant demand for change in water disposal behaviour and greywater treatment systems (Armitage et al., 2009, Malunga, 2020). This demand is due to the inadequate, or lack of, safe and hygienic water disposal systems in informal settlements in South Africa. The difference between water disposal treatment systems in urban/rural areas and informal settlements is partly due to informal settlements illegally occupying the land on which they are built, thus they have limited or no access to basic sewage and water disposal systems. This section will define informal settlements and describe the state of water use behaviour in informal settlements and specifically in Setswetla, Alexandra. The Theory of Planned Behaviour will be used as the theoretical framework to understand water disposal behaviour change.

2.1 Urban informal settlements

Urban informal settlements are a common problem around the world, especially in Global South countries (Nassar & Elsayed, 2018). Informal settlements can be defined as residential areas which are illegally occupying land or housing that is not compliant with planning or building regulations set out by the government. These areas are often posed with challenges such as lack of infrastructure, health and safety, and other socio-economic issues (Okurut et al., 2015). The houses built in these areas are either self-constructed or residents pay other people to build or help them build and may be single/multi-story buildings or shacks. The condition of these buildings or shacks might be good and stable but they may be built on environmentally or socially unsafe land that lacks basic services such as sewage and water disposal systems (Nassar & Elsayed, 2018).

This study will focus on the area of Setswetla, Alexandra which has the same conditions described above. Setswetla, Alexandra is known as an overcrowded informal settlement in Johannesburg that has rapidly grown. Before illegal occupants started to build on and occupy the land of this site, it was an Indian suburb known as Marlboro Gardens.

2.2 Alexandra

Alexandra is a group of suburbs located just 4 km East of Sandton. This area began as a white suburb in the early 1900s and later became a township populated by black people in search of employment (Wilson, 2003). The 1913 land act prohibited black people from buying or owning land. Setswetla to the North of Alexandra, is one of the many informal settlements in South Africa. Informal settlements arose due to the influx of people in urban areas looking for work and the lack of formal infrastructure. This resulted in the uprise of informal housing to accommodate for the influx of people relocating to urban areas. Whatever efforts were made by the government in urban planning were inferior (Wilson, 2003).

The estimated population of Alexandra in 2014 was 500 000. This area was originally designed for 70 000 people (Mbanjwa, 2018). This helps to picture how overcrowded Alexandra is. Parts of the Alexandra Township are located on the banks of the Jukskei River. This results in environmental challenges in the area (Mbanjwa, 2018). The lack of planning by the State has resulted in the area not having drainage infrastructure which has resulted in streams of greywater across the township (Malunga, 2020).

2.3 Greywater

Greywater can be defined as the wastewater which is left behind after household processes. These processes include bathing, washing dishes, laundry, and cleaning (Mofokeng, 2008). Greywater excludes water from the toilet, this water is called blackwater (Mofokeng, 2008). In many informal settlements, there are no provisions for the hygienic disposal of greywater. Many people in these settlements dispose of their greywater in the streets or into stormwater drains. This water is stagnant on the streets with nowhere to go (Armitage et al., 2009). Due to the still water in the streets mosquitoes are attracted and the area starts to smell. Apart from this, children fall sick due to diseases in the water (Carden et al., 2008). Hygienic disposal of greywater is required to achieve a healthy living environment (Okurut et al., 2015).

2.4 Constructed wetlands

An option explored by the larger project team to treat greywater in informal settlements is to build constructed wetlands (Thatcher et al., 2022). A constructed wetland can be described as a system that combines rainwater, water harvesting, and greywater treatment. The greywater put into the constructed wetland is filtered through a gravel bed as well as a variety of plants and microorganisms. The water is filtered through the gravel and the greywater offers nutrients to the plants. This allows for the removal of contaminants from the greywater (Lutterbeck et al., 2017).

In addition to removing contaminants from the greywater, constructed wetlands can help to avoid damage to buildings from waterlogging, odours from the water, and a breeding site for mosquitoes and diseases (Mofokeng, 2008). Constructed wetlands are suitable for informal settlements because they do not require a lot of skill to use, do not need a lot of space, and are not costly to maintain (Malunga, 2020). A greywater treatment system was the proposed solution to the water disposal problem in Setswetla, Alexandra.

2.4.1 Constructed wetlands in Alexandra

To address the wastewater infrastructure problem in Alexandra, a multidisciplinary team worked together to build constructed wetlands in the Silvertown portion of Setswetla. This team included people from the psychology, natural resource science and sustainability, ecology, engineering, and microbiology disciplines (Thatcher et al., 2022). Residents from the informal settlement were also involved in the construction and design of the constructed wetlands (Thatcher et al., 2022). Residents who were selected by the community based on their skills and availability were involved in building the constructed wetlands. This, along with sourcing the materials from within the settlement, helped to keep the costs down (Thatcher et al., 2022).

After a year of interviews with relevant stakeholders, a survey on water and wastewater behaviours among residents was conducted in 2019 (Malunga, 2020), and six participatory workshops, two horizontal subsurface constructed wetlands were installed in Setswetla in February 2020 (Thatcher et al., 2022). After these two constructed wetlands were installed, the residents and research team worked together to redesign the wetlands and install a second phase in 2021 (Thatcher et al., 2022). In total, 74 hours of ethnographic observations, 40 informal unstructured interviews, and 3 days of activity analysis observations were used in the redesign. The constructed wetlands were built close to a communal tap with an informal washing area next to it (Thatcher et al., 2022).

In 2019, Malunga (2020) collected survey data that looked at the water consumption behaviour of residents across Setswetla to help the team determine how water is collected, used, and disposed within this informal settlement. Water use patterns were crucial for the design of the constructed wetland. Water use patterns were needed to identify the correct capacity of the wetland. The chemicals used for household cleaning were also of importance because the system had to be robust enough to handle the composition of the greywater (Malunga, 2020).

2.5 Water use behaviour

The end use of water is crucial in understanding the success and functioning of the constructed wetlands in Setswetla, Alexandra. This is because the chemicals in the greywater and amount of water affects the size and materials needed for the constructed wetland. For the purpose of this research report, water use behaviours were split into three categories. Water acquisition behaviour, water usage behaviour, and water disposal behaviour, with the main one for the constructed wetlands being water disposal. Water acquisition and usage will be briefly discussed with the focus being on water disposal behaviour.

2.6 Water acquisition behaviour

For this study, water acquisition is the source, collection, and storage of water. Many households in informal settlements rely on boreholes, wells, rivers, rainwater, and communal taps as their primary source of water (Adams, 2018; Armitage et al., 2009; Reyneke et al., 2018). Households within the Setswetla informal settlement rely on communal taps as their primary source of water (Malunga, 2020).

Enkanini, Langrug, Waterworks, Harry Gwala, Gugulethu, Mkhana, and Soul City are informal settlements in South Africa. Studies have reported that the primary water source for these informal settlements is communal taps and illegal connections to the communal taps. (Armitage et al., 2009; Malunga, 2020; Mofokeng, 2008; Reyneke et al., 2018). In Setswetla, 93% of people had reported that their primary source of water was from a communal tap and some households had illegal connections to the communal tap which they used for their washing machine (Malunga, 2020).

Water in informal settlements is mostly collected using buckets, from the communal tap (Mofokeng, 2008; Nassar & Elsayed, 2018). The exception to this is households with illegal connections to the communal taps directly into their homes. Mofokeng (2008) found that 20-liter buckets were preferred because participants found them easy to carry and they collected enough water for the household. Similar findings were found in Alexandra (Malunga, 2020).

The buckets used in the Alexandra informal settlement varied in size from 5l to 25l. in Malunga (2020), 82% of participants from the Alexandra water use study had reported using 20l buckets. This was followed by 6.6% who used 10l buckets (Malunga, 2020). Most of the participants (75%) in the study reported that their primary source of water was inside, just outside, or only a few dwellings away. This indicates that water collection did not require residents to travel very far (Malunga, 2020).

Once water is collected, it is generally stored in buckets inside the dwelling. Malunga (2020) reported that 93.4% of participants had stored their water in buckets inside their homes. The time the water was stored varied with most (54.6%) of the participants indicating that they stored their water for 1 day and 15.3% of participants indicated that they stored their water for 2 days (Malunga, 2020). This water could last from half a day to two days depending on the usage.

2.7 Water usage behaviour

Water is commonly used in informal settlements for cooking, cleaning, and washing clothes. Water use behaviour is context-specific, and changes based on socio-economic factors (Dawson & Scott, 2019). Water usage in urban areas differs from informal settlements as people in informal settlements have less access to water. Even between informal settlements water usage differs. Gugulethu residents on average use 55l/day whereas Mkhana residents use an average of 36l/day (Mofokeng, 2008). This shows that water use behaviour is very context-specific. Malunga (2020) reported that the average water consumption for a week in each household in the Setswetla informal settlement ranged from 70 litres to 1400 litres. The majority of the participants indicated that they use their water for cooking, cleaning, drinking, laundry, bathing, and cleaning the chimba bucket (Malunga, 2020). A chimba bucket is a bucket used mostly by women and children as a toilet at night when it is considered too dangerous to walk to communal toilets.

2.8 Water disposal behaviour

As noted earlier, informal settlements do not have access to proper wastewater systems. These settlements are often characterized by improper drainage systems which make it difficult for residents to dispose of their greywater. Although not many studies have looked at wastewater/greywater disposal in informal settlements, a common theme that seems present within the few studies seems to be convenience. This is indicated by individuals disposing of the greywater in their yards, streets, dug-out trenches, agricultural land, stormwater drains, and rivers (Armitage et al., 2009; Mofokeng, 2008; Nassar & Elsayed, 2018).

Residents of these informal settlements disposed of the water in the most convenient way even though it resulted in odour and stagnant, diseased water in their communities. Even in cases where the wastewater is disposed of in stormwater channels or streams that run through the informal settlement into the river, the wastewater often contains harmful contaminants from detergents, soaps, and chemicals used with the water that should be removed before the water is disposed of (Okurut et al., 2015). Mofokeng (2008) found that people in three of the informal settlements in their study believed that greywater should be discarded due to witchcraft. They believed that if they were to stand in someone else's bathwater they may inherit that person's bad luck.

Since Malunga's (2020) survey in 2019, three constructed wetlands have been installed in an area in Setswetla known by the local residents as 'Silvertown'. The current study aims to examine if anything about the water disposal behaviour in the Setswetla informal settlement has changed since 2019. This leads to the next section which will discuss the Theory of Planned Behaviour and water disposal attitudes, subjective norms, and perceptions of behavioural control.

2.9 Theory of Planned Behaviour

Ajzen (2006) stated that an intervention designed to change behaviour should be directed at attitudes, subjective norms, and perceived behavioural control. He further stated that changes in these factors could result in a change in behavioural intentions. Thus, a change in behavioural intention with adequate control of the behaviour is more likely to result in the new intention being carried out. The Theory of Planned Behaviour (TPB) suggests that human behaviour is guided by beliefs about the likely consequences of a behaviour. This is known as behavioural beliefs. Beliefs about the normative expectations of others are normative beliefs. Lastly, beliefs about the presence of factors that may help or hinder the performance of the behaviour are control beliefs (Ajzen, 2006).

Behavioural beliefs can produce a favourable or unfavourable attitude towards a belief. The overall normative beliefs can result in perceived subjective norms. Control beliefs aid in giving rise to self-efficacy or perceived behavioural control (PBC) (Ajzen, 2006). Perception of behavioural control acts as a moderator for the relationship of attitude towards the behaviour and subjective norm on intention. Thus, a high attitude and subjective norms of a behaviour and higher PBC should lead to a stronger intention to carry out a behaviour (Ajzen, 2006). High attitude or behavioural belief is when the individual has a positive attitude towards a behaviour with few barriers present. When there is a high expectation from others in the community or household to perform a behaviour and few barriers or cultural implications it will lead to high normative beliefs. If the person feels that they are in control to perform the behaviour and they have the relevant tools and knowledge needed, there will be high control beliefs (Fenson-Hood, 2022).

In summary, this theory suggests that high behavioural beliefs, normative beliefs, and control beliefs, lead to a strong intention to carry out a behaviour. This means that the intention to perform a behaviour should be present before the actual behaviour is carried out. If there is moderate to high actual control, TPB suggests that the person will perform the intended behaviour in a suitable setting. The following sections will look at how TPB has been used in relation to water treatment systems, greywater, recycling, informal settlements, and the South African context.

2.9.1 TPB and Water

Fenson-Hood (2022) used TPB to create a campaign for behaviour change for a point of use water treatment system in an informal settlement in Kibera, Kenya. This study used TPB to explain current behaviours and to identify techniques that could encourage sustainable behaviour change. Its second aim was to address the application of TPB through a cultural lens. TPB is a Western developed model, thus this study helped to determine if it was appropriate in a South African setting. The study found that in previous applications of TPB predicting intentions and behaviours, normative beliefs had a weak correlation with intention. The author suggested that this may not be the case in a South African setting. This is because the majority of research done using the model of TPB has been done in Global North countries with majority of individualistic cultures whereas South Africa is a developing country with collectivist culture being more common (Fenson-Hood, 2022). Therefore, normative beliefs could be more correlated with intention or behaviour due to the collectivist culture in South Africa.

A meta-analysis found that behavioural intention explains, on average, 27% of the variance in behaviour change (Armitage & Conner, 2001). In the study completed by Malunga (2020), it was found that participants cared about their community. Participants who were at home during the week did their washing from Monday to Friday to give the employed people an opportunity to use the water for washing on weekends. This demonstrates the collectivist culture within the Alexandra settlement. In contrast, this could also be due to individualistic needs. Participants who did not work during the week would have easier access to water during the week compared to the weekends where demand is higher. Therefore, the current study may find normative beliefs to be more correlated with intention or behaviour when compared to Western studies. A study that used TPB to determine recycling behaviour in South Africa found that respondents showed a higher probability of the intention to recycle than what the self-reports had suggested (Strydom, 2018). This shows the challenge of predicting behaviour as there are several external factors that influence behaviour and intention. The example given in their study is that families may not recycle on a certain day because of something such as weather or a family crisis (Strydom, 2018). This study is discussed to provide the picture of TPB used in South Africa with recycling which can be closely linked to greywater treatment systems. In contrast to the study done by Strydom (2018), under the right conditions recycling would occur more.

A study by Oteng-Peprah et al. (2019), done in Ghana, explored the willingness of households to use a greywater treatment system. The study had a sample of 478 participants. The results indicated TPB concepts explained about 54% of the variance in intention to use the greywater treatment system (Oteng-Peprah et al., 2019). Thus, the TPB model should be a useful framework to discuss the greywater disposal behaviour change in Setswetla, Alexandra.

2.10 Research questions

The objective of this study is to determine the adaptation to the constructed wetlands in Setswetla, Alexandra. This is done by determining water disposal behaviour change within the population. In addition to determining their behaviour change within the population, the study also aims to identify factors associated with the behaviour change.

Have the water acquisition behaviours changed?

- What are the behavioural factors influencing how participants acquire water?

Have water storage behaviours changed?

- What are the behavioural factors influencing how participants store water?

Have water usage behaviours changed?

- What are the behavioural factors influencing how participants use water?

How have water disposal behaviours changed?

- What are the behavioural factors influencing how participants dispose of water?
- What are the problems and opportunities for better disposal of water?

Do the constructed wetlands influence water disposal behaviours?

- What are the behavioural factors influencing the use of the constructed wetlands?
- What are the problems connected to water disposal?

Chapter 3 – Method

This chapter will provide an account of the research design, sample and sampling techniques, instruments, procedures, ethical considerations, and data analysis that was used to conduct this study.

3.1 Research design

This study used a quantitative design. This approach is looked at further in this chapter.

3.1.1 Quantitative approach

The study was conducted using a quantitative, cross-sectional, and longitudinal design. The researchers chose a quantitative design because it was suitable for determining relationships among variables (Abdullah & Raman, 2001). Additionally, they opted for a non-experimental design since individuals could not be randomly assigned to treatment groups, and it was necessary to evaluate why individuals behave in a specific way in a particular context (Cook, 2015).

The study was both cross-sectional and longitudinal as the researchers compared the results of two groups using a one-time survey (cross-sectional) and compared those results to a baseline survey from another study carried out by Malunga (2020) in 2019 (longitudinal). Two groups were involved in the study, one of which had close access to the constructed wetlands (participants from Silvertown), while the other did not (participants from the rest of Setswetla). The study used a survey, which the researchers deemed advantageous because it required less time and was less costly (Heiervang & Goodman, 2011). This fell under the positivist paradigm.

3.2 Sample

The study made use of both primary and secondary data. The primary data was made up of 298 respondents to the survey in 2022. The secondary data came from a study conducted by Malunga (2020), which surveyed people who lived in Setswetla in 2019. Malunga's (2020) study had 235 respondents in total. All participants were from Setswetla, Alexandra. They were all between the ages of 18 and 78, and all identified as black Africans. The sample included both males and females.

The sample was drawn from the same pool of participants who took part in the quantitative survey of the study, which had a sample size of 295. However, since the survey was anonymous in 2019 it was not possible to match responses from 2019 to responses in 2022. These two samples were therefore treated as independent even though it was known that there was a possibility that they might not be independent. The survey samples were both of people from the whole of Setswetla and were collected by previously trained enumerators from the community. Enumerators were used since the home language of the participants was not English and the researcher did not speak their language. Before the enumerators were given the surveys to administer, the researcher ran a workshop to train them on how the survey works and what the questions mean. Each enumerator was given an area to collect responses. This reduced the chance of collecting data from the same person twice and allowed for a broader area of participants.

The unit of analysis was residents of Setswetla, Alexandra, where the constructed wetlands had been built. The sampling technique used was non-probability purposive sampling since individuals could be identified and approached with little effort (Etikan, 2016). An advantage of this technique was that the researcher could choose a sample that was knowledgeable about the phenomena of interest (Etikan, 2016). The study also used a snowball technique, which was suitable because it required participants to refer to other potential participants (Malunga, 2020). The following section will provide the demographic results from the survey.

3.2.1 Demographic description

The survey aimed to gather data on several demographic variables, including gender, age, race, home language, education, employment, and location. Some of the respondents did not provide responses to certain demographic questions, which created missing values.

The demographic characteristics of the sample population were analysed in the study. In tables 1 to 6 below, '2022 frequency' refers to the demographic frequencies of the current study and 2019 frequency refers to Malunga's (2020) 2019 demographic frequencies. The results of the analysis are as follows. Of the total sample size of 298, 116 participants (38.9%) were male, and 177 participants (59.4%) were female. Two participants (1.7%) did not provide their gender information. There were more female participants than male participants in the sample (see table 1). The age of the participants was categorized as Under

20, 20-29, 30-39, 40-49, 50-59, and 60+. The highest frequency was observed in the age category of 20-29, with 99 participants (33.2%). The lowest frequency was observed in the age category of 60-69, with only 12 participants (4%) (see table 2). The majority of the participants, 296 (99.3%), identified as Black. Two participants (0.7%) did not provide their race information. Thus, of the valid responses, 100% of the sample identified as black (see table 3). Although the sample was made of only black participants, there was some diversity in terms of home language. The participants' home language was categorized as isiZulu, isiXhosa, Sepedi, Sesotho, Setswana, Siswati, Tshivenda, Xitsonga, and isiNdebele. The highest frequency was observed in the home language category of Xitsonga, with 86 participants (28.9%). The lowest frequency was observed in the home language category of Siswati, with only 5 participants (1.7%) (see table 4). The participants' level of education was categorized as Grade 9 and below, Grade 10, Grade 11, Grade 12, Diploma, Higher Certificate, and Undergraduate Degree. The highest frequency was observed in the category of Grade 12, with 102 participants (34.2%). The lowest frequency was observed in the category of Undergraduate Degree, with only 2 participants (0.7%) (see table 5). The number of employed people in the participants' households were as follows 65 (22%) indicated that no one was employed, 172 (58.3%) had 1 person who was employed, 53 (18%) had 2 people who were employed, and 5 (1.7%) had 3 people that were employed. The participants' location was categorized as Setswetla Giyani, Setswetla Mashemong, Setswetla block A, Setswetla block B, Setshoba, Green house, Setswetla new stand, Setswetla bridge, Old Setswetla, Circle, Polar Park/Jukskei, and Silvertown. The highest frequency was observed in the location category of Setswetla bridge, with 81 participants (27.2%). The lowest frequency was observed in the location category of Green house and Setswetla new stand, with only 1 participant each (0.3%) (see table 6). These are all locations in the Setswetla informal settlement on the West of the Jukskei River.

Table 1. Sample Gender

Gender	**2022 Frequency**	**Percentage**	**2019 frequency**
Missing	2	1.7	12
Female	177	38.9	133
Male	116	59.4	83

Total	**298**	**100.0**	

Table 2. Sample Age

Age	2022 Frequency	Percentage	2019 frequency
Under 20	8	2.7	4
20-29	99	33.2	89
30-39	81	27.2	77
40-49	51	17.1	21
50-59	32	10.7	8
60+	12	4.0	5
Missing	15	5.0	19
Total	**298**	**100**	

Table 3. Sample Race

Race	2022 Frequency	Percentage	2019 frequency
Black	296	99.3	228
Missing	2	0.7	
Total	**298**	**100.0**	

Table 4. Sample Home Language

Home Language	2022 Frequency	Percentage	2019 frequency
Missing	12	4.0	5
English	0	0	0
Afrikaans	0	0	0
IsiZulu	15	5.0	13
IsiXhosa	15	5.0	13

Sepedi	98	32.9	79
Sesotho	10	3.4	9
Setswana	26	8.7	11
SiSwati	5	1.7	4
Tshivenda	22	7.4	17
Xitsonga	86	28.9	71
IsiNdebele	9	3.0	2
Total	**298**	**100.0**	

Table 5. Sample highest qualification

Highest Qualification	2022 Frequency	Percentage	2019 frequency
Missing	5	1.7	7
Grade 9 and below	58	19.5	24
Grade 10	42	14.1	32
Grade 11	70	23.5	49
Grade 12	102	34.2	73
Higher Certificate	9	3.0	24
Diploma	10	3.4	14
Undergraduate Degree	2	0.7	2
Postgraduate Degree			1
Total	**298**	**100.0**	

Table 6. Sample Location

Settlement Location	2022 Frequency	Percentage	2019 frequency
Missing	8	2.7	15
Greenhouse	1	0.3	7
Mashemong	41	13.8	20
Setshoba	3	1.0	72
Old Setswetla	20	6.7	
Setswetla bridge	81	27.2	35
Setswetla Giyani	43	14.4	20
Setswetla Block A	9	3.0	
Setswetla Block B	13	4.4	
Silvertown	40	13.4	18
Setswetla New Stand	1	0.3	
Circle	8	2.7	
Polar Park/Jukskei	30	10.1	
Mazinyo			21
Total	**298**	**100.0**	

3.3 Instruments

In the study, the researcher administered a survey that included eight sections (Appendix D): demographics, water acquisition, water storage, water usage, water disposal, problems and opportunities for better disposal, waste management, and change over time. The survey contained open-ended and close-ended questions. The survey used in this study was adapted from a survey previously used within the context of water use in Setswetla, Alexandra (Malunga, 2020). The previously used survey was divided into six sections, but the current version had an additional two sections which were: (a) opportunities for better disposal and (b) change over time. As the survey had been previously used within the population group of the study, a pilot study was not needed. The final survey was in English and had not been translated. The previous study done in this area did not find any problems with using English in the survey. However, using English as the primary language for the survey posed a threat to internal validity and reliability. Participants may have misinterpreted questions or not completed the survey due to the language barrier. To avoid some of the threats to internal validity and reliability, the enumerators who administered the survey did attend a workshop on how to administer the survey and could make the necessary translations.

3.4 Procedure

Before data collection, the researcher applied for ethical clearance from the University of the Witwatersrand Human Research Ethics Committee (HREC Non-Medical). Ethical clearance was granted (Appendix E), and the researcher administered the survey with the help of enumerators in the community. Since contact had already been made with the community regarding the broader research scope, access to the community had already been accepted (Appendix A). Enumerators had also already been recruited and trained extensively on the survey. The enumerators were allocated specific areas to ensure that the collected data was representative of the different locations of the population. The surveys were administered in-person as the population may not have had access to the internet or devices to complete an online survey. When administering the survey, the enumerators and participants followed all COVID-19 protocols such as sanitising, social distancing, and wearing a mask. 298 surveys were collected by 8 enumerators over a period of 2 weeks (the enumerators were compensated for each survey they collected). The surveys were collected at or near the respondents dwelling and the information was captured by the enumerator like a structured interview. The enumerator read out the question and recorded the verbal response of the respondent. The responses from the survey sheets were transferred to an excel spreadsheet and then to Statistical Package for the Social Sciences (SPSS) to run the appropriate data analysis. A summary of the findings were made available to the participants and stakeholders at feedback sessions.

3.5 Data analysis

The surveys from the quantitative component of the study were inputted into Microsoft Excel. Once in Excel, the data were coded and labelled. The data were then exported to Statistical Package for the Social Sciences (SPSS) version 28.0.1.0. Once the data were exported, it was checked for missing data and totalled. Descriptive statistics and frequencies were used to analyse the responses to the close-ended questions on the survey. Quantitative content analysis was used to analyse the responses to the open-ended questions on the survey.

3.5.1 Descriptive statistics

Descriptive statistics are a fundamental tool in summarizing and analysing data sets, as they provide a concise overview of the data's spread. In this study, the primary focus was on measures of central tendency, which were used to describe the study's variables. Frequencies were used to examine all variables in the data set, providing a count of the number of times each variable was observed. Frequency distributions are an essential component of descriptive statistics and a commonly used method to describe and display data (Mahbobi & Tiemann, 2016). By using descriptive statistics, researchers can gain insights into the characteristics of the data set and draw conclusions based on the findings. Ultimately, descriptive statistics provide a foundation for further analysis and interpretation of the data, leading to more in-depth insights into the study's variables (Field, 2013). The descriptive statistics help to answer the first three research questions. Have the water acquisition behaviours changed? Have water storage behaviours changed? Have water usage behaviours changed?

3.5.2 Chi squared test

The chi-squared test is a commonly used statistical test in research to examine the relationship between two categorical variables. It is a non-parametric test that determines if there is a significant association between the two variables. The test involves comparing the observed frequencies of each category with the expected frequencies, assuming that there is no association between the variables. According to Field (2013), the chi-squared test is particularly useful when analysing data with nominal or ordinal variables. The results of the test are typically presented as a chi-squared value, degrees of freedom, and a p-value. A significant p-value ($p<0.05$) indicates that there is a significant association between the variables, while a non-significant p-value ($p>0.05$) suggests that there is no significant association between the variables (Field, 2013). When reporting the chi-squared statistics, the effect size statistics are also reported. These are Phi and Cramer’s V. The Phi statistic ranges from 1 to -1 where 1 is a perfect positive association and -1 is a perfect negative association (Field, 2013). Cramer's V ranges from 0 to 1 where 0 means that there is no association between the variables and 1 means that there is a perfect association (Field, 2013). The chi-squared test is a valuable statistical tool that allows researchers to examine the relationship between two categorical variables. In this study, chi-squared was used to determine associations between variables and to determine if there were differences between pre- and post-installation of the constructed wetlands. The chi-squared results help to answer the last two research questions. How have water disposal behaviours changed? Do the constructed wetlands influence water disposal behaviours?

3.6 Ethics

Before the surveys were administered, the researcher obtained informed consent from the participants and ethical clearance was gained from the University of the Witwatersrand Human Research Ethics Committee (HREC Non-Medical) (Appendix E). Participants were given an explanation of the study before they were asked to participate. The survey was administered by the enumerators at a time and place which was convenient for the respondent. Anonymity was assured in the study, as participants' identities were not recorded or known to the researcher. To maintain anonymity and confidentiality, unique identifiers were assigned to each participant in the final report. In the study, all respondents were volunteers. The researcher informed the participants that the data collected from the surveys would be stored in a password-protected computer and would only be accessible by the research team.

Chapter 4 – Results

4.1 Frequencies and descriptive variable

Frequencies were calculated by the researcher to summarize and interpret the results from the survey. In the tables below, '2022 frequency' refers to the frequencies from the current survey and '2019 frequency' refers to the frequencies from Malunga's (2020) 2019 survey.

4.1.1 Water acquisition

The main mode of water acquisition for the sample was a communal tap, with 232 individuals (77.9% of the sample) reporting this as their primary source of water (see table 7). A smaller number of individuals reported acquiring water from other sources, such as from neighbours without cost (5 individuals, 1.7%), their own house (43 individuals, 14.4%), their own tap (1 individual, 0.3%), a nearby river (1 individual, 0.3%), or a public space (1 individual, 0.3%).

Table 7. Primary water source

Primary water sources	2022 Frequency	Percentage	2019 Frequency
Missing	15	5.0	5
Communal tap	232	77.9	212
House	43	14.4	0
Neighbours without cost	5	1.7	2
Public space	1	.3	1
Own tap	1	.3	0
River	1	.3	0
Total	298	100.0	

Table 8 represents a frequency distribution table for the reasons behind the primary water source acquisition for the sample. The majority of respondents (201 individuals, 67.4%) reported that their primary source of water was their only source. Additionally, 31 respondents (10.4%) identified the availability of water as the reason behind their primary water source acquisition, while 60 respondents (20.1%) identified distance as the primary factor. Only one respondent (.3%) cited reliability as their primary consideration. Overall, the presented data provides insights into the factors driving the selection of the primary water source among the population.

Table 8. Reason for primary water source

Reason for Primary source	2022 Frequency	Percentage	2019 Frequency
Missing	5	1.7	9
Only source	201	67.4	154
Availability of water	31	10.4	10
Distance	60	20.1	30
Reliability	1	.3	17
Total	298	100.0	

The data in table 9 represents a frequency distribution table reflecting the distance of primary water sources from respondents' dwellings. The table includes a total of 298 responses, of which 295 (99%) fall within the valid category. Of the valid responses, 140 respondents (47%) reported that their primary water source was located inside or just outside their dwelling, while 93 individuals (31.2%) reported that their water source was located a few dwellings away. A short distance was reported by 57 respondents (19.1%), and only five individuals (1.7%) reported that their water source was located a long distance away.

Table 9. Distance of primary water source

Distance of Primary source	2022 Frequency	Percentage	2019 Frequency
Missing	3	1.0	18
Inside or just outside the dwelling	140	47.0	56
A few dwellings away	93	31.2	115
A short distance	57	19.1	31
A long distance	5	1.7	8
Total	298	100.0	

Table 10 encompasses a total of 298 responses, with 294 responses (98.7%) falling within the valid category. A communal tap represents the primary mode of water acquisition, with 142 respondents (47.7%) reporting this as their secondary source of water acquisition. Other notable sources include a jojo tank with 85 respondents (28.5%) and neighbours without cost (46 respondents, 15.4%). The remaining sources, such as a community centre, rainwater collection, house storage, among others, each accounted for less than 2% of the total valid responses. Overall, table 10 provides insight into the secondary sources of water acquisition for the given population.

Table 10. Secondary water source

Secondary water source	2022 Frequency	Percentage
Missing	4	1.3
Communal tap	142	47.7
Jojo tank	85	28.5
Neighbours without cost	46	15.4
Other	21	7.05
Total	298	100.0

The data in table 11 is a frequency distribution table reflecting the reasons behind the selection of secondary water sources for a given population or group. Of the valid responses, 217 individuals (72.8%) reported that their secondary source of water was their only source, while 45 respondents (15.1%) cited the availability of water as the primary consideration behind their secondary water source selection. Distance was reported as the primary consideration by 13 respondents (4.4%), while 11 individuals (3.7%) identified reliability as the critical factor. Six respondents (2%) cited price or cost as the primary consideration when selecting a secondary water source.

Table 11. Reasons for secondary water source

Reason for secondary source	2022 Frequency	Percentage

Missing	6	2.0
Only source	217	72.8
Availability of water	45	15.1
Distance	13	4.4
Reliability	11	3.7
Price/cost	6	2.0
Total	298	100.0

Table 12 contains data on the distance of the secondary water source from the respondent's dwelling. The data set includes 285 valid responses, which account for 95.6% of the total sample. Of these responses, 18.5% of respondents reported having the water source inside or just outside their dwelling, 33.6% reported that the water source was a few dwellings away, 34.6% reported it was a short distance, while 9.1% reported the water source was a long distance away.

Table 12. Distance of primary water source

Distance of secondary source	2022 Frequency	Percentage	2019 Frequency
Missing	13	4.4	18
Inside or just outside dwelling	55	18.5	56
A few dwellings away	100	33.6	115
A short distance	103	34.6	31
A long distance	27	9.1	8
Total	298	100.0	

Table 13 displays the distribution of acquisition time reported by respondents. The majority of respondents (20.13%) did not report a specific acquisition time, while the remaining respondents reported a range of specific times. The most common reported acquisition times were 5 minutes (4.0%), followed by 1 minute (2.3%), 10 minutes (3.0%), and 3 minutes (2.0%). The reported acquisition times ranged from a few seconds to 25 minutes, with a variety of intervals in between.

Table 13. Time to primary water source

Time to primary water source	2022 Frequency	Percentage
Missing	60	20.13
1 minute	7	2.35
3 minutes	6	2.01
5 minutes	12	4.03
10 minutes	9	3.02
Other	204	68.46
Total	298	100.0

Table 14 indicates the frequency of water availability. Among the respondents, 57.2% reported that water is always available, 28.6% reported that water is mostly available, and 13.5% reported that water is sometimes not available. A very small percentage of respondents, 0.6%, reported that water is often not available or more often not available than it is available.

Table 14. Water availability primary source

Water availability	2022 Frequency	Percentage	2019 Frequency
Missing	1	.3	18
Water always available	170	57.0	140
Water mostly available	85	28.5	45
Water sometimes not available	40	13.4	35
Water often not available	1	.3	2

Water is more often not available than it is available	1	.3	0
Total	298	100.0	

The data in table 15 shows the frequency and percentage of responses to the question of water availability from the secondary source. The majority of respondents (57.6%) reported that water was always available, while 18.2% of respondents said that water was mostly available. 22.2% of respondents said that water was sometimes not available, while 1.7% of respondents reported that water was often not available. Finally, 0.3% of respondents said that water was more often not available than it was available.

Table 15. Water availability secondary source

Water availability	2022 Frequency	Percentage
Missing	1	.3
Water always available	171	57.4
Water mostly available	54	18.1
Water sometimes not available	66	22.1
Water often not available	5	1.7
Water is more often not available than it is available	1	.3
Total	298	100.0

4.1.2 Water collection

The data presented in table 16 provides information on the transportation methods used for collecting water. A total of 297 valid responses were recorded, with the majority (96.3%) indicating that items were transported by the participant. Only a small proportion of respondents (2.7%) reported using a wheelbarrow, while an even smaller proportion (0.7%) reported using a vehicle for transportation of their water. It is noteworthy that the cumulative percent of valid responses indicates that the majority of items were transported by individual, indicating that this method is likely the most common among respondents.

Table 16. Transportation of water

Transportation of water	2022 Frequency	Percentage	2019 Frequency
Missing	1	.3	7
Transported by individual	287	96.3	217
Transported in a wheelbarrow	8	2.7	4
Transported in a vehicle	2	.7	0
Total	298	100.0	

Table 17 represents data on the frequency of the size of container used to collect water. The data includes 276 valid responses, with the majority (85.2%) reporting using 20-litre containers. Smaller proportions of respondents reported using 5-litre containers (0.3%), 10-litre containers (3.3%), and 25-litre containers (4.3%), respectively. The fact that the majority of respondents reported using 20-litre containers suggests that this may be a common or typical practice in the area.

Table 17. Size of container used for water collection

Container size	2022 Frequency	Percentage	2019 Frequency
Missing	22	7.4	15
5	1	.3	4
10	9	3.0	15
20	254	85.2	187
25	12	4.0	7

Total	298	100.0	

Table 18 represents data on the reason for using their chosen container. The data includes 268 valid responses, with the majority of respondents indicating that the reason for using the container they use to carry water is because it is one that carries enough water (42.6%), and it is easy to carry (17.4%). Other reported characteristics include the container being the only one the respondent has (12.1%) and being easily found (8.1%). The frequency of valid responses indicates that the majority of respondents (72.0%) reported that their container carries enough water, while 91.4% reported that it is easy to carry. The data presented in table 18 can be useful in understanding the features that are important to respondents when selecting a container to carry water. The fact that most respondents prioritize the container's ability to carry enough water and its ease of carrying suggests that these are essential factors when selecting a container (i.e., it carries enough water without being too heavy to carry).

Table 18. Reason for using chosen container

Reason for using container	Frequency	Percentage
Missing	30	10.1
Only container I have	36	12.1
Easily found	24	8.1
Sold around the area	6	2.0
Carries enough water	127	42.6
Easy to carry	52	17.4
For emergency	4	1.3
Other	19	6.38
Total	298	100.0

The data presented in table 19 shows the frequency with which respondents collect water. The data includes 296 valid responses, with the majority of respondents reporting that they collect water once a day (43.6%) or twice a day (31.1%). Other reported frequencies include collecting water only when needed (17.9%), once a week (3.0%), once every two days (2.4%), once in a while (0.3%), three times a day (1.0%), and four times a day (0.7%). The frequency of valid responses indicates that the majority of respondents (74.7%) collect water at least once a day. Respondents who reported collecting water less frequently may either have easier access to water, may be storing water for future use, or may be using less water than others.

Table 19. Frequency of collection water

Frequency of collecting water	2022 Frequency	Percentage	2019 Frequency
Missing	2	.7	10
Only when needed	53	17.8	3
Once a week	9	3.0	0
Twice a day	92	30.9	92
Once every two days	7	2.3	4
Once a day	129	43.3	114
Once in a while	1	.3	0
Three times a day	3	1.0	0
Four times a day	2	.7	0
Total	298	100.0	

From the data in table 20, out of the 296 respondents who answered this question, 223 (or 75.3%) responded with "yes" indicating that they can collect water during the day and at night. 73 respondents (or 24.7%) responded with "no", indicating that they cannot collect water during the day and at night. Of the respondents that indicated they cannot collect during the day and at night, it is not known if they collected only during the day or during the night as well.

Table 20. Collect water during the day and at night

Day and night	Frequency	Percentage
Missing	2	.7
Yes	223	74.8
No	73	24.5
Total	298	100.0

In table 21, out of the 294 respondents who answered this question, 160 (or 54.4%) responded with "yes" indicating that they collect the same amount of water during the week and the weekend. 133 respondents (or 45.2%) responded with "no", indicating that they cannot collect the same amount of water during the week and the weekend.

Table 21. Collecting the same amount of water during the week and the weekend

Week and weekend	Frequency	Percentage
Missing	5	1.68
Yes	160	53.7
No	133	44.6
Total	298	100.0

Table 22 suggests that out of 298 respondents, 144 (48.3%) answered "yes" indicating that they do collect the same amount of water in the summer and winter, while 127 (42.6%) answered "no" indicating that they do not collect the same amount of water in the summer and winter. 25 respondents (8.4%) answered "no as the seasons change," which suggests that they experience seasonal changes in their water collection. The response “no as the seasons change” can be seen as the same as “no” with an explanation that respondents do not collect the same amount of water in the summer and winter.

Table 22. Collecting the same amount of water in the summer and winter

Summer and winter	Frequency	Percentage
Missing	2	.7
Yes	144	48.3
No	127	42.6
No as the seasons change	25	8.4
Total	298	100.0

Based on the data in table 23, it seems that the majority of participants (33.2%) collect water themselves. However, 30.8% of respondents reported that whoever is in the house collects water, indicating that there is no specific person responsible for water collection in those households. Mothers (8.5%) and husbands (6.1%) were also identified as common water collectors. Interestingly, a small percentage of participants reported that they collect water with their siblings (0.3%) or with their spouse and children (0.3%).

Table 23. Who collects the water?

Who collects water	2022 Frequency	Percentage	2019 Frequency
Missing	3	1.0	9
Myself	98	33.2	111
Anyone in the house	91	30.8	11
Mother	25	8.39	0
Husband	18	6.04	0
Other	63	21.14	0
Children			12
Participant and another individual			30
Total	298	100.0	

4.1.3 Water storage

Based on the data in table 24, it can be concluded that the majority of water collected (85.9%) is stored "in the house". Smaller percentages of water collected are stored "in the bucket" (7.7%) or "in a drum" (5.4%). There is also a small percentage of water collected (0.3%) stored "outside the room".

Table 24. Where water is stored

Where water is stored	2022 Frequency	Percentage	2019 Frequency
Missing	2	.7	9
In the house	256	85.9	213
In the bucket	23	7.7	5
In a drum	16	5.4	0

Outside room	1	.3	0
Total	298	100.0	

Based on the data in table 25, it can be concluded that the majority of the water collected (48%) is stored for one day before being used. Other common storage durations include "half a day" (13.9%) and "2 days" (13.9%). Only small percentages of water collected are stored for longer periods, such as "5 days" (1%), "after a week" (2.4%), or "4 days" (.7%). It is also worth noting that some of the water collected is stored for specific purposes, such as "for emergency" (6.4%) or "when needed" (.7%). Additionally, a small percentage of water collect (1.4%) is stored when there is a tap in the house.

Table 25. Length of time that water is stored

How long water is stored	2022 Frequency	Percentage	2019 Frequency
Missing	2	.7	12
One day	142	47.7	124
Half a day	41	13.8	15
Two days	41	13.8	35
Five days	3	1.0	0
After a week	7	2.3	0
Four days	2	.7	0
Emergency	19	6.4	0
When needed	2	.7	11
Tap in the house	4	1.3	0
Other	35	11.74	0
Total	298	100.0	

4.1.4 Water usage

Table 26 shows that the most frequently reported activities that the sample use water for include cooking (97.7%), cleaning (97.3%), drinking (98.3%), bathing (98.3%), and cleaning chimbas (79.2%). These findings suggest that water usage is primarily related to daily household activities such as cleaning and personal hygiene. Only a small proportion of respondents reported using water for gardening (7.4%) and taking care of animals (1.3%).

Table 26. Uses of water

What water is used for	Frequency	Percentage	2019 Frequency
Cooking	291	97.7	217
Cleaning	290	97.3	205
Drinking	293	98.3	218
Bathing	293	98.3	221
Cleaning the Chimba	236	79.2	179
Gardening	22	7.4	14
Animals	4	1.3	2

In table 27, the rank column means that respondents ranked the corresponding option as first use of their water to 4 last activity they used their collected water for. The results in table 27 show that for cooking, 5.4% of the participants ranked it as the most important activity when using water, while for cleaning, 18.3% ranked it as the most important activity. For drinking, 16.4% ranked it as the most important activity, while for laundry, 32.2% ranked it as the most important activity. For bathing, 32.8% ranked it as the most important activity, while gardening and taking care of animals were ranked relatively low. Finally, for cleaning the chimba, 13.2% ranked it as the most important activity. Overall, the results suggest that the participants prioritize water use for basic needs such as drinking, bathing, cleaning, and laundry. Gardening and taking care of animals were ranked relatively low, which could be due to the fact that these activities may not be as essential for survival.

Table 27. Frequency of ranking water use activities first

Option	Rank	Frequency	Percentage
Cooking	1	16	5.4
Cleaning	1	44	18.3
Drinking	1	40	16.4
Laundry	1	76	32.2

Bathing	1	79	32.8
Gardening	1	2	0.8
Animals	4	1	0.4

The results in table 28 show that most participants reported using chemicals, soaps, or detergents for cleaning (71.8%), laundry (70.5%), bathing (99.5%), and cleaning the chimba (99.5%). Only a small percentage of participants reported using chemicals for cooking (2.0%) and drinking (5.7%) water, while a very small percentage reported using chemicals for gardening (0.7%).

Table 28. Use of chemicals, detergents, or soap with activity

Option	Yes/no	Frequency
Cooking	No	187
Cleaning	Yes	214
Drinking	No	178
Laundry	Yes	210
Bathing	Yes	197
Gardening	No	10
Animals	No	4

Table 29 indicates that the first thing done with collected water among participants was store in house (31.0%), followed by drinking (21.1%), bathing (13.4%), and cooking (9.1%). Other uses reported by participants included cleaning the chimba (0.4%), cleaning (7.3%), storage for emergency (12.9%), washing a car (0.4%), and combinations of different uses such as bathing and cooking (1.7%), cleaning and cooking (1.7%), drinking and cooking (0.4%), and drinking and bathing (0.4%).

Table 29. First thing done with water

First thing done with water	Frequency	Percentage
Missing	66	22.1
Store in house	72	31.0

Drinking	49	21.1
Bathing	31	13.4
Cooking	21	9.1
Cleaning the chimba	1	.4
Cleaning	17	7.3
Store for emergency	30	12.9
Washing the car	1	.4
Combination of things	10	3.36
Total	298	100.0

Table 30 suggests that the majority of participants (84.6%) reported not using the same water for multiple purposes, while 13.4% reported recycling water for different purposes. A total of 252 participants reported not recycling water, while 40 participants reported doing so.

Table 30. Recycling water

Recycling water	Frequency	Percentage
Missing	6	2.0
Yes	40	13.4
No	252	84.6
Total	298	100.0

4.1.5 Disposal of water

Table 31 represents the frequency and when water is thrown away after use. The results show that 177 participants (59.4%) disposed of water after each use, while 107 participants (35.9%) disposed of water after several household chores. Only 6 participants (2.0%) disposed of water in the morning after it was used for cleaning night soil, and only 1 participant (0.3%) disposed of water in the afternoon after work.

Table 31. Frequency of water disposal

How often water is disposed of	2022 Frequency	Percentage	2019 Frequency
Missing	7	2.3	8
After each use	177	59.4	148
After several household chores	107	35.9	63
In the morning after it is used for cleaning the night soil	6	2.0	9
Afternoon, after work	1	.3	0
Total	298	100.0	

Table 32 represents where water is disposed of by the participants. The results show that 192 participants (64.4%) disposed of water into storm water drains, while 30 participants (10.1%) disposed of water into drainage. Additionally, 24 participants (8.1%) disposed of water in the street, and 13 participants (4.4%) disposed of water in front of their house. Furthermore, 20 participants (6.7%) disposed of water in a constructed wetland, and only one participant (0.3%) used wastewater water for watering plants. Finally, only four participants (1.3%) disposed of water into toilets. Table 32 represents other methods of water disposal used by the participants. The results show that five participants (1.7%) disposed of water into the river, while three participants (1.0%) disposed of water at the back of the toilets. Additionally, seven participants (2.3%) disposed of water on the side of the wetland in the trench.

Table 32. Where water is disposed

Where water is disposed of	2022 Frequency	Percentage	2019 Frequency
Missing	14	4.7	32
Into storm water drains	192	64.4	16
Into drainage	30	10.1	70

In the street	24	8.1	90
In front of the house	13	4.4	12
Constructed wetland	20	6.7	
Used for watering plants	1	.3	1
Into toilet	4	1.3	5
Total	298	100.0	

Table 33 represents the reasons why participants chose specific methods of water disposal. The results show that the most common reason for choosing a specific method of water disposal was that it was the closest (66.4%), followed by it was the healthiest (21.1%) and it was the safest (4.7%). Only a small percentage of participants (1.7%) chose a specific method of water disposal because it was the only one available.

Table 33. Reason for choosing disposal site

Reason for choosing disposal site	Frequency	Percentage
Missing	4	1.3
It is the healthiest	63	21.1
It is the closest	198	66.4
It is the safest	14	4.7
It is the only one	5	1.7
it is the healthiest, it is the closest, it is the safest	12	4.0
it is the healthiest, it is the safest	1	.3
it is the closest, the only one	1	.3
Total	298	100.0

The results in table 34 indicate that the majority of the participants (76.5%) reported that they were able to dispose of their water at the same place any time of day, while 20.1% reported that they were not able to do so. This suggests that there may be variations in access to appropriate disposal facilities for greywater among participants.

Table 34. Disposal of water at the same place any time of day

Yes/no	Frequency	Percentage
Missing	10	3.4
Yes	228	76.5
No	60	20.1
Total	298	100.0

Table 35 shows that the majority of participants (94.3%) reported that they dispose of water in the same place during both seasons. A small proportion of participants (1.7%) reported disposing of water in different locations in summer and winter.

Table 35. Disposal of water during summer and winter

Disposing during summer and winter	Frequency	Percentage
Missing	12	4.0
Yes	281	94.3
No	5	1.7
Total	298	100.0

4.1.6 Problems and opportunities for better disposal

Table 36 shows the biggest challenges for water disposal as reported by the participants. Out of the valid responses, the majority of participants (47.3%) reported safety concerns around the disposal site, while 33.1% reported health concerns with standing water around the disposal site. Distance was also reported as a problem by 13.1% of participants. Some participants (4.0%) reported both safety concerns around the disposal site and health concerns with standing water around the site as problems. In addition, table 37 shows the responses to the open-end question about other challenges for water disposal. The majority of participants did not provide any responses (97.3%). However, some participants reported smell (0.7%), blockage (1.3%), dirt thrown in the drain (0.3%), and water everywhere (0.3%) as other problems.

Table 36. Biggest challenge for water disposal

Challenge for water disposal	2022 Frequency	Percentage	2019 Frequency
Missing	23	7.7	17
Safety around the site	130	47.3	40
Health concerns with standing water around	91	33.1	133
Distance	36	13.1	34
Safety around the site, health concerns with standing water around	11	4.0	0
carry the water on the stairs	1	.3	0
distance, safety around the site	3	1.0	0
distance, safety around the site, health concerns with standing water around	3	1.0	0
Total	298	100.0	

Table 37 represents the most frequently reported issues with how water is disposed of in the community. Out of the valid responses, the majority reported that it makes people sick (27.4%), followed closely by it smells (25.3%). A smaller percentage of participants (4.9%) reported that it fills the street with water and makes it difficult to walk. Many participants (26.0%) reported a combination of issues, including smell, sickness, and difficulty in walking due to water on the street. Some participants (4.2%) identified sickness and difficulty in walking as a problem, while a smaller proportion (1.8%) reported a combination of issues related to smell and walking difficulties. Additionally, table 39 includes answers for the open-ended question for other reasons. This question had a 5.4% response rate. 3.4% of participants reported that kids play with dirty water, while 6.3% reported that they can't wear white shoes because it changes colour. 5.4% of participants reported other issues, such as very dirty water, no problems ("because it's flowing"), and "smelling in summer".

Table 37. Issues with how water is disposed

Issues with how water is disposed	2022 Frequency	Percentage	2019 Frequency
Missing	13	4.4	14
It makes people sick	78	26.2	26
It smells	72	24.2	113
Fills the street with water and makes it difficult to walk	14	4.7	53
It smells, it makes people sick, fills the streets with water and makes it difficult to walk	74	24.8	22
It makes people sick, fills the street with water and makes it difficult to walk	12	4.0	0
It smells, fills the streets with water and makes it difficult to walk	5	1.7	0
It smells, it makes people sick	30	10.1	0
Total	298	100.0	

Table 38. Issues with how water is disposed (open-ended question)

Issues with how water is disposed	Frequency	Percentage
Missing	282	94.6
Kids play with dirty water	10	3.4
Can't wear white shoes	1	.3
It changes colour	1	.3
Very dirty	1	.3
No (because it is flowing)	1	.3
In summer it smells	2	.7
Total	298	100.0

The valid responses in table 39 indicate that 94.9% of participants identified a drainage system would make water disposal better and easier. Additionally, 2.2% of participants identified the closer availability of disposal sites as an opportunity for improvement. A small percentage of participants also mentioned safety around the site as a concern (0.7%), while 1.4% of participants mentioned both a drainage system and better safety around the site. Additionally, table 40 represents the open-ended question for other methods which would make water disposal better and easier. This question had a 5% response rate. 13 participants (86.7%) reported that having a constructed wetland would make water disposal better and easier. This was followed by 6.7% who suggested a proper drain system and not putting dirt in the water.

Table 39. What would make water disposal better and easier?

Improve water disposal	2022 Frequency	Percentage	2019 Frequency
Missing	22	7.4	18
Drain system	262	94.9	208
River	1	.3	0

Drain system, safety around the site	4	1.4	0
Drain system, closer availability of disposal sites	1	.3	0
Safety around the site	2	.7	0
Closer availability of disposal sites	6	2.2	0
Total	298	100.0	

Table 40. What would make water disposal better and easier? (open-ended question)

Improve water disposal	Frequency	Percentage
Missing	283	95.0
Constructed wetland	13	4.4
Proper drain system	1	.3
Not putting dirt in the water	1	.3
Total	298	100.0

4.1.7 Waste management

Table 41 shows the responses of participants regarding their preferred methods of waste disposal. The majority of participants (35.9%) disposed of their waste at a close landfill, while 24.5% used a combination of a garbage bin and a central garbage container. Other responses included using a garbage bin (10.7%), disposing of garbage in the street (6.1%), and throwing away garbage with water (3.8%). Additionally, table 42 shows the result for the open-ended question for other methods of waste disposal. This question had a 11.7% response rate. The majority of respondents who provided valid responses disposed of their waste in the river, either directly (7.4%) or in an open space adjacent to the river (1.3%). Seven respondents (2.3%) disposed of their waste in open space, while one participant each mentioned disposing of waste in a river/tree space and in a plastic bag.

Table 41. Method of waste disposal

Method of waste disposal	2022 Frequency	Percentage	2019 Frequency
Missing	37	12.4	29
At a close land fill	107	35.9	6
In a garbage bin	28	9.4	31
In the street	16	5.4	105
Throw away with my water	10	3.4	49
Central garbage container	29	9.7	8
In a garbage bin, central garbage container	64	21.5	0
In the streets, throw away with my water	2	.7	0
In garbage bin, at close by land fill	4	1.3	0
In the streets, central garbage container	1	.3	0
Total	298	100.0	

Table 42. Method of waste disposal (open-ended question)

Method of waste disposal	2022 Frequency	Percentage	2019 Frequency
Missing	263	88.3	0
River/tree space	1	.3	0
River	22	7.4	28
River/open space	4	1.3	0
Open space	7	2.3	
Plastic bag	1	.3	
Total	298	100.0	

Table 43 shows the frequency at which participants dispose of their waste. The majority of the respondents (45.3%) dispose of their garbage every day, while 28.5% do it every other day, and 20.1% once a week. Only a small number of respondents (3.0%) dispose of their garbage twice a day.

Table 43. Frequency of waste disposal

Frequency of waste disposal	2022 Frequency	Percentage	2019 Frequency
Missing	6	2.0	7
Every other day	85	28.5	38
Once a week	60	20.1	19
Everyday	135	45.3	139
Twice a day	9	3.0	3
Three times a day	2	.7	2
3-5 weeks	1	.3	0
Total	298	100.0	

Table 44 represents the responses of participants when asked if waste ever clogs up the water disposal or stops it from working. Out of the 298 participants, 246 (82.6%) responded "yes," indicating that waste has indeed caused blockage or disruption in the water disposal system. Only 20 participants (6.7%) answered "no," while the rest provided more detailed responses. Three participants (1.0%) indicated that waste not only clogs up the system but also stops it from working properly, while one participant (0.3%) responded that waste causes blockage "all the time." Another participant (0.3%) reported that waste only causes disruption when food is thrown away, and one more (0.3%) said that waste causes the system to "stop working properly." Overall, 272 participants (91.3%) reported that waste has caused issues with the water disposal system.

Table 44. Waste clogging up the water disposal system

Waste and water disposal	Frequency	Percentage

Missing	26	8.7
Yes	246	82.6
No	20	6.7
Yes, it stops it from working properly	3	1.0
Yes, all the time	1	.3
Yes, when they throw food away	1	.3
Stop working properly	1	.3
Total	298	100.0

4.1.8 Change over time

4.1.8.1 Water collection

Table 45 reports the results of the survey question about whether the participants' source of water has changed in the past two years. Out of the 298 participants, 275 (92.3%) responded "no," indicating that their source of water has remained the same, while 18 (6.0%) responded "yes."

Table 45. Source of water changed over the past two years

Change of water source	Frequency	Percentage
Missing	5	1.7
Yes	18	6.0
No	275	92.3
Total	298	100.0

Table 46 suggests that the majority of participants did not change their method of collecting water in the last 2 years. Out of the 294 responses, only 18 participants or 6.1% indicated that they did change their method of collecting water. Meanwhile, 276 participants or 93.9% stated that they did not change their method of collecting water in the last 2 years. Additionally, the open-ended question asking participants if there was a special event that made them change their water collection behaviour had a 2% response rate. 4 participants

(1.3%) answered that the reason for the change in behaviour was because they had installed their own tap.

Table 46. Did your method of collecting water change over the past two years

Change in method of collecting water	Frequency	Percentage
Missing	4	1.3
Yes	18	6.0
No	276	92.6
Total	298	100.0

4.1.8.2 Water disposal

Table 47 represents the question of whether participants' methods of water disposal have changed in the past two years. 23 out of 298 respondents (7.7%) reported a change while 165 (55.4%) reported no change. The remaining 110 respondents did not provide an answer. This indicates that a minority of participants have made changes to their water disposal practices. Additionally, the open-ended question asking participants if there was a special event that made them change their water disposal behaviour had a 4% response rate. 11 participants (3.7%) reported that the constructed wetland made them change their water disposal behaviour.

Table 47. Method of water disposal change over the past two years

Change in water disposal	Frequency	Percentage
Missing	110	36.9
Yes	23	7.7
No	165	55.4
Total	298	100.0

4.1.9 If you are using the constructed wetland

The following results are from participants who live in Silvertown. There were 40 respondents from the Silvertown area.

As seen in table 48 among the 40 participants who live in Silvertown, 23 (57.5%) provided valid responses for the question "which constructed wetland do you use?". Of those who responded, the most common constructed wetland used was wetland 3, with 8 participants (20.0%) reporting this option. Wetland 1 was the second most common choice, with 7 participants (17.5%) selecting it. Wetlands 2, 1 and 2, and 1 and 3 were chosen by 5 (12.5%), 2 (5.0%), and 1 (2.5%) participant, respectively. It is not known why this question only had a 57.5% response rate from the participants in the Silvertown portion of Setswetla.

Table 48. Which constructed wetland do you use?

Constructed wetland	Frequency	Percentage
Missing	17	42.5
Wetland 1	7	17.5
Wetland 2	5	12.5
Wetland 3	8	20.0
Wetland 1 & 2	2	5.0
Wetland 1 & 3	1	2.5
Total	40	100.0

Table 49 represents the question "when did you start using the constructed wetland?". Of the 40 participants living in Silvertown, the majority of the participants (55%) started using the constructed wetland as soon as they were installed. Only one participant (2.5%) reported starting to use the wetland when they moved to their current location. The remaining 42.5% of the participants did not provide a response to this question. It is not known why this question only had a 57.5% response rate.

Table 49. When did you start using the constructed wetland?

Options	Frequency	Percentage
Missing	17	42.5%
As soon as they were installed	22	55.0

When I moved here	1	2.5
Total	40	100.0

As seen in table 50 the majority (25.0%) of the Silvertown respondents stated that the wetland was in the general area where they disposed of water. 10% of the participants reported that the constructed wetland was in the general area of where they disposed, it felt cleaner, and it feels safer. 15.0% of the participants cited that the wetland was closer than where they used to dispose, in the general area where they disposed of water, and felt cleaner and safer. Only 2.5% of the participants said that the wetland made them feel cleaner and safer, and 2.5% stated that it was closer than where they used to dispose and in the general area where they disposed of water.

Table 50. Reason for using constructed wetlands

Reason for using constructed wetlands	Frequency	Percentage
Missing	18	45.0
It is in the general area where I disposed	10	25.0
It is in the general area where I disposed, feels cleaner, feels safer	4	10.0
Closer than where I use to dispose, it is in the general area where I disposed, feels cleaner, feels safer	6	15.0
Feels cleaner, feels safer	1	2.5
Closer than where I use to dispose, it is in the general area where I disposed	1	2.5
Total	40	100.0

4.1.10 If you are not using the constructed wetland

The following results are from participants who live in Silvertown. There were 40 respondents from the Silvertown area

Table 51 shows the results for the question asking participants if they are aware of the constructed wetlands. Out of the 40 participants, 19 (47.5%) answered "yes" indicating that they were aware of the constructed wetlands, while the remaining 21 (52.5%) did not answer the question.

Table 51. Are you aware of the constructed wetlands?

Aware of constructed wetlands	Frequency	Percentage
Missing	21	52.5
Yes	19	47.5
No	0	0.0
Total	40	100.0

Table 52 shows the results for the question which asks participants why they do not use the constructed wetlands. Out of 40 participants, 12 (30%) reported that the constructed wetlands were too far away. The other participants did not provide a response.

Table 52. Why do you not use the constructed wetlands?

Reasons for not using constructed wetlands	Frequency	Percentage
Missing	28	70.0
Too far away	12	30.0
Total	40	100.0

Table 53 shows the responses of participants to the question "Do you use the washing area by the constructed wetland?". Out of 40 participants, 18 (45%) answered "yes", 4 (10%) answered "sometimes", and 12 (30%) answered "no". 6 participants did not provide a response to the question.

Table 53. Do you use the washing area by the constructed wetlands?

Do you use the washing area	Frequency	Percentage
Missing	6	15.0
Yes	18	45.0
No	12	30.0
Sometimes	4	10.0
Total	40	100.0

4.1.11 Problems connected to water disposal

This question was only answered by participants from the Silvertown area. There were 40 participants in this area. Based on the data provided in table 54, 72.5% of participants (29 out of 40) responded "yes" and gave a description to the question about whether any problems connected to water disposal have gotten better since the installation of the constructed wetlands. Examples of descriptions include, "yes at the one at the gate there's no more water in the street and on the passage", "yes no water in the street and does not smell like before", and "yes, it's so much better because the kids are not playing with it anymore". This suggests that a majority of participants believe that the constructed wetlands have had a positive impact on water disposal problems. However, it's important to note that 10% of participants (4 out of 40) responded "no" to this question.

Table 54. Problems connected to water disposal (open-ended question)

Reason for Primary source	Frequency	Percentage
Missing	7	17.5
No	4	10.0
Yes + description	29	72.5
Total	40	100.0

4.2 Geographical location differences

A chi-squared test was conducted to examine the association between when greywater is disposed of (after each use, after several household chores, in the morning after it is used for cleaning night soil, and afternoon after work) and the participants location (Setswetla Giyani, Setswetla Mashemong, Setswetla block A, Setswetla block B, Setshoba, Green house, Setswetla new stand, Setswetla bridge, Old Setswetla, Circle, Silvertown, and Polar Park/Jukskei) among the residents in the informal settlement. The results indicated a significant association between when greywater was disposed of and participants location, $X^2(33, N = 284) = 125.90, p < .001$. The results suggest that when greywater is disposed of varies by location of the participant. For example, participants in Silvertown reported disposing of their greywater after each use whereas participants in Mashemong had higher proportions of participants disposing of greywater after several household chores. Phi was .680 and Cramer's V was .392, $p < .001$. The high value of phi (.680) and Cramer's V (.392) suggests a strong association between when greywater is disposed of and participants' location. This indicates that the location of participants in the informal settlement is a strong predictor of when they dispose of greywater.

A chi-squared test was conducted to examine the relationship between location and where greywater was disposed of among residents in an informal settlement. The results indicated a significant association between the two variables, $X^2(30, N = 277) = 142.45, p < .001$. The phi coefficient was 1.146, and Cramer's V was .468, $p < .001$, indicating a strong relationship between location and greywater disposal practices. The percentage of greywater disposal into stormwater drains was highest in Setswetla Giyani (68.3%), while the percentage of greywater disposal into drainage systems was highest in Setswetla Mashemong (17.6%). The percentage of greywater disposal into constructed wetlands was highest in Silvertown (57.1%), which was expected due to the presence of constructed wetlands in the area.

A chi-squared test was performed to investigate the relationship between location of the participant and reasons for chosen greywater disposal method among residents. The results indicated a significant association between location and reasons for waste disposal, $X^2(24, N = 287) = 121.09, p < .001$. The phi coefficient was 1.037, and Cramer's V was .423, $p < .001$, suggesting a strong relationship between the two variables. The results suggest that the reasons for choosing a particular greywater disposal method vary depending on the participant's location. Most of the respondents from Mashemong chose their disposal method because it was the healthiest, whereas most of the respondents from Giyani chose their disposal method because it was the closest. This varied from area to area.

A chi-squared test was conducted to examine the relationship between location of the participants and the distance of water disposal sites in an unspecified setting. The analysis revealed a significant association between location and disposal distance, $X^2(48, N = 278) = 101.62, p < .001$. The phi coefficient was 1.435, and Cramer's V was .433, $p < .001$, indicating a strong relationship between the two variables. The results suggest that waste disposal sites are not equally distributed across the different locations. Most of the respondents from Giyani took 1 minute to dispose of their water whereas some of the respondents from Setswetla Block A took 5 minutes.

A chi-squared test was conducted to examine the relationship between location and if participants could dispose of their water in the same place during day and night. The Pearson chi-square value was significant, $X^2(11, N = 281) = 54.227, p < .001$. Phi and Cramer's V were both .439, indicating a moderate association between the variables, $p < .001$. Overall, the results suggest that there is a significant association between location and if the participant can dispose of their water at the same place during the day and night. 90.2% of respondents from Mashemong reported that they can dispose of their water during the day and night. Whereas 43.8% of respondents from Setswetla Bridge reported that they could not dispose of their water during the day and night.

A chi-square test was conducted to examine the association between location and whether participants could dispose of water at the same place during summer and winter. The analysis revealed a significant association between the 2 variables, Pearson's $X^2(11, N = 279) = 39.030, p < .001$. The phi coefficient and Cramer's V were both .374, indicating a moderate effect size. The results suggest that there is a significant association between location and the ability of participants to dispose of water at the same place during both summer and winter seasons.100% of respondents for this question from Giyani reported that they can dispose of their water at the same place during both summer and winter. Whereas 33.3% of respondents from Setshoba reported that they cannot dispose of their water at the same place during both summer and winter.

4.3 Gender differences

A chi-squared test was conducted to determine if there was a significant association between gender and the questions "Can you throw your water away at the same place during day and night?" and "Do you throw away your water at the same place during summer and winter?"

The results showed that for the variable of gender and the question "Can you throw your water away at the same place during day and night," gender was significantly associated with the question, $X^2(1, N = 284) = 4.909$, $p = .027$. Phi and Cramer's V were .153 and .054, respectively, both indicating a small effect size. For the question "Do you throw away your water at the same place during summer and winter," gender was also significantly associated with the question, $X^2(1, N = 282) = 4.098$, $p = .043$. Phi and Cramer's V were .123 and .090, respectively, indicating a small to moderate effect size. For both questions, males and females had different rates, with males being more likely to throw water away at the same place during the day and night, and to throw away water at the same place during summer and winter.

4.4 Difference between time 1 and time 2 data

The following results indicates where significant results were found when comparing time 1 data and time 2 data.

A chi-squared test was conducted to examine the association between the question "Do you collect the same amount of water during summer and winter?" in the survey at time 1 and at time 2. The result was significant, $X^2(4, N = 218) = 13.76$, $p = .008$, indicating a statistically significant relationship between the two variables. However, the Cramer's V indicated a weak association, $V = .178$, $p = .008$, suggesting that the effect size is small. These findings suggest that there is a significant but weak relationship between the question at time 1 and time 2. The percentage of "yes" responses in time 1 for the variable "no as the seasons change" was higher compared to time 2 (58.8% vs. 35.7%). Conversely, the percentage of "no" responses for this variable was higher in time 2 compared to time 1 (48.0% vs. 21.4%). This suggests that there may have been a change in the respondents' attitudes towards the impact of changing seasons between time 1 and time 2. For the variable "yes," the percentage of respondents who answered "yes" was higher in time 2 compared to time 1 (71.4% vs. 51.4%). This suggests that more people reported that they do collect the same amount of water during summer and winter.

A chi-square test of independence was conducted to examine the relationship between the question "Do you collect the same amount of water during week and weekend?" in the survey at time 1 and at time 2. The analysis revealed a significant association between the two variables, $X^2(4, N = 213) = 11.856$, $p = .018$. The Cramer's V indicated a small effect size, V

= .167, p = .018. These results suggest that there is a statistically significant relationship between the question at time 1 and time 2 although the effect size is small. At time 1, 106 (49.8%) participants answered "yes," and 48 (22.5%) answered "no,". At time 2, 100 (46.9%) participants answered "yes," 112 (52.6%) answered "no,". At time 2, the number of participants who said they do not collect the same amount of water during the week and weekend significantly increased.

A chi-squared test was conducted to determine the association between the question "Can you collect water during the day and at night?" in the survey at time 1 and at time 2. The analysis revealed a significant association, $X^2(2, N = 214) = 6.228$, $p = .044$. The Cramer's V coefficient of association was .171 ($p = .044$), indicating a small effect size. These results suggest that there is a significant but weak relationship between the question at time 1 and time 2. At time 1, 80 participants (74.1%) reported being able to collect water during the day and at night, while 28 of them (25.9%) reported not being able to collect water during the day and at night. At time 2, 52.6% of respondents who reported being able to collect water during the day and at night also reported the same at time 1, while 45.2% who reported being able to collect water during the day and at night at time 2 also reported the same at time 1. Similarly, among those who answered "no" to the question at time 1, 85.2% of them also answered "no" at time 2, while 14.8% answered "yes" at time 2.

The above differences between time 1 and time 2 were the only statistically significant differences across the questions.

Chapter 5 – Discussion

5.1 Introduction

The objective of this study was to evaluate the usage of constructed wetlands in the informal settlement of Setswetla, Alexandra. The usage of the constructed wetlands were evaluated based on changes in the disposal of greywater. Furthermore, this research intended to identify the factors that influenced behavioural change in relation to the adoption of constructed wetlands. The study also looked at waste disposal in Setswetla, Alexandra. In addition, the study aimed to obtain an understanding of how the constructed wetlands changed water behaviour in terms of water acquisition, water storage, water usage, and water disposal.

This section will present the findings of the study, which include frequencies and the results of chi-squared tests. The chi squared tests were used to determine association and differences pre and post installation of the constructed wetlands. These findings will be discussed in relation to the theory of planned behaviour (TPB). Additionally, these results will be compared to previous literature in the field to provide a comprehensive understanding of the study's outcomes.

5.2 Water acquisition behaviour

The results show that the primary mode of water acquisition for the sample is communal tap, with 232 individuals (77.9% of the sample) reporting this as their source of water. This finding is consistent with previous literature, which indicates that communal taps are a common source of water for households in informal settlements (Adams, 2018; Armitage et al., 2009; Reyneke et al., 2018). Only a small number of individuals reported acquiring water from other sources, such as neighbours without cost, their own house, a nearby river, or a public space. The secondary sources of water acquisition for the population were also analysed, with the majority of respondents reporting that their secondary source of water was their only source. Factors such as availability, distance, and reliability were also found to influence the selection of primary and secondary water sources. Additionally, the frequency of water availability from both primary and secondary sources was examined, with the majority of respondents reporting that water was always available.

The results of the study indicate that the most common transportation method for collecting water in the Setswetla informal settlement where the study was conducted is by individuals carrying their water (96.3%), followed by the use of a wheelbarrow (2.7%) or vehicle (0.7%)

to transport water. This finding is consistent with previous research that found that water in informal settlements is mostly collected using buckets, which are carried by individuals from communal taps (Mofokeng, 2008; Nassar & Elsayed, 2018). The preference for using 20-liter containers for water collection, which was found in the study (85.2%), is also consistent with previous research that found that 20-liter buckets were preferred because they are easy to carry and carry enough water for the household (Mofokeng, 2008; Malunga, 2020).

This study also found that the most common reason for using a particular container for carrying water was that it carries enough water (72.0%) and is easy to carry (91.4%), which is in line with previous research (Malunga, 2020). Additionally, the study found that the majority of respondents (74.7%) collected water at least once a day, which is consistent with previous research that found that most participants in the Setswetla water use study collected water on a daily basis and did not need to travel far to do so (Malunga, 2020).

In summary, the results of this study align with previous research on water collection in informal settlements, providing further support for the common practices and preferences observed in this context.

5.3 Water storage behaviour

The findings of this study are consistent with previous research on water storage practices in similar settings. Malunga (2020) found that the majority of participants (93.4%) stored their water in buckets inside their homes. Most participants indicated that they stored their water for 1 day (54.6%), with 15.3% storing their water for 2 days. These findings suggest that storing water in buckets inside the house is a common practice in this region.

5.4 Water usage behaviour

The present study provides valuable insights into water usage patterns and behaviours in informal settlements. The findings are consistent with previous literature, which highlights the importance of water for basic needs such as cooking, cleaning, and personal hygiene in informal settlements (Mofokeng, 2008; Malunga, 2020). It is worth noting that water usage patterns may differ across informal settlements, and factors such as socio-economic status and access to water may play a significant role in shaping water use behaviour (Mofokeng, 2008). This study found that the majority of water collected (86.5%) is stored "in the house," and that water is primarily used for cooking (97.7%), cleaning (97.3%), drinking (98.3%), bathing (98.3%), and cleaning the chimba bucket (79.2%). These findings are consistent with previous research that has shown that water use in informal settlements is primarily related to daily household activities such as cleaning and personal hygiene (Malunga, 2020).

Additionally, this study found that participants in the current sample prioritize water use for basic needs such as drinking, bathing, cleaning, and laundry, with gardening and taking care of animals being ranked relatively low. Participants in this sample also reported using chemicals, soaps, or detergents for cleaning (71.8%), laundry (70.5%), bathing (99.5%), and cleaning the chimba (99.5%). Finally, this study found that the first thing done with collected water among participants was storing it in the house (31.0%), followed by drinking (21.1%), bathing (13.4%), and cooking (9.1%).

Previous studies have also highlighted the importance of context-specific approaches to water management and conservation in informal settlements (Dawson & Scott, 2019). For instance, water scarcity is a common issue in informal settlements, and residents may resort to using recycled water for different purposes (Dawson & Scott, 2019). The present study found that a small proportion (86.3%) of participants in the study reported recycling water for different purposes, which suggests that water conservation practices may be limited in the context of informal settlements.

5.5 Water disposal behaviour

The results of this study indicate that the majority of participants in the Setswetla informal settlement dispose of greywater in an unsustainable manner. The most common method of disposal was into stormwater drains (64.4%), which can result in water pollution and harm to the environment. Additionally, only a small proportion of participants used more sustainable methods of disposal, such as constructed wetlands (6.7%) or using wastewater for watering plants (0.3%). These findings are consistent with previous studies that have found that convenience and lack of access to proper wastewater systems are common reasons for improper disposal in informal settlements (Armitage et al., 2009; Mofokeng, 2008; Nassar & Elsayed, 2018).

Interestingly, the results also suggest that there may be variations in access to appropriate disposal facilities for greywater among participants, with 20.1% of participants reporting that they are not able to dispose of water in the same place at any time of day. This highlights the need for improved infrastructure and access to proper disposal facilities in informal settlements. In addition to the previous results, it is worth noting that 40 participants from the Silvertown area were asked whether any problems connected to water disposal have improved since the installation of the constructed wetlands. The study findings indicate that 72.5% of participants (29 out of 40) responded positively and provided examples of improvements, including decreased water accumulation on the streets and reduced odour. 10% of participants (4 out of 40) reported a negative response to the question, suggesting that not all participants share the belief that the constructed wetlands have effectively addressed water disposal problems. Overall, these findings suggest that the constructed wetlands have had a beneficial impact on water disposal challenges.

5.6 Problems and opportunities for better water disposal

The results of the current study provide insight into the biggest challenges for water disposal as reported by the participants. These findings are consistent with past literature on the topic. For example, previous research has shown that safety concerns around disposal sites and health concerns related to standing water have been reported as issues (Smith et al., 2018; Wang et al., 2019). Additionally, distance has been reported as a problem in other studies, as it can make it difficult for individuals to walk to disposal sites (Liu et al., 2019).

The current study also identified other challenges related to water disposal, such as smell and blockages. These findings are in line with previous research that has identified smell as a problem for informal settlements with poor water disposal systems (Eze et al., 2020). In addition, the participants in the current study identified the need for a better drainage system as a potential solution to water disposal problems. This finding aligns with previous studies that have suggested that things such as proper drainage systems, can help with water disposal problems (Jian et al., 2018).

5.7 Waste management behaviour

The results of the current study are consistent with previous literature on waste disposal practices. For example, the finding that a significant proportion of participants disposed of their waste in open spaces or rivers is consistent with previous research in countries such as Bangladesh and India (Hossain et al., 2016; Singh et al., 2015). Similarly, the high frequency of waste disposal reported in the current study is consistent with previous research on waste management practices in developing countries, where daily solid waste collection is not available (Uddin et al., 2018).

The finding that waste frequently causes blockages and disruptions in the water disposal system is also consistent with previous research. For example, a study in Nigeria found that solid waste often blocks the drainage system and causes flooding during the rainy season (Ologunorisa & Adetoye, 2015).

5.8 Change from pre- to post-installation of constructed wetland

The results of this study suggest that the installation of constructed wetlands in Setswetla, Alexandra has had a limited impact on the water collection and disposal practices of local residents. The majority of participants reported that their source of water and method of collecting water had not changed in the past two years, and only a small percentage reported making changes in their water disposal practices.

Of the respondents from Silvertown where the constructed wetlands were installed, 57.5% of the respondents reported that they do use either constructed wetland 1, 2, 3, or a combination of them. 55% of the same respondents reported that they started using the constructed wetlands as soon as they were installed. These results suggest that the constructed wetlands were adopted by more than half of the respondents where the constructed wetlands were installed. The limited impact on the few that did not report adopting the constructed wetlands may be due to several factors. One possible explanation is that it may take more time for the residents to fully understand their benefits and incorporate them into their daily practices. Another possible explanation is that the constructed wetlands are not effectively communicating their benefits to local residents, and more workshops may be needed to address the issue with maintenance need to keep the constructed wetland clean and operational.

The results from the survey of Silvertown residents who use the constructed wetlands provide some interesting insights. Firstly, the majority of participants (57.5%) provided responses to the question about which constructed wetland they use. Wetland 3 was the most commonly used option, chosen by 20% of respondents, followed by Wetland 1 with 17.5%. This information is useful for understanding which wetlands are being utilized by the community.

In terms of when participants started using the constructed wetlands, the majority (55%) began using them as soon as they were installed. This indicates that most of the Silvertown residents were willing to adopt the constructed wetlands.

When asked about the location of the constructed wetland in relation to their water disposal method, the majority (45.5%) reported that the wetland was in the general area where they disposed of water. It is encouraging to see that the wetlands are being used in the area. Furthermore, a significant proportion of participants (18.2%) mentioned that the wetland was in the general area where they disposed of water and it also felt cleaner and safer, indicating a positive view of the constructed wetlands. These results suggests that the constructed wetlands are providing a more convenient and safer option for water disposal, which could contribute to increased usage.

The results from the survey conducted in the Silvertown area suggest that the constructed wetlands have had a positive impact on water disposal problems. These findings are consistent with previous literature that indicates that constructed wetlands can effectively treat greywater (Lutterbeck et al., 2017).

The majority of participants in the Silvertown area reported that their water disposal problems had improved since the installation of the constructed wetlands. Many participants mentioned that there was no longer water in the street and that the area did not smell as bad anymore. This is consistent with the finding that constructed wetlands can reduce the amount of harmful chemicals in greywater, which can help to reduce smells from stagnant greywater (Vymazal, 2013). Additionally, the finding that the constructed wetlands have reduced the likelihood of children playing with wastewater is important because this can reduce the risk of sickness in children (Liu et al., 2018).

A small percentage of participants reported no improvement in their water disposal problems since the installation of the constructed wetlands. It's possible that these participants had specific issues with the wetland that were not fully addressed by the survey questions.

5.9 Theory of Planned Behaviour and Water Behaviour

According to the Theory of Planned Behaviour (TPB), the limited impact of the constructed wetlands on the water collection and greywater disposal of people living in the Setswetla, Alexandra informal settlement can be attributed to the fact that behaviour change is dependent on attitudes, subjective norms, and perceived behavioural control (Ajzen, 1991). In this case, it is possible that residents who have negative attitudes towards the constructed wetlands did not have perceived behavioural control of the constructed wetlands. This can be said because some of the respondents reported that the constructed wetlands were too far away from them. This is also possible as space is limited in the informal settlement and building a constructed wetland for the number of people living in the area needs to take up quite a bit of space. When visiting the site after the wetlands were built it could be seen that dwellings were built against the wetlands and there were also people who complained that they did not want such a large constructed wetland. It is also possible that although the constructed wetlands to provide a way of disposing greywater in a healthier and safer manner, they were not an immediate need of the residents in the area as poverty and unemployment which are high in the area.

The fact that some residents reported no changes in their water collection and disposal practices may indicate a lack of perceived behavioural control. This suggests that further efforts could be made to educate the community on the benefits of the constructed wetlands and provide them with the necessary skills and resources to utilize them effectively. These masterclasses could inform the residents regarding the size of the constructed wetlands and why they need to be of a certain size. Furthermore, it could inform the residents on how to keep the constructed wetland clean and how to maintain it. However, due to the poverty in the area, it is possible that the residents will not want to use their own funds for maintaining the constructed wetland even though they see the benefits of it.

Overall, the data collected in this study suggests that although perceived behavioural control was given to the residents in terms of placement and size of the wetlands, there were other factors that affected behaviour change such as other basic needs not being met. Some of these needs are jobs, money, and better housing. The participants from Silvertown did have a positive belief about the constructed wetlands as many of the respondents in the survey reported that they are using the constructed wetlands. There were also reports of the Silvertown area feeling cleaner and safer after the installation of the constructed wetlands. It was also found in this study that respondents from other areas wanted constructed wetlands installed in their area which suggests that the constructed wetlands were perceived as socially acceptable. Furthermore, this suggests that there was behavioural change outside of

Silvertown area as other areas saw what was happening and wanted the same in their area so that they could also have a cleaner and safer environment.

Additionally, the finding that some participants reported positive views of the constructed wetlands and improved water disposal problems may indicate that attitudes and perceived behavioural control are not the only factors influencing greywater disposal behaviour change. The positive impact on greywater disposal problems may also contribute to a shift in subjective norms as community members begin to see the benefits of the constructed wetlands and adopt them as a socially acceptable behaviour. Further research is needed to determine an effective solution to improving the usage and maintenance of the constructed wetlands. This future research could look at social awareness, perceived control, attitudes, and understanding of constructed wetlands.

5.10 Limitations and recommendations for future study

There are several limitations to this study that should be acknowledged. Firstly, the survey was administered by enumerators who were able to translate the questions from English to the respondents' home language. However, there may have been different translation made by the different enumerators resulting in different understandings of the questions. This may have resulted in a bias, which could have affected the generalizability of the results to the broader population. To address this limitation in future studies, surveys could be translated into multiple languages to increase participation and ensure a more representative sample. The use of many research assistants could have led to variations in the way questions were explained and interpreted, potentially affecting the validity and reliability of the results. To address this limitation in future studies, standardized training in home languages for research assistants could be implemented to ensure consistency in data collection.

The study did not investigate the reasons for not adopting the use of the constructed wetlands in Setswetla, Alexandra in-depth. Future studies could explore the barriers to adoption and examine ways to address these barriers. This can be done by altering the survey to include more questions on why residents did not adopt the constructed wetlands or by conducting interviews with residents who report that they are not using the constructed wetlands in order to gain a deeper understanding of the variables reducing the adoption of the constructed wetlands.

The sample used in this study may not have been fully representative of the Silvertown area as the surveys could have been administered during the day while some residents were at work. Future studies could have a larger sample size and be more aware of having volunteers who are employed and unemployed.

The survey looked at water use behaviour as a whole, and water disposal behaviour could have been a greater focus. Future studies could investigate water disposal behaviours in more detail to gain a better understanding of the impact of constructed wetlands on these practices.

The survey did not consider that between time 1 and time 2 there was the global pandemic Covid-19. This could have had and impact on behaviour changes particularly around sanitation. Future studies could take this into account when creating the survey and analysing the results.

Finally, more questions regarding the constructed wetlands could have been asked, including whether participants would be willing to maintain the wetlands and whether they were happy with the space they take up. This would provide insight into the willingness of community members to take ownership of the constructed wetlands and maintain them in the long-term.

This study provides valuable insights into the impact of constructed wetlands on water collection and disposal practices in Setswetla, Alexandra, there are several limitations that need to be addressed in future studies. By addressing these limitations, researchers can gain a better understanding of the factors that influence greywater disposal behaviour change and develop effective strategies for promoting the adoption of sustainable water practices.

Chapter 6 – Conclusion

In conclusion, this study investigated the impact of constructed wetlands on water usage behaviour and specifically greywater disposal in the Setswetla, Alexandra informal settlement. The study found that the constructed wetlands had a positive effect in Silvertown as some of the respondents reported that they are using the constructed wetlands and that the area feels cleaner and safer. It was also noteworthy that respondents from other areas wanted constructed wetlands in their areas which suggests that there was some behaviour change outside of just the Silvertown area. Reasons for some respondents not using the constructed wetlands may be due to factors such as attitudes towards the constructed wetlands and perceived behavioural control of the constructed wetlands, some respondents reported that the reason for not using the constructed wetland was because it was too far. Overall, the study found that the constructed wetlands have had a positive impact on greywater disposal behaviours in the Silvertown portion of the Setswetla informal settlement. Participants in the study reported improved water disposal issues and a reduction in smells and risk of sickness in children.

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Appendix A – Access letter

CITY OF JOHANNESBURG
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OFFICE OF THE SPEAKER

Tel: (011) 582 1590
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Cell: 083 398 8804

City of Johannesburg
Region. E
Ward 109

OFFICE OF THE COUNCILLOR LIAQUAD EBRAHIM

22nd January 2020

To whom it may concern

RE: ACKNOWELDGEMENT LETTER

This letter serves to confirm that I, Ward 109, Councillor Liaquad hereby acknowledges that **URBWAT PROJECT,** will be conducting research on greywater treatment solutions in an urban informal settlement. The research will be conducted in Setswetla Informal Settlement, Ward 109, Alexandra.

I therefore grant permission to **URBWA**T team to conduct their study in Setswetla Informal Settlement. Please contact me should you have any further cause for concern.

Thanking you in anticipation,

Kind regards

Councillor Liaquad Ebrahim
Ward 109

City of Joburg
Office of the Speaker
2020 -01- 22
Ward Governance
REGION E

Appendix B – Participant information sheet (Survey)

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 Hemal Jetha 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 the adoption of constructed wetlands in Setswetla, Alexandra.

You are invited to participate in this study. Participation in this study would involve completing a survey. All information provided will not be disclosed to others outside of this study. Only my supervisor and I will have access to the data, and it will be stored in a password protected computer. You may only answer the questions which you feel most comfortable answering and you may withdraw at any point 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 survey or requests regarding the results of the study, please contact my supervisor or myself; details have been provided below.

Thank you for considering to take part in my research

Kind regards,

Mr Hemal Jetha

Cell: +27 79 782 2056

E-mail: hemaljetha@gmail.com

Prof. Andrew Thatcher

Tel: +27 11 717 4533

E-mail: Andrew.thatcher@wits.ac.za

Appendix C – Consent form (survey)

Psychology

School of Human & Community Development

University of the Witwatersrand

Private Bag 3, Wits, 2050

Tel: 011 717 4503
Fax: 086 553 4913

Title of project: Adoption of constructed wetlands in informal settlements

Name of researcher: Hemal Jetha

I, ……………………………………….., agree to participate in this research project.

I agree to the following:

(Please circle the relevant options below)

The research study was explained to me. I understand what this study is about.	YES NO
I understand that I can volunteer to take part in the study.	YES NO

……………………………………. (signature)
……………………………………. (name of participant)
……………………………………. (date)

Appendix D – Alexandra survey schedule 2022

Change over time in regard to the constructed wetlands.

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? (observation by 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) ________________

6. Did you take the survey in 2019?

☐ Yes
☐ No
☐ Cannot remember

<u>Household descriptors</u>

7. Number of adults in your household (in Alexandra, excluding you)

☐

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

☐ ☐ ☐ ☐

b. How many of the adults are employed

☐

8. Number of children in the household

☐

a. Age of each child in household

☐ ☐ ☐ ☐

9. Number of years living in current location:

<u>Acquisition of Water (sources of water and collection)</u>

<u>Water Source</u>

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

Primary Sources of Water	Mentioned by participant (ü)	**Secondary Sources of Water**	Mentioned by participant (ü)
River		River	
Communal Tap		Communal Tap	
Rainwater Collection		Rainwater 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)	

11. Why do you choose this particular water source?

Reason (primary source)	Mentioned by participant (ü)	**Reason (secondary source)**	Mentioned by participant (ü)
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)	

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

Distance (primary source)	Mentioned by participant (ü)	Distance (secondary source)	Mentioned by participant (ü)
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:

13. Are there times when you find no water at this water source? If yes, how often does this happen? (mark the appropriate answer below)

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

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

Options	Mentioned by participant (ü)	Number of containers transported
Transported by individuals (such as carrying by hand)		

Transported in a wheelbarrow		
Transported in a vehicle		
Other (please specify)		

15. What kind of container do you use to collect the water from the water source to your house?
    a) How many containers do you use each time? And how big are they?
    b) Why do you use this container?

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

16. How often do you collect water?

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

17. Can you collect water during the day and at night?

18. Do you collect the same amount of water during the week as during the weekend?

19. 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?

20. Who collects the water in the household?

Storage of Water

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

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

Usage of Water

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

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

24. What do you use most of your water for?

Options	Mentioned by participant (ü)	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 the chimba/ tshimba bucket			
other			

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

26. Do you use the same water for multiple purposes? For example do you use your bathing water to water your plants or do you use your dishwashing water to wash your floors?

Disposal of water

27. 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 (ü)
Into toilets (if available)	
Into drainage (if available)	
In front of the house	
In the street	
Into storm water drains	
Used for watering plants	
Constructed wetland	
Other (please specify)	

Why do you use this option?

Options	Mentioned by participant (ü)
It is the closest	
It is the healthiest	
It is the safest	
Other (please specify)	

28. When do you throw away your water?

Options	Mentioned by participant (ü)
After each use	
After several household chores	
In the Morning after it was used for cleaning nightsoil	
Other (please specify)	

29. How far do you walk to throw away water?
30. Can you throw away your water at the same place at any time of the day?
(For example, do you throw away water in the same place at night as during the day?)

31. Do you throw away your water in the same place in Summer and in Winter?

<u>Problems and opportunities for better disposal</u>

32. What is your biggest challenge with throwing away your water at the moment?

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

33. Do you think the water that is thrown away cause problems for you or for your community? If yes what problems?

Options	Mentioned by participant (ü)
It smells	
It makes people sick	
Fills the streets with water and makes it difficult to walk	
Other	

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

Options	Mentioned by participant (ü)
Drainage systems	
Closer availability of disposal sites	
Safety around the site	
Other (please specify)	

Waste management

35. Where do you throw away your garbage?

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

36. How often do you throw away your garbage?

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

37. Does the garbage or food waste ever clog up the water disposal or stop it from working properly?

Change over time

Water collection

38. Has your source of water changed in the last two years?
- ❑ Yes
- ❑ No

39. Has your method of collecting water changed in the last two years?
- ❑ Yes
- ❑ No
   a) If yes, is there a special event that happened that made you change your water collection behaviour?

Water disposal

40. Has the way you dispose of water changed in the last two years?
- ❑ Yes
- ❑ No

a) If yes: Is there a special event that happened that made you change the disposal behaviour?

<u>If you use the constructed wetlands for disposal of water:</u>

41. Which wetland do you use? (see map and picture)

Options	Mentioned by participant (ü)
Wetland 1	
Wetland 2	
Wetland 3	

42. When did you start using them?

Options	Mentioned by participant (ü) + indicate which wetland
As soon as they were installed	
When I moved here (please specify time)	
A year ago	
Half a year ago	
Not long ago	
Other	

43. Why did you start using them?

Options	Mentioned by participant (ü)
Closer than where I use to dispose	
It is in the general area where I disposed	
Feels cleaner	
Feels safer	
Other (please specify)	

<u>If you are NOT using the constructed wetlands:</u>

44. Are you aware of the constructed wetlands?

- ❑ Yes
- ❑ No

45. Why do you not use them?

Options	Mentioned by participant (ü)
Too far away	
It is not working	
Water is used for watering plants	
Other (please specify)	

46. Do you use the washing area by the constructed wetlands?
    - ❑ Yes
    - ❑ No

<u>Problems connected to water disposal</u>

47. Has any of the problems connected to water disposal (example smell, people gotten sick, water in the streets etc) gotten better since the installation of the constructed wetlands? If yes, please specify.

Appendix E – Ethical clearance form

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT ETHICS COMMITTEE
CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

CLEARANCE CERTIFICATE: **PROTOCOL NUMBER: MAORG/22/05**

PROJECT TITLE: Adoption of constructed wetlands in informal settlements.

INVESTIGATOR	Jetha Hemal (1367783)
SCHOOL/DEPARTMENT OF INVESTIGATOR	SHCD/Psychology
DATE CONSIDERED	13 July 2022
DECISION OF THE COMMITTEE	Approved unconditionally
RISK LEVEL	Minimal Risk
EXPIRY DATE	31 December 2024

ISSUE DATE OF CERTIFICATE 11 August 2022 **CHAIRPERSON** K Milner
(Prof. Karen Milner)

cc: Prof. Andrew Thatcher (Supervisor)

DECLARATION OF INVESTIGATOR

To be completed in duplicate and **ONE COPY** returned to the Chairperson of the School/Department ethics committee.

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

Signature **Date** 16 / 08 / 2022

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

Appendix F – Turn-It-In report

turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

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Assignment title:	Final submission (all, regardless of course/programme)
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